Figure 8-7: Implementation of Pumping Management Framework: Adaptive Management with Implementation of Group 1, 2, and 3 Projects & Demand Reduction Strategies Management Actions

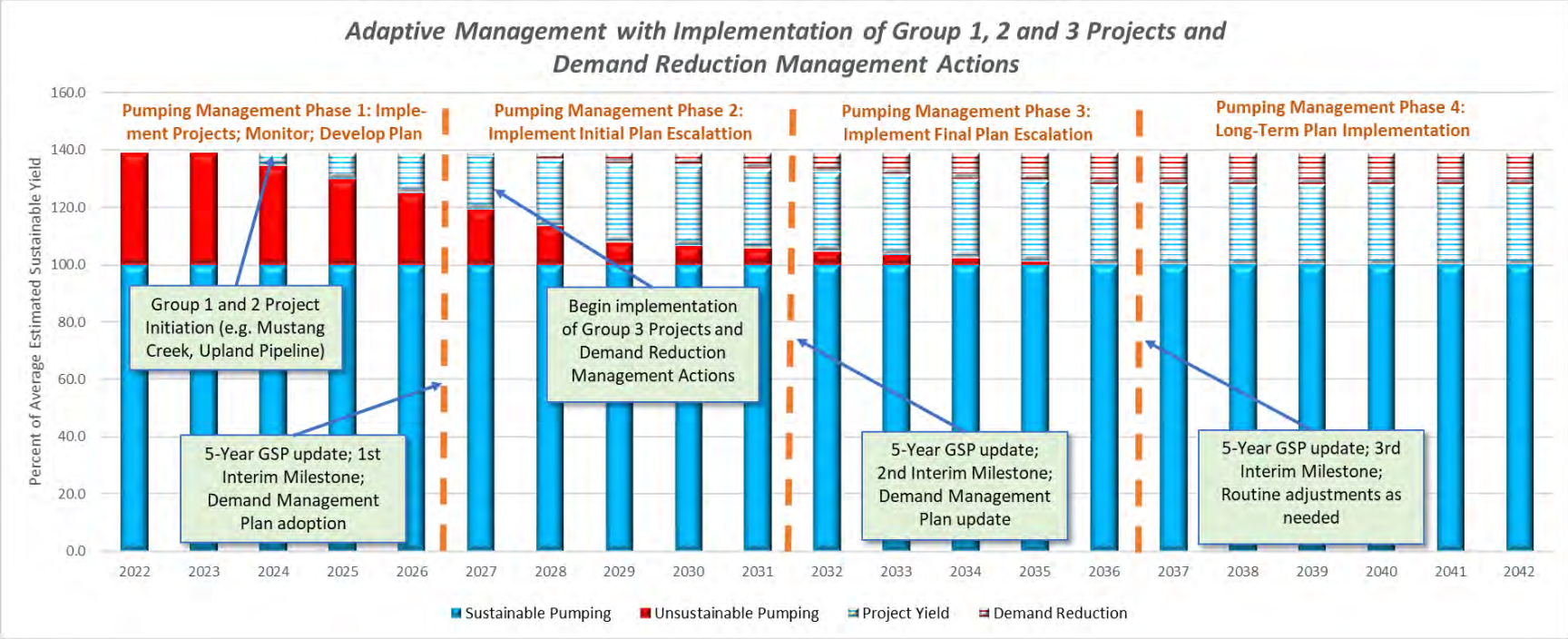
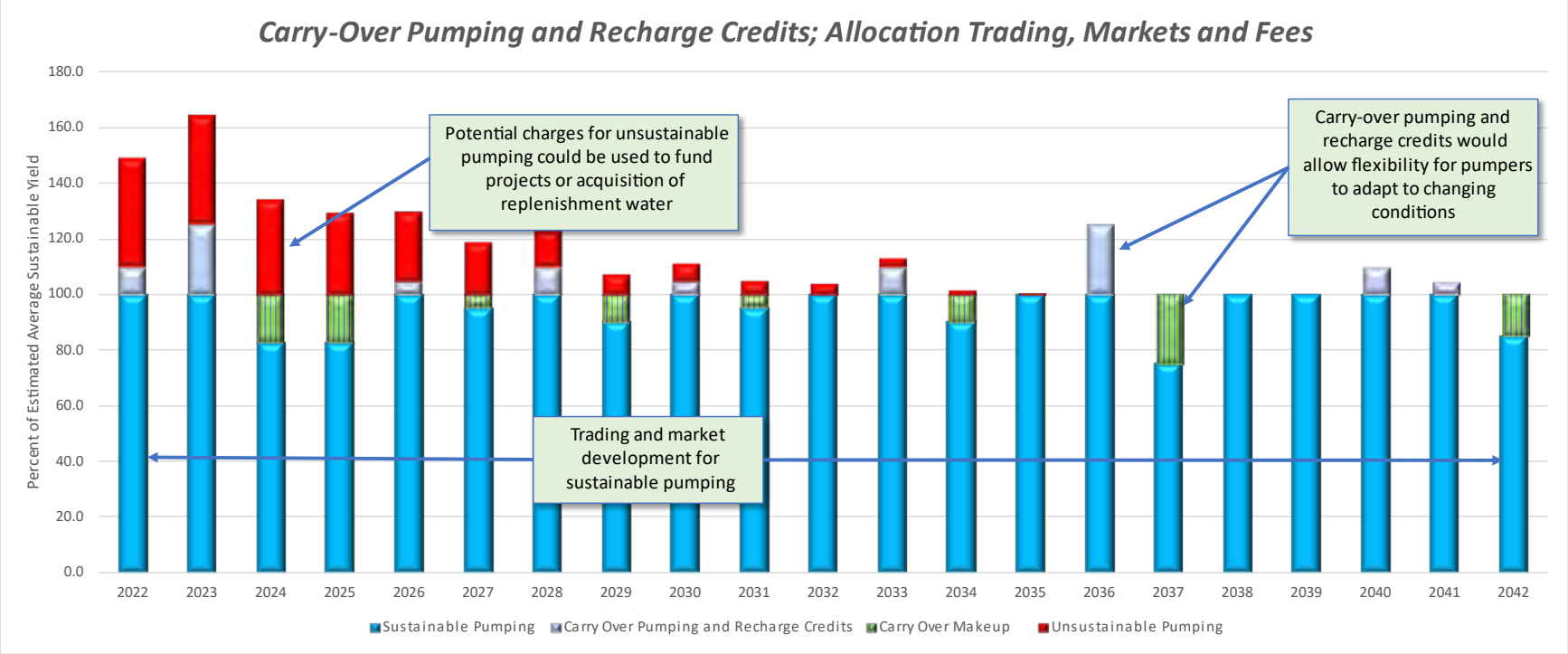


Figure 8-8: Implementation of Pumping Reduction Framework: Operations Flexibility and Incentives including Carry-Over Pumping and Recharge Credits, Allocation Trading, Markets and Fees



8.4.2.1. Groundwater Extraction Reporting Program (Management Action 3)

8.4.2.1.1. Management Action Description

The Groundwater Extraction Reporting Program would be implemented in two phases: an initial voluntary program followed by a comprehensive program:

1. Voluntary Extraction Reporting - This phase of the program is intended to provide voluntary annual reporting of groundwater use by agricultural and private well owners. A survey and registration form will be sent to the fee title holders of all parcels in each GSP advising them of the program and requesting registration to participate in metering and annual reporting of groundwater extractions from their wells. Additional public outreach will be conducted introducing the program. The DMS will be set up with appropriate input data forms for voluntary reporting of groundwater use as well as other relevant information, such as irrigated acreage, crop type, and sources of water.

2. Comprehensive Extraction Reporting - This phase of the program is intended to address data gaps that may remain after implementation of the voluntary program. Implementation of this phase will occur by one of two methods selected by the GSAs: (1) Consumptive water use will be estimated annually for each parcel through the use of remote sensing imagery to calculate the evapotranspiration of crops and subtract surface water deliveries; or (2) Installation of meters and annual reporting will be made mandatory for all non *de minimis* production wells.

The Groundwater Extraction Reporting Program would exclude *de minimis* extractors that pump less than 2 AFY.

8.4.2.1.2. Public Notice

Successful implementation of either component of this program would require the support and coordination of member agencies, well owners throughout the Subbasin, and other stakeholders.

The voluntary program would be noticed via public outreach and education about the logistics of participating in the program as well as the purpose and importance of doing so, as well as the potential alternatives that would be implemented during the second phase of the program. Outreach may include public notices, meetings, potential website presence and email announcements prior to each phase of the program.

8.4.2.1.3. Permitting and Regulatory Process

The Groundwater Extraction Reporting Program is not expected to require any permitting, or other regulatory involvement.

8.4.2.1.4. Expected Benefits

Benefits to Sustainability Indicators

Direct measurement of groundwater extractions may not have direct impacts on sustainability indicators but would improve future water budget and sustainable yield refinement. The accurate and widespread collection of extraction data will provide the Turlock Subbasin GSAs with critical information to assist in management of the Subbasin, development of additional Management Actions, and monitoring the success of the GSP against the SMC.

Benefits to Disadvantaged Communities

The Groundwater Extraction Reporting Program would exclude *de minimis* extractors.

Volumetric Benefits to Subbasin Groundwater System

Measurement of groundwater extractions provides a vast improvement to the refinement of water budgets and basin storage calculations.

8.4.2.1.5. Implementation Criteria, Status, and Plan

A specific plan for the implementation of voluntary groundwater extraction reporting is anticipated to be developed shortly after the GSP is submitted and reported in the First Annual Report for GSP implementation. The effectiveness of this program would be evaluated during the first year of implementation and a Comprehensive Groundwater Extraction Plan will be prepared and reported on during the Second Annual Report for GSP implementation. Reporting of extraction volumes will continue annually in all future years in accordance with the comprehensive programs adopted by each GSA.

8.4.2.1.6. How the Management Action will be Accomplished

Voluntary extraction reporting programs have achieved widespread participation other subbasins and could be readily supplemented with consumptive use estimates for agricultural parcels derived from remote sensing data. This program does not rely on the availability of water supplies because it is a planning effort that will support overall supply reliability by providing additional information for better management of the Subbasin and moving the Subbasin towards sustainability.

8.4.2.1.7. Legal Authority

SGMA provides GSAs with the authority to require registration of groundwater extraction facilities (CWC §10725.6) and authorizes a GSA to require metering and reporting of groundwater extraction (CWC §10725.8).

8.4.2.1.8. Estimated Costs and Funding Plan

The estimated costs for the Groundwater Extraction Reporting Program would vary depending on the components that are implemented:

- The costs for the voluntary component are minimal and include:
- One-time costs for initial public outreach and setup of tools and procedures to receive and compile voluntary submitted data
- Ongoing annual administrative costs to review and compile the voluntarily submitted data as well as continued outreach
- The costs for implementing the more comprehensive program would be larger as they may include:
- One-time costs for initial public outreach and setup of tools and procedures for comprehensive groundwater extraction assessment
- Procurement of annual ET data derived from publicly-available satellite data and analysis to supplement reported pumping information at a parcel scale Ongoing annual administrative costs to review and compile the submitted data and remote sensing-derived data (if applicable) as well as continued outreach

The Groundwater Extraction Reporting Program is in preliminary stages of development. Therefore, no costs have been estimated for its development and implementation. Such costs will be developed prior to implementation by each GSA.

8.4.2.1.9. Management of Groundwater Extractions and Recharge

This program would not directly impact groundwater extractions or recharge but would develop and expand the reporting of groundwater extractions, including during both dry and wet periods, to support better management of the Subbasin.

8.4.2.2. Groundwater Allocation and Pumping Management Program (Management Action 4)

8.4.2.2.1. Management Action Description

This strategy entails development of a Groundwater Allocation and Pumping Management Program that would assign groundwater extractions into categories, assign pumping allocations to groundwater users, and manage pumping as needed to stay within the Subbasin's sustainable yield. The Management Action would be implemented by each GSA as necessary and desired for management of groundwater pumping within its jurisdictional boundaries.

Outlined here is a framework for how the Turlock Subbasin GSAs would develop and define pumping allocations and implement management in the Subbasin based on the estimated sustainable yield and the magnitude of projected overdraft. It is expected that the preliminary estimates of sustainable yield and overdraft developed by the current version of the C2VSimTM model will be updated as additional data are gathered and projects are implemented, so this Management Action will be implemented using an adaptive management approach informed by ongoing groundwater monitoring.

There are six key steps to defining pumping allocations within the GSAs where this Management Action is implemented:

1. Determine the sustainable yield of the Basin (see **Section 5.3** of this GSP) and its division between the GSAs. This determination may be updated periodically as new and more reliable information and data become available.
2. Allocate Sustainable Pumping using a method to be developed by the GSAs in consultation with stakeholders.
3. Allocate Unsustainable Pumping for each parcel by subtracting Sustainable Pumping from the reported or calculated pumping from the Groundwater Extraction Reporting Program (Management Action 3). This represents the difference between actual pumping and Sustainable Pumping and will be phased out over time as discussed in **Section 8.4.2**.
4. Define Carry-Over Pumping as a temporary exceedance of Sustainable Pumping that is/can be offset by pumping below the Sustainable Pumping allocation in prior or subsequent years. Carry-Over Pumping will be allocated on an annual basis.
5. Define Recharge Credits for the owner-implemented recharge projects. These credits could be used by a grower or traded/sold on a water market and would provide an incentive for implementation of dispersed recharge projects.
6. Define, characterize, and allocate any additional pumping types or credits, such as allocations of the yield of specific projects, as appropriate, and determine how new/additional supplies would be allocated.

The Groundwater Allocation and Pumping Management Program has been developed at a conceptual level at this time and will be further refined as summarized below. Where implemented, groundwater allocation and pumping management is anticipated to be implemented in phases as follows.

Phase 1: Program Establishment and Data Gathering (GSP Implementation Years 1 to 5)

- During the first five years, information will be gathered to better assess Subbasin trends, water budget information, and the basin response to climatic conditions and projects. Gaps in the monitoring networks will be addressed, MTs/MOs may be refined, and the Subbasin groundwater flow model will be updated and used to develop a refined understanding of sustainable yield and overdraft in the Subbasin.
- Group 1 and 2 projects will begin to be implemented and are expected to offset a portion of the Unsustainable Pumping. Group 3 projects will be developed and implemented as possible, and additional project opportunities may be identified and implemented. In addition, it is anticipated that further reductions in net groundwater demand would be achieved through voluntary water conservation, land fallowing and other demand reduction actions during implementation of Management Actions 1 and 2.

- The effectiveness of PMAs to mitigate overdraft will be discussed in Annual Reports.
- A Pumping Management Plan will be prepared, describing the methods and schedule for the first phase of demand reductions needed to achieve the Subbasin's 10-year IMs. The demand reductions would be scaled based on monitoring data using the updated C2VSimTM model to assess the amount of demand reduction needed. The Pumping Management Plan will be appended to the GSP Five-Year Assessment Report.
- The GSAs may decide to implement an initial increment of pumping reduction during this phase during the latter portion of this period.
- If an undesirable result is documented based on the criteria established in **Chapter 6**, Implementation Support Activity 5 (see **Section 9.5**) will be implemented.

Phase 2: Initial Pumping Reduction (GSP Implementation Years 6 to 10)

- The Pumping Management Plan would be implemented starting in Year 6 of GSP implementation. Monitoring data will be gathered to allow assessment of the Subbasin response to demand reduction and the Subbasin groundwater flow model may be further refined updated as appropriate. Additional data gaps may be assessed, and MTs/MOs may be further refined.
- Group 1, 2 and 3 projects will continue to be implemented and additional projects may be developed and implemented, and further reductions in net groundwater demand may be achieved through voluntary water conservation, land fallowing, and other demand reduction actions during continued implementation of Management Actions 1 and 2.
- If an undesirable result is documented based on the criteria established in **Chapter 6**, Implementation Support Activity 5 (see **Section 9.5**) will be implemented.
- The effectiveness of PMAs, including pumping reduction, to mitigate overdraft would be discussed in Annual Reports.
- In Year 10, the Pumping Management Plan will be updated to refine the methods and schedule for the second phase of demand reductions needed to achieve the Subbasin's 15-year IMs and phase out all Unsustainable Pumping. The demand reductions would be scaled based on monitoring data using the updated C2VSimTM model to assess the amount of demand reduction needed. The updated Pumping Management Plan will be appended to the GSP 10-Year Update.

Phase 3: Final Pumping Reduction (GSP Implementation Years 11 to 15)

- At this point, projects are assumed to be fully phased in, and pumping reductions will be further phased in as needed to maintain pumping within the sustainable yield of the Subbasin by the end of the period and achieve the 15-year IM.
- The Subbasin response to project, climatic, and pumping conditions will continue to be monitored and adjustments will be made to the pumping reduction strategy as needed.

- If an undesirable result is documented based on the criteria established in **Chapter 6**, Implementation Support Activity 5 (see **Section 9.5**) will be implemented.
- The effectiveness of PMAs to mitigate overdraft and any adjustments to the program will be discussed in Annual Reports and Five-Year Assessment Reports.

Phase 4: Long-Term Program Operation (Years 16 forwards)

- The Subbasin response to PMAs, climatic, and pumping conditions would continue to be monitored and adjustments would be made to the pumping reduction strategy as needed.
- If an undesirable result is documented based on the criteria established in **Chapter 6**, Implementation Support Activity 5 (see **Section 9.5**) will be implemented.
- The effectiveness of PMAs to mitigate overdraft and any adjustments to the program will be discussed in Annual Reports and Five-Year Assessment Reports.

8.4.2.2.2. Public Notice

Development of a Groundwater Allocation and Pumping Management Program would require substantial public, landowner, and other stakeholder input to understand the potential impacts of groundwater pumping reduction and baseline needs that should be accounted for, and to establish a workable program with broad community support. The Turlock Subbasin GSAs anticipate that public outreach would include multiple public workshops and meetings, potential website and/or email announcements, along with other public notices for the workshops. The Groundwater Allocation and Pumping Management Program would be circulated for public comment before finalized, though final approval of the plan would be made by the Turlock Subbasin GSAs for their jurisdictions as they deem appropriate, in partnership with their respective member agencies.

8.4.2.2.3. Permitting and Regulatory Process

Development of a Groundwater Allocation and Pumping Management Program would not require any permitting but would require consideration of existing water rights and applicable permits and regulations associated with groundwater pumping in the Subbasin. Further investigation for possible permitting requirements will need to be performed.

8.4.2.2.4. Expected Benefits

Benefits to Sustainability Indicators

Sustainability indicators benefitting from the Groundwater Allocation Program include:

- Chronic lowering of groundwater levels – By reducing groundwater demand, this Management Action would reduce pumping and pumping-related contributions to chronic lowering of groundwater levels and would be implemented for the purpose of meeting groundwater level IMs and avoiding undesirable results.

- Reduction of groundwater storage – Reduced pumping throughout the Subbasin contributes to a smaller rate of reduction in groundwater storage and would be implemented for the purpose of brining the basin into balance over time.
- Degraded water quality – This Management Action does not address this sustainability indicator.
- Land subsidence – Reduced groundwater pumping would reduce the risk of subsidence associated with lowering of groundwater levels.
- Depletion of interconnected surface water – Reduced pumping would reduce the potential for negative impacts to surface water flows associated with lowering groundwater levels.

Benefits to Disadvantaged Communities

Benefits to disadvantaged communities overlap with the benefits described above for sustainability indicators.

Volumetric Benefits to Subbasin Groundwater System

The volumetric benefit to the groundwater system cannot be accurately estimated using the tools and project information available at this time. It is anticipated that this Management Action will lead to a long-term balanced water budget and recovery of groundwater storage in areas where groundwater levels are currently below the MTs. The extent of recovery will be further studied when a Groundwater Reduction Plan is prepared by one or both GSAs.

8.4.2.2.5. Implementation Criteria, Status, and Plan

This Management Action would be based on one or more implementation plans developed based on data gathered during initial implementation of the GSP and adjusted as needed to meet the SMC established in **Chapter 6**. The Turlock Subbasin GSAs will develop Annual Reports to evaluate progress toward meeting the sustainability goal and document Groundwater Pumping Management Plans and amendments in Five-Year Assessment Reports. If monitoring efforts demonstrate that the PMAs being implemented are not effective in achieving stated targets, the GSAs will convene a working group to evaluate the implementation of additional supply-side and demand-side actions, such as the adaptive management approaches in the Pumping Management Framework.

8.4.2.2.6. How the Management Action will be Accomplished

This Management Action would be developed using a transparent, stakeholder-driven approach, but ultimately adopted and implemented as a requirement under the authority of the GSPs. This program does not rely on groundwater supplies from outside the Subbasin because it is a planning and management effort that will result in pumping reductions. It will support overall supply reliability by reducing overdraft in the Subbasin and moving the Subbasin towards sustainability.

8.4.2.2.7. Legal Authority

Under SGMA, GSAs have authority to establish and enforce groundwater extraction allocations. Specifically, SGMA authorizes GSAs to control groundwater by "…regulating, limiting, or suspending extractions from individual wells or extractions in the aggregate…or otherwise establishing groundwater extraction allocations" (CWC §10726.4(a)). SGMA and GSPs adopted under SGMA cannot alter water rights.

8.4.2.2.8. Estimated Costs and Funding Plan

Development and initiation of an allocation program is expected to include upfront costs to conduct the analysis, set up the tracking system, and conduct outreach. Costs to implement the plan would depend on the level of enforcement required to achieve allocation targets and the level of outreach required annually to remind users of their allocation for a given year. The Groundwater Allocation and Pumping Management Program would also include an annual cost that covers ongoing enforcement and implementation. Because the Groundwater Allocation Program is in preliminary stages of discussion and possible consideration, no costs have been estimated. Such costs will be developed should either or both Turlock Subbasin GSAs decide to pursue such programs in the future.

8.4.2.2.9. Management of Groundwater Extractions and Recharge

The Groundwater Allocation and Pumping Management Program would include provisions for the recovery of groundwater levels and groundwater storage during non-drought periods.

8.4.2.3. Groundwater Extraction Fee Program (Management Action 5)

8.4.2.3.1. Management Action Description

This strategy entails setting up a Groundwater Extraction Fee Program structure for Unsustainable Pumping by a groundwater user. The fee structure could work in conjunction with the groundwater pumping reduction and reporting programs (Management Actions 3 and 4), such that a fee is implemented that serves as an incentive to discontinue Unsustainable Pumping. Revenues from the fee could be used to fund additional projects, procure replenishment water, and/or purchase and permanently fallow marginally-productive agricultural lands dependent on groundwater. This strategy may be implemented within one or both GSAs as needed to achieve the sustainability goals.

8.4.2.3.2. Public Notice

Development of a Groundwater Extraction Fee Program would require substantial public input to understand the potential impacts and needs that should be accounted for. The Turlock Subbasin GSAs anticipate that public outreach would include multiple public workshops and meetings, potential website and/or email announcements, along with other public notices for the workshops. The Groundwater Extraction Fee framework would be circulated for public comment before being finalized, though final approval of the plan

would be made by the Turlock Subbasin GSAs preparing to implement this program in partnership with its member agencies.

Additional noticing for the public would be conducted consistent with permitting and other regulatory requirements in the case of the enactment of fees. GSA outreach may include public notices, meetings, website or social media presence, and email announcements. Prior to implementing any fee or assessment program, the GSAs would complete a rate assessment study or other analysis if required by the regulatory requirements.

Per CWC §10730, prior to imposing or increasing a fee, a groundwater sustainability agency shall hold at least one public meeting, at which oral or written presentations may be made as part of the meeting. Notice of the time and place of the meeting shall include a general explanation of the matter to be considered and a statement that the data required by this section is available. The notice shall be provided by publication pursuant to §6066 of the Government Code, by posting notice on the Internet Web site of the groundwater sustainability agency, and by mail to any interested party who files a written request with the agency for mailed notice of the meeting on new or increased fees. A written request for mailed notices shall be valid for one year from the date that the request is made and may be renewed by making a written request on or before April 1 of each year. At least 20 days prior to the meeting, the groundwater sustainability agency shall make available to the public data upon which the proposed fee is based. Any action by a groundwater sustainability agency to impose or increase a fee shall be taken only by ordinance or resolution.

8.4.2.3.3. Permitting and Regulatory Process

Fees imposed pursuant to CWC §10730 shall be adopted in accordance with subdivisions (a) and (b) of §6 [property-related fees] of Article XIII D of the California Constitution [Prop.218]. Post-GSP adoption, fees are required to comply with the requirements for Proposition 218, except for the voter approval requirement.

A fee or charge shall not be extended, imposed, or increased by any agency unless it meets all of the following requirements:

- Revenues derived from the fee or charge shall not exceed the funds required to provide the property related service.
- Revenues derived from the fee or charge shall not be used for any purpose other than that for which the fee or charge was imposed.
- The amount of a fee or charge imposed upon any parcel or person as an incident of property ownership shall not exceed the proportional cost of the service attributable to the parcel.
- No fee or charge may be imposed for a service unless that service is actually used by, or immediately available to, the owner of the property in question. Fees or charges based on potential or future use of a service are not permitted. Standby

charges, whether characterized as charges or assessments, shall be classified as assessments and shall not be imposed without compliance with **Section 4**.

- No fee or charge may be imposed for general governmental services including, but not limited to, police, fire, ambulance or library services, where the service is available to the public at large in substantially the same manner as it is to property owners.

Procedural requirements include the following:

- The parcels upon which a fee or charge is proposed for imposition shall be identified. The amount of the fee or charge proposed to be imposed upon each parcel shall be calculated. The agency shall provide written notice by mail of the proposed fee or charge to the record owner of each identified parcel upon which the fee or charge is proposed for imposition, the amount of the fee or charge proposed to be imposed upon each, the basis upon which the amount of the proposed fee or charge was calculated, the reason for the fee or charge, together with the date, time, and location of a public hearing on the proposed fee or charge.
- The agency shall conduct a public hearing upon the proposed fee or charge not less than 45 days after mailing the notice of the proposed fee or charge to the record owners of each identified parcel upon which the fee or charge is proposed for imposition. At the public hearing, the agency shall consider all protests against the proposed fee or charge. If written protests against the proposed fee or charge are presented by a majority of owners of the identified parcels, the agency shall not impose the fee or charge.

8.4.2.3.4. Expected Benefits

Benefits to Sustainability Indicators

Collection of groundwater extraction fees incentivizes the use of supplemental or alternative water supplies where fees can also fund activities/projects that increase groundwater supplies, such as groundwater recharge, thus reducing declines in groundwater elevations and groundwater storage. Other sustainability indicators benefitting from the Groundwater Extraction Fee program include:

- Chronic lowering of groundwater levels – A fee would incentivize reductions in Unsustainable Pumping. By reducing groundwater demand, this Management Action would reduce pumping and pumping-related contributions to chronic lowering of groundwater levels.
- Reduction of groundwater storage – A fee would incentivize reductions in Unsustainable Pumping. Reduced pumping throughout the Subbasin contributes to a smaller rate of reduction in groundwater storage.
- Degraded water quality – This Management Action does not address this sustainability indicator.

- Land subsidence – A fee would incentivize reductions in Unsustainable Pumping. Reduced groundwater pumping would reduce the risk of subsidence associated with lowering of groundwater levels.
- Depletion of interconnected surface water – A fee would incentivize reductions in Unsustainable Pumping. Reduced pumping would reduce the potential for negative impacts to surface water flows associated with lowering groundwater levels.

Benefits to Disadvantaged Communities

Per CWC, §10730(a), a groundwater fee programs must exclude *de minimis* extractors.

Volumetric Benefits to Subbasin Groundwater System

The volumetric benefit to the groundwater system would depend on the framework of the fee implemented and would be further studied as a Groundwater Extraction Fee Program is developed by the GSAs.

8.4.2.3.5. Implementation Criteria, Status, and Plan

If this Management Action is implemented, it would be adopted using a publicly noticed process in compliance with application regulations and requirements. Implementation would be documented and tracked by each GSA and included in their audited financial statements. Implementation status would be reported in the Annual Reports and Five-Year Assessment Reports.

8.4.2.3.6. How the Management Action Will be Implemented

This Management Action would be developed using a transparent, stakeholder-driven approach, in accordance with the appropriate process for adoption of fees by a public agency. This action does not rely on groundwater supplies from outside the Subbasin because it is a planning and management effort that will result in pumping reductions and make funds available for recharge projects or replenishment water procurement. It will support overall supply reliability by reducing overdraft in the Subbasin and moving the Subbasin towards sustainability. The Groundwater Extraction Fee Program would apply in both drought and non-drought periods.

8.4.2.3.7. Legal Authority

GSAs possess the legal authority to implement special taxes, assessments, and user fees within the project proponent service area or area of project benefit. Fees imposed include fixed fees and fees charged on a volumetric basis, including, but not limited to, fees that increase based on the quantity of groundwater produced annually, the year in which the production of groundwater commenced from a groundwater extraction facility, and impacts to the basin.

8.4.2.3.8. Estimated Costs and Funding Plan

While there are certain administrative costs anticipated with the development and implementation of a Groundwater Extraction Fee, the Groundwater Extraction Fee itself is a

potential mechanism to fund the costs of groundwater management. This includes, but is not limited to, the following:

- Administration, operation, and maintenance, including a prudent reserve
- Acquisition of lands or other property, facilities, and services
- Supply, production, treatment, or distribution of water
- Other activities necessary or convenient to implement the plan

8.4.2.3.9. Management of Groundwater Extractions and Recharge

This program, in conjunction with the Groundwater Extraction Reporting Program (Management Action 3) and the Groundwater Allocation and Pumping Management Program (Management Action 4), would directly develop and expand the reporting of groundwater extractions, including during both drought and non-drought periods, to support better management of the Subbasin, would incentivize groundwater pumping reductions, and could be used to help fund groundwater supply and recharge projects.

8.4.2.4. Groundwater Pumping Credit Market and Trading Program (Management Action 6)

8.4.2.4.1. Management Action Description

This program would establish rules for the use of Carry-Over Pumping Allocations and establishes operational flexibility for a groundwater pumper to exceed their allocated Sustainable Pumping in a given year if the exceedance is offset in prior or subsequent years. It could also establish groundwater credit markets and trading programs that facilitate reductions in Unsustainable Pumping. Groundwater credit markets and trading programs would be considered to exchange, trade or sell the Sustainable Pumping or Carry-Over Pumping allocation of groundwater use by each landowner within each GSA, or among the GSAs as a whole within each Subbasin, and would provide additional operational flexibility and mediate the effects of pumping reduction requirements through market forces. This strategy is contingent upon implementation of the groundwater reporting, allocation and management programs (Management Actions 3 and 4), so that the credit and trading market can monitor the exchange of groundwater allocations among the landowners and/or the GSAs. Should the Turlock Subbasin GSAs decide to pursue a program in the future, the Turlock Subbasin GSAs would seek guidance from experts with experience in water markets to identify options for communications and outreach with stakeholders, program design, and mechanisms to ensure that non-participating stakeholders are not adversely impacted by the program.

8.4.2.4.2. Public Notice

Development and implementation of a Groundwater Pumping Credit Market and Trading Program would require substantial public input to understand the potential impacts and nuances or implementing such a program. The Turlock Subbasin GSAs anticipate that public outreach would include multiple public workshops and meetings, potential website and/or

email announcements, along with other public notices for the workshops. The program plan would be circulated for public comment before finalized, though final approval of the plan would be made by a Turlock Subbasin GSA or GSAs in partnership with its/their member agencies.

8.4.2.4.3. Permitting and Regulatory Process

Permitting and other regulatory compliance issues will be identified and addressed when the program is further explored and developed, consistent with CWC §10726.4 (a) (3 & 4).

8.4.2.4.4. Expected Benefits

Benefits to Sustainability Indicators

Sustainability indicators benefitting from the Groundwater Pumping Credit Market and Trading Program include:

- Chronic lowering of groundwater levels – By facilitating reduction of groundwater demand, this Management Action would reduce pumping and pumping-related contributions to chronic lowering of groundwater levels.
- Reduction of groundwater storage – Facilitation of reduced pumping throughout the Subbasin contributes to a smaller rate of reduction in groundwater storage.
- Degraded water quality – This Management Action does not address this sustainability indicator.
- Land subsidence – Facilitation of reduced groundwater pumping would reduce the risk of subsidence associated with lowering of groundwater levels.
- Depletion of interconnected surface water – Facilitation of reduced pumping would reduce the potential for negative impacts to surface water flows associated with lowering groundwater levels.

Benefits to Disadvantaged Communities

Benefits to disadvantaged communities overlap with the benefits described above for sustainability indicators.

Volumetric Benefits to Subbasin Groundwater System

The volumetric benefit to the groundwater system will depend on the framework of the credit market and trading program implemented and will be further studied when the program is developed by the GSAs.

8.4.2.4.5. Implementation Criteria, Status, and Plan

A legally-documented framework would be used for the trade, exchange and sale of Sustainable and Carry-Over allocations. All transactions would be documented using an auditable process. The function of the trading and markets program would be documented in Annual Reports.

8.4.2.4.6. How the Management Action Will be Implemented

If this Management Action is implemented, it would be developed using a stakeholder-driven process facilitated by an expert in the development of water markets. An agreed upon framework and platform would be developed for the tracking of Carry-Over Pumping allocations and for the trade, exchange and sale of Sustainable and Carry-Over allocations. The Subbasin area will be the source of groundwater and will be limited by the hydrology of the region.

8.4.2.4.7. Legal Authority

CWC §10726.4 (a) (3 & 4) provide legal authority for groundwater transfer and accounting programs.

8.4.2.4.8. Estimated Costs and Funding Plan

The Groundwater Pumping Credit Market and Trading Program is in preliminary stages of discussion and possible consideration. Therefore, no costs have been estimated for its development and implementation. Such costs will be developed should the Turlock Subbasin GSAs or an individual GSA decide to pursue a program in the future. Costs could include additional staffing required to administer the program and would be borne by the participants.

8.4.2.4.9. Management of Groundwater Extractions and Recharge

The implementation of a Groundwater Pumping Credit Market and Trading Program would facilitate reductions in groundwater pumping and the recovery of groundwater levels and groundwater storage during non-drought periods.

8.4.3. Domestic Well Mitigation Program (Management Action 7)

8.4.3.1. Management Action Description

Background Conditions for Domestic Wells in the Turlock Subbasin

There are approximately 4,840 domestic wells that have been drilled in the Turlock Subbasin as of October 2021 (DWR Well Completion Reports database). Exact locations and current status are unknown for many of the domestic wells. It is reasonable to assume that many older wells have been replaced, but data are not sufficiently detailed to match older well records to new wells that have likely replaced them.

In addition, construction data (including well depths) are not available for about 6.5% of the wells (316 wells). Pump settings are generally not included in the construction data. Finally, local examinations of small neighborhoods on a parcel by parcel basis indicate that records are not available for many active wells.

Approximately 165 wells (about 4 percent of the estimated total wells drilled at that time) were reported to have failed during the drought conditions during 2015 – 2017. Stanislaus County officials note that many failed wells were shallow (less than 100 feet deep) and older

wells (more than 50 years old), and as a result, many of the failures may not have been due solely to drought conditions.

Since 2015, about 483 new domestic wells have been drilled in the Subbasin, almost 3 times the number of previously failed wells (DWR Well Completion Reports, October 2021). When plotted with the locations of the failed wells, it appears that most of the new wells were drilled close to or at the same locations as the failed wells. Overall, new wells were drilled to deeper depths than previous wells in the same area. Given these conditions, it is reasonable to assume that most, if not all of the original reported 165 failed wells during the drought conditions in 2015 – 2017 have been replaced.

Since 2016, no additional failed wells have been reported on the DWR Household Water Supply Shortage Reporting System (Household Water Supply Shortage Reporting System (ca.gov)). Stanislaus County reports a few additional calls from well owners but causes of the few new well issues have not been determined. Nonetheless, without knowing current well status, construction, pump setting, and accurate locations, it is not possible to determine how many domestic wells in the Turlock Subbasin remain at risk of failure due to even modest water level declines.

Sustainable Management Criteria and Potential Impacts to Domestic Wells

The current MTs are set at 2015 levels – or higher – for all of the sustainability indicators in the Subbasin. The definition of undesirable results allows for some water level declines for a third of the representative monitoring wells during 3 consecutive dry years, but water levels are required to recover following this short-term decline. Water level declines during multi-year droughts have typically been less than 30 feet in areas of the previously failed wells and less than 20 feet in areas where most failures occurred.

However, wells in the Eastern Principal Aquifer and a few in the western principal aquifers have been assigned an IM, allowing for continuing water level declines during the first five years of GSP implementation while projects are brought online. Given the uncertainty associated with well status and construction, some wells could be affected. This program includes various steps for addressing conditions to mitigate impacts to domestic wells during GSP implementation.

Steps for Domestic Well Mitigation Program

1. **Coordinate with Existing Programs.** Many drinking water quality programs are being implemented in the Turlock Subbasin to ensure the Human Right to Water is met. These programs have varying objectives and include Nitrate Control Program, Drought Emergency, Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS), County Well Owner Assistance Programs[38], and Safe Affordable Funding for Equity and Resilience (SAFER), among others. The coordination of these various

[38] Both Stanislaus and Merced counties have developed programs to respond to well owner needs such as provision of temporary water tanks, trucked water, and other measures.

programs will be an integral part of the Turlock Subbasin Domestic Well Mitigation Program. Each program is gathering information about domestic wells and providing services to meet their own charges. Turlock Subbasin GSAs will engage with those entities and identify additional data gaps and services that might benefit from basin-wide activities.

2. **Assess the need for a Well Registration Program for Domestic Wells.** As mentioned previously, current datasets do not accurately reflect location, construction, or status of domestic wells in the Subbasin. Various other programs, including those listed above, are developing datasets to meet program-specific objectives. Some of these datasets are likely to contain more accurate information for domestic wells. For example, as part of the Nitrate Control Program, the Valley Water Collaborative has initiated a domestic well survey and outreach regarding nitrate concentrations in homeowners' wells. This program is reportedly developing accurate locations to interface with geographical information software (GIS).

   A potential approach for developing a database of GSP-relevant information regarding domestic wells is provided below for consideration during GSP implementation in the Turlock Subbasin.

   a. Determine how other programs are collecting and managing data on Subbasin domestic wells. Beginning with a database that incorporates domestic well information from DWR Well Completion Reports and County well permits, add relevant information from datasets available from other programs.

   b. Identify data gaps from existing data. Based on specific Subbasin needs, consider development of a Turlock Subbasin-specific questionnaire for domestic well owners to complete. Questionnaires would include information on well location, construction, and status. Examples of information would include, when available:

      i. Well location (APN and GPS)

      ii. Construction including boring and casing depth, well screen intervals, pump setting and capacity

      iii. Other well appurtenances such as water tanks or other supplemental storage

      iv. Whether it serves as the sole source of water supply for one household or multiple households

      v. DWR well completion report, if available.

   c. Incorporate questionnaire data into the domestic well database, linking likely duplicates and associated wells on the same parcel where data allow. Database can be maintained as a component of the GSP Data Management System for the Subbasin.

d. Institute an outreach program encouraging domestic well owners to register their wells and provide key information on which to base groundwater management decisions.

e. Work with Counties on well permit applications as they are submitted. Deny well permits that are likely to be insufficient to provide water supply during multi-year droughts or encourage modifications to ensure sufficient supplies in multi-year droughts.

f. Monitor the DWR website (Household Water Supply Shortage Reporting System (ca.gov) periodically and identify areas where wells have reported shortages. Coordinate these efforts with County officials, who are automatically notified when wells are recorded on the website.

3. Develop an Education and Outreach Program

    a. Share information with local drinking water programs and well drillers on anticipated water levels in various portions of the Subbasin so that well owners can be informed of, and plan for, possible future changes in water levels.

    b. Outreach and coordination with land use planning agencies regarding groundwater supplies and availability.

    c. Outreach to domestic well owners. Activities could include educating new well owners about MTs and MOs and how they relate to their well, the importance of spacing wells to avoid potential well interference, and other information to help well owners plan their wells to reduce the likelihood of problems in the future.

4. Monitor Areas of Domestic Well Information Gaps.

    a. Areas of previously-failed wells are being monitored by local representative monitoring wells, which provide good coverage across the Western Upper Principal Aquifer.

    b. Areas of previously-failed wells in the Eastern Principal Aquifer are targeted for additional monitoring well installation, including currently-budgeted new wells in the northeastern area of the WTSGSA.

5. Target GSP Projects in Areas of Potentially Vulnerable Wells.

    a. The Regional Surface Water Supply Project will provide surface water for drinking water supply to cities of Ceres and Turlock by 2023, resulting in less pumping in areas near domestic wells. Modeling analyses predict higher water levels adjacent to city wellfields near areas of previously-failed wells.

    b. The GSAs have initiated identification of areas of recharge using the Groundwater Recharge Assessment Tool (GRAT). Modeling demonstrates the ability to quickly raise water levels in localized areas with targeted on-farm recharge.

c. In the Modesto Subbasin, the Stanislaus & Tuolumne Rivers Groundwater Basin Association (STRGBA) GSA is implementing a GSP project to bring surface water supply to the City of Waterford, located just across the Tuolumne River from the disadvantaged community of Hickman. Reduction of groundwater pumping in this critical area will provide some protection for a concentrated area of local domestic wells in the Turlock Subbasin.

6. Develop a three-tiered Corrective Action Plan for Potential Domestic Well Mitigation. A possible framework for consideration is included in **Table 8-19** as an example (see following page). The program will be further developed during GSP implementation.

8.4.3.2. Public Notice

Development and implementation of a Domestic Well Mitigation Program would require substantial public input to understand the potential impacts and nuances or implementing such a program. The Turlock Subbasin GSAs anticipate that public outreach would include multiple public workshops and meetings, potential website and/or email announcements, along with other public notices for the workshops. The program plan would be circulated for public comment before finalized, though final approval of the plan would be made by a Turlock Subbasin GSA or GSAs in partnership with its/their member agencies.

8.4.3.3. Permitting and Regulatory Process

Permitting and other regulatory compliance issues will be identified and addressed when the program is further explored and developed, consistent with CWC §10726.4 (a) (3 & 4).

8.4.3.4. Expected Benefits

Benefits to Sustainability Indicators

This Management Action includes various steps for addressing conditions to mitigate impacts to domestic wells during early years of GSP implementation.

Benefits to Disadvantaged Communities

Benefits to disadvantaged communities overlap with the benefits described above for sustainability indicators.

Volumetric Benefits to Subbasin Groundwater System

The volumetric benefit to the groundwater system will depend on the framework of the Domestic Well Mitigation Program and will be further studied when the program is developed by the GSAs.

Table 8-19: Potential Corrective Action Plan for Potential Domestic Well Mitigation

Triggers	Groundwater Conditions	Quantifiable Measures	Potential Corrective Actions
Green Light	Groundwater levels at or above MTs	In compliance with MTs and MOs	None
Yellow Light	Groundwater levels below MTs in areas of concentrated domestic wells	Domestic wells have failed due to low water levels; additional domestic wells are projected to go dry with current groundwater trends (metrics to be further developed along with program specifics).	• Identify impacted areas; determine causes • Coordinate with local programs and water quality regulatory agencies • Coordinate with available assistance programs to provide initial or temporary solutions until more durable solutions can be identified or implemented. • If impacts are due to water level declines - re-assess current pumping patterns and/or consider localized projects/actions • Encourage surface water use (when available) by local growers, in-lieu of groundwater from nearby agricultural wells.
Red Light	Groundwater elevations reach undesirable results	Analyses demonstrate domestic wells have failed due to water level declines and undesirable results; other wells projected to fail. (metrics to be further developed along with the program specifics)	• Identify impacted areas; determine causes if possible. • Coordinate with local programs and water quality regulatory agencies • Coordinate with available assistance programs to provide initial or temporary solutions until more durable solutions can be identified or implemented. • If impacts are due to water level declines – reassess current pumping patterns and/or consider localized projects/actions • Encourage surface water use (when available) by local growers, in-lieu of groundwater from nearby wells. • Consider restrictions on pumping • Identify long-term solutions / programs, such as consolidations with other water systems

8.4.3.5. Implementation Criteria, Status, and Plan

These components are described under the heading “Steps for Domestic Well Mitigation Program” within **Section 8.4.3.1**.

8.4.3.6. Water Source and Reliability

If certain groundwater conditions are met, corrective actions are proposed to respond to the situation. The program will operate in both drought and non-drought conditions.

8.4.3.7. Legal Authority

No additional legal authority is needed for the implementation of this action. The potential corrective actions will be based on water availability, funding, and coordination with corrective actions being taken by other regulatory and land use agencies, such as the counties, and regulated water quality coalitions.

8.4.3.8. Estimated Costs and Funding Plan

The Domestic Well Mitigation Program is in preliminary stages of development. Therefore, no costs have been estimated for its development and implementation. Such costs will be developed prior to implementation by each GSA. Program details are scheduled for development during the first two years of the GSP.

8.4.3.9. Management of Groundwater Extractions and Recharge

This program includes various steps for addressing conditions to mitigate impacts to domestic wells during these early years of GSP implementation. It includes provisions for developing a Corrective Action Plan that organizes a response to certain groundwater conditions.

8.5. PLAN FOR ACHIEVING SUSTAINABILITY

8.5.1. Integrated Modeling Scenarios

To evaluate the effects of PMAs in meeting the sustainability goals of the Turlock Subbasin, Group 1 and 2 Projects have been analyzed using the C2VSimTM model. C2VSimTM is a fully integrated surface and groundwater flow model capable of analyzing the effects of the PMAs on the land surface, stream, and groundwater systems of the Turlock Subbasin.[39] The C2VSimTM model is used to develop the GSP's water budget estimates for historical, current, and projected conditions, as well as basin groundwater levels, streamflow, and interconnected surface water bodies under historical, baseline, and various project conditions. It is understood that the projections of future groundwater conditions using the C2VSimTM model are based on the current understanding of the Subbasin, which can be further refined as more information becomes available. The 50-year projection of groundwater conditions using C2VSimTM is based on assumptions that has uncertainties in hydrologic and climatic conditions, agricultural crop mix and patterns, irrigation practices, population growth patterns and urban development trends, land use plans, and environmental regulations. However, the C2VSimTM is currently the best available analysis

[39] This is based on the best available information at this time, but the GSAs acknowledge that the model will be refined as more and better data becomes available.

tool to assist in evaluation of project benefits and impacts, not in an absolute sense, but in a relative scale.

The analysis below evaluates the proposed projects relative to the C2VSimTM Projected Conditions Baseline. The results of this analysis are then compared to MTs to estimate the approximate amount of additional net demand reduction that will be needed to meet the sustainability goal of the Subbasin. This gap in net demand reduction can be met through the implementation of additional projects, through management actions to promote water conservation, or by requiring pumping reduction. The Projected Conditions Baseline applies the projected water supply and demand conditions under the 50-year hydrologic period of WYs 1969-2018. A total of eleven (11) Group 1 and 2 Projects and one (1) management action were grouped into five (5) scenarios based on their use-sector and GSA. **Table 8-20** shows a matrix of the simulated projects and their respective scenarios. Each of these projects are described in detail in **Section 8.2**, with modeling assumptions outlined in sub-section 5 for each project.

Table 8-20: Projects and Management Actions Analyzed Using C2VSimTM Model

Urban and Municipal Projects (WTSGSA)		Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
1	Regional Surface Water Supply Project	X	X	X	X	X
2	Waterford/Hickman Surface Water Pump Station and Storage Tank	X	X	X	X	X
3	Dianne Storm Basin	X	X	X	X	X
4	Stanislaus State Stormwater Recharge	X	X	X	X	X
5	Advanced Metering Infrastructure Project (AMI)	X	X	X	X	X
WTSGSA – Agricultural Projects						
6	TID On-Farm Recharge Project (in WTSGSA)		X		X	X
7	Recycled water to TID from City of Turlock		X		X	X
8	TID Ceres Main Regulating Reservoir		X		X	X
ETSGSA – Agricultural Projects						
9	Agricultural Recharge Project (in ETSGSA)			X	X	X
10	Mustang Creek Flood Control Recharge Project			X	X	X
11	Upland Pipeline Project			X	X	X
WTSGSA- and/or ETSGSA (as needed) – Demand Management Actions						
12	Net Demand Reduction					X

Scenario 1: Urban and Municipal Surface Water Supply

Scenario 1 includes the five urban and municipal projects as proposed by their respective agencies. These projects, shown in **Table 8-21** total an average net-recharge of 16,080 AFY over the 50-year simulation period. Impacts to the subbasin were simulated by adjusting the simulated Tuolumne River operations, municipal demand and pumping schedules, and incorporating additional recharge facilities in specified areas. **Table 8-21** below summarizes the individual and cumulative impacts of each project within this scenario.

Table 8-21: Scenario 1 Project Summary

	Project	Direct Recharge	In-Lieu Recharge	Pumping Reduction
WTSGSA Urban and Municipal Projects	Regional Surface Water Supply Project		17,500	-3,600[2]
	Waterford/Hickman Surface Water Pump Station and Storage Tank[1]		100	
	Dianne Storm Basin	20		
	Stanislaus State Stormwater Recharge	460		
	City of Modesto Additional Conservation[1]			1,600
	All Urban and Municipal Projects	480	17,600	-2,000
All Scenario 1 Projects		480	17,600	-2,000

Notes: All Units are in acre-feet

[1] The Waterford/Hickman Surface Water Pump Station and Storage Tank and City of Modesto additional conservation Projects include beneficiaries in both the Turlock and Modesto Subbasin. The volumes in this table represent an estimated fraction of the effective contribution to the Turlock Subbasin

[2] This includes 2,200 AFY of increased pumping by the cities to provide off-set water supply to TID for agricultural water use, per the SRWA agreement. Additionally, it includes 1,400 AFY of increased private agricultural pumping due to reduction in surface water supply by TID to the growers. A negative number in this field indicates an increase in GW pumping.

Scenario 1 projects are expected to reduce net groundwater pumping in the subbasin by 16,080 AFY. The net benefit to groundwater storage is to reduce the projected average annual groundwater storage deficit from 5,500 AFY under the Baseline conditions to 2,700 AFY with these projects, resulting in a net savings of 2,800 AFY of groundwater in storage. Details are shown in **Table 8-25**.

Principally, Scenario 1 projects were implemented to mitigate lowering groundwater levels, depletions of interconnected surface water systems, and potential subsidence near the urban centers within the Turlock Subbasin. **Section 8.1.2** presents the simulated groundwater conditions under both the projected conditions baseline and each of the PMA scenarios.

Scenario 1 is anticipated to be implemented in conjunction with multiple other agriculturally based projects to further improve and project aquifer conditions. See the descriptions of the following scenarios for information on the cumulative impacts to the system.

Scenario 2: WTSGSA Agricultural Water Supply Projects

Scenario 2 builds on the benefits of Scenario 1 to incorporate all WTSGSA projects. The addition of agricultural projects to this scenario increases the net simulated contribution to the groundwater system from an average of 17,480 AF to 24,280 AFY. The WTSGSA proposed three agricultural Group 2 projects to be evaluated for benefits to the aquifer system. The proposed projects include:

(1) TID On-Farm Recharge Project, providing up to 8,000 AFY of direct recharge and 2,950 AFY of additional conveyance recharge in wet and above normal years (5,200 AFY on average)

(2) Recycled Water from the City of Turlock which facilitates 2,000 AFY of in-lieu recharge in all water year types

(3) Construction of the Ceres Main Regulating Reservoir, which will provide both 400 AFY of direct recharge in all water year types and whose operations will also all allow TID to pump 600 acre-feet less from the aquifer system each year.

Table 8-22: Scenario 2 Project Summary

	Project	Direct Recharge	In-Lieu Recharge	Pumping Reduction
WTSGSA Urban and Municipal Projects	Regional Surface Water Supply Project		17,500	-3,600[2]
	Waterford/Hickman Surface Water Pump Station and Storage Tank[1]		100	
	Dianne Storm Basin	20		
	Stanislaus State Stormwater Recharge	460		
	City of Modesto Additional Conservation[1]			1,600
	All Urban and Municipal Projects	***480***	***17,600***	***-2,000***
WTSGSA Ag. Projects	TID On-Farm Recharge Project (in WTSGSA)	5,200		
	Recycled Water from City of Turlock		2,000	
	TID Ceres Main Regulating Reservoir	400		600
	All WTSGSA Agricultural Projects	***5,600***	***2,000***	***600***
All Scenario 2 Projects		**6,080**	**19,600**	**-1,400**

Notes: All Units are in acre-feet

[1] The Waterford/Hickman Surface Water Pump Station and Storage Tank and City of Modesto additional conservation Projects include beneficiaries in both the Turlock and Modesto Subbasin. The volumes in this table represent an estimated fraction of the effective contribution to the Turlock Subbasin.

[2] This includes 2,200 AFY of increased pumping by the cities to provide off-set water supply to TID for agricultural water use, per the SRWA agreement. Additionally, it includes 1,400 AFY of increased private agricultural pumping due to reduction in surface water supply by TID to the growers. A negative number in this field indicates an increase in GW pumping.

Scenario 2 projects are expected to reduce net groundwater pumping in the subbasin by 24,280 AFY. The net benefit to groundwater storage is to reduce the projected average annual groundwater storage deficit from 5,500 AFY under the Baseline conditions to 1,500 AFY with these projects, resulting in a net savings of 4,000 AFY of groundwater in storage. Details are shown in **Table 8-25**.

Scenario 3: ETSGSA Agricultural Water Supply Projects

Scenario 3 adds three ETSGSA agricultural projects to the urban and municipal projects of Scenario 1. The three projects include following:

1) ETSGSA Agricultural Recharge Project brings both direct and in-lieu surface water to the GSA in wet and above normal years. During the irrigation season it is estimated that up to 8,800 acre-feet can be made available with a long-term average of 3,400 AFY. Additionally, outside of the irrigation season this project can utilize up to 6,000 AFY of flood flows with a long-term average of 1,600 AFY

2) Mustang Creek Flood Control Recharge Project can recharge up to 980 AFY in wet years, averaging nearly 600 AFY across the simulation period

3) Upland Pipeline Project is a direct and in-lieu recharge project designed to be able to recharge up to 1,770 AFY in wet and above normal years, with lesser volumes based on water availability in drier conditions, and a long-term average of 1,100 AFY.

As presented in **Table 8-23** below, the total average annual impacts of the ETSGSA agricultural projects simulated in Scenario 3 total 6,700 AFY, including 3,300 AFY of direct recharge and 3,400 of in-lieu recharge.

Scenario 3 projects are expected to reduce net groundwater pumping in the Subbasin by 22,780 AFY. The net benefit to groundwater storage is to reduce the projected average annual groundwater storage deficit from 5,500 AFY under the Baseline conditions to 1,600 AFY with these projects, resulting in a net savings of 3,900 AFY of groundwater in storage. Details are shown in **Table 8-25**.

Table 8-23: Scenario 3 Project Summary

	Project	Direct Recharge	In-Lieu Recharge	Pumping Reduction
WTSGSA Urban and Municipal Projects	Regional Surface Water Supply Project		17,500	-3,600[2]
	Waterford/Hickman Surface Water Pump Station and Storage Tank[1]		100	
	Dianne Storm Basin	20		
	Stanislaus State Stormwater Recharge	460		
	City of Modesto Additional Conservation[1]			1,600
	All Urban and Municipal Projects	***480***	***17,600***	***-2,000***
ETSGSA Ag. Projects	Agricultural Recharge Project (in ETSGSA)	1,600	3,400	
	Mustang Creek Flood Control Recharge Project	600		
	Upland Pipeline Project	1,100		
	ETSGSA Projects	***3,300***	***3,400***	***0***
All Scenario 3 Projects		**3,780**	**21,000**	**-2,000**

Notes: All Units are in acre-feet

[1] The Waterford/Hickman Surface Water Pump Station and Storage Tank and City of Modesto additional conservation Projects include beneficiaries in both the Turlock and Modesto Subbasin. The volumes in this table represent an estimated fraction of the effective contribution to the Turlock Subbasin

[2] This includes 2,200 AFY of increased pumping by the cities to provide off-set water supply to TID for agricultural water use, per the SRWA agreement. Additionally, it includes 1,400 AFY of increased private agricultural pumping due to reduction in surface water supply by TID to the growers. A negative number in this field indicates an increase in GW pumping.

Scenario 4: WTSGSA and ETSGSA Agricultural Water Supply Projects

Scenario 4 is designed to compile all Group 1 and 2 designated projects into a single simulation and evaluate the beneficial impacts to the aquifer system. The total long-term simulated operational contribution to the groundwater system under Scenario 4 is an average of 30,980 AFY. This includes the 16,080 AFY from WTSGSA urban and municipal projects, 8,200 AFY from WTSGSA agricultural projects, and 6,700 AFY from ETSGSA agricultural projects. Over the 50-year simulation period, the cumulative effect of these projects is generally broken down to include 9,380 AFY of direct recharge, and 23,000 AFY of In-lieu recharge. A breakdown of the recharge in each project under Scenario 4 is presented in **Table 8-24**.

Table 8-24: Scenario 4 Project Summary

	Project	Direct Recharge	In-Lieu Recharge	Pumping Reduction[2]
Urban and Municipal Projects	Regional Surface Water Supply Project		17,500	-3,600[2]
	Waterford/Hickman Surface Water Pump Station and Storage Tank[1]		100	
	Dianne Storm Basin	20		
	Stanislaus State Stormwater Recharge	460		
	City of Modesto Additional Conservation[1]			1,600
	All Urban and Municipal Projects	***480***	***17,600***	***-2,000***
WTSGSA Ag. Projects	TID On-Farm Recharge Project (in WTSGSA)	5,200		
	Recycled Water from City of Turlock		2,000	
	TID Ceres Main Regulating Reservoir	400		600
	All WTSGSA Agricultural Projects	***5,600***	***2,000***	***600***
ETSGSA Ag. Projects	Agricultural Recharge Project (in ETSGSA)	1,600	3,400	
	Mustang Creek Flood Control Recharge Project	600		
	Upland Pipeline Project	1,100		
	ETSGSA Projects	***3,300***	***3,400***	***0***
All Scenario 4 Projects		**9,380**	**23,000**	**-1,400**

Notes: All Units are in acre-feet

[1] The Waterford/Hickman Surface Water Pump Station and Storage Tank and City of Modesto additional conservation Projects include beneficiaries in both the Turlock and Modesto Subbasin. The volumes in this table represent an estimated fraction of the effective contribution to the Turlock Subbasin

[2] This includes 2,200 AFY of increased pumping by the cities to provide off-set water supply to TID for agricultural water use, per the SRWA agreement. Additionally, it includes 1,400 AFY of increased private agricultural pumping due to reduction in surface water supply by TID to the growers. A negative number in this field indicates an increase in GW pumping.

Scenario 4 projects are expected to reduce net groundwater pumping in the subbasin by 30,980 AFY. The net benefit to groundwater storage is to reduce the projected average annual groundwater storage deficit from 5,500 AFY under the Baseline conditions to 400 AFY with these projects, resulting in a net savings of 5,100 AFY of groundwater in storage. Details are shown in **Table 8-25**.

Scenario 5: Sustainable Conditions

Scenario 5 is designed to combine the supply side and demand side PMAs together to address the estimated gap in net demand reduction remaining after implementation of the Group 1 and Group 2 projects and ensure that the sustainability goals of the Subbasin are met based on the sustainability indicators discussed in **Chapter 6**. Scenario 4, which represents the implementation of supply side projects with a high planning certainty, improves Subbasin conditions but does not meet the sustainability goals as defined by the Minimum Thresholds (MTs) outlined in **Chapter 6**, Sustainable Management Criteria. To meet the MTs, modeling results indicate that additional projects and actions will be needed. The modeling approach used for Scenario 5 is the same as the methodology used in determining sustainable yield, which is described in detail in **Chapter 5**, **Section 3**.

Analysis of demand reduction was performed through systematic reductions in groundwater pumping in each GSA independently and at Subbasin scale and comparing the projected groundwater levels to MTs established at Representative Monitoring Sites. The analysis further indicated that a 25% reduction in groundwater demand would be sufficient to meet the Subbasin scale sustainability goals. This level of demand reduction is equivalent to 61,300 acre-feet per year of pumping across ETSGSA, reducing the subbasins total projected pumping from 417,200 AFY as presented in the Projected Conditions Baseline, to 334,300 AFY. It is understood that the 25% groundwater demand reduction is subject to uncertainties inherent in the assumptions and data used in developing the model for a 50-year projection required by the GSP regulations, and the ability of the model to accurately calculate groundwater levels at specific locations. Uncertainties in forecast assumptions include hydrologic and climatologic conditions, land use and cropping patterns, irrigation practices, water supply and river/reservoir operations, population growth and urban development trends. These uncertainties are therefore included in the modeling analysis and projections performed. Future monitoring, data and information collection, and enhancements to the model and the projections analysis will be needed to ascertain more accurate demand reduction estimates. In order to address the uncertainty in the analysis, as explained in **Section 8.4**, the demand reduction will be implemented using an adaptive management approach to ensure an adequately scaled response is implemented that appropriately limits economic impacts on the agricultural community, while meeting the sustainability goals of the Subbasin.

Aquifer conditions under Scenario 5 are anticipated to experience an average annual increase in storage of 13,100 AFY, an improvement of 18,600 AFY over the Projected Conditions Baseline. Over the 50-year simulation period this is anticipated to improve aquifer storage by over 655,000 AFY, or over 930,000 greater than the baseline as shown in **Figure 8-9.** This is the effect of a net decrease in groundwater production by 82,900 AFY (met by a combination of possible supply side projects with the remainder made up by demand side reduction actions) and an increase in direct recharge of 9,400 AFY by implementing Group 1 and 2 projects. Under Scenario 5, simulated deep percolation is reduced by 4,500 AFY since less water is applied to agricultural fields. Expected impacts to the groundwater system include a reduction to net-stream seepage of 55,200 AFY and 14,000 AFY less subsurface flow from adjacent subbasins. The complete groundwater

budget projected conditions under Scenario 5 is shown below in **Figure 8-10** and a tabular summary for all projected scenarios is shown below in **Table 8-25**.

Figure 8-9: Scenario 1-5 Cumulative Change in Storage

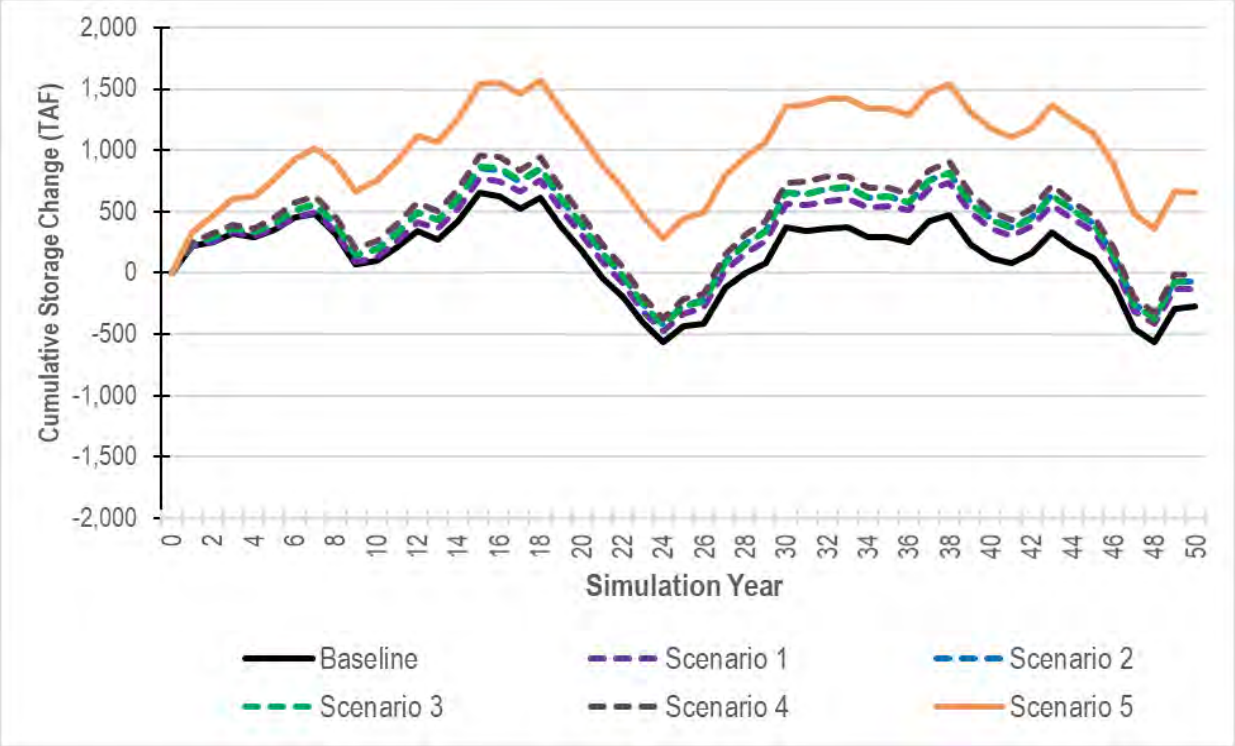


Figure 8-10: Scenario 5 Groundwater Budget

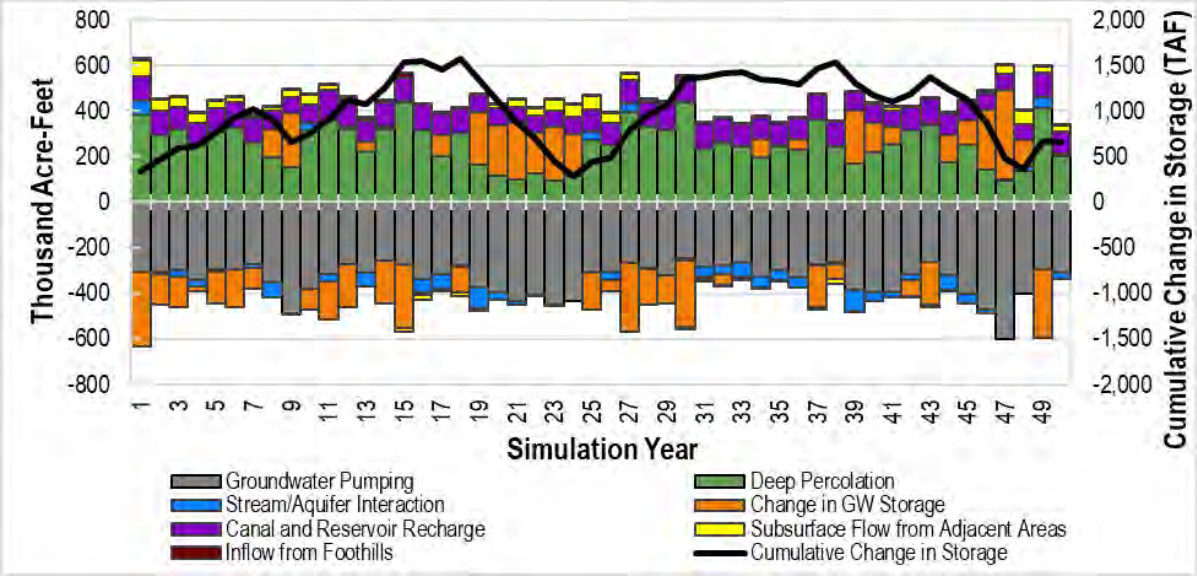


Table 8-25: Scenarios 1-5 Groundwater Budgets

	Baseline	Scenario 1 Urban & Municipal	Scenario 2 WTSGSA Agricultural	Scenario 3 ETSGSA Agricultural	Scenario 4 All Projects	Scenario 5 Projects & Dem. Red.
Deep Percolation	258,400	258,200	258,600	258,700	259,100	254,900
Canal, Res., & Direct Recharge	85,400	85,900	91,500	89,200	94,800	94,800
Net Stream Seepage	36,900	31,300	28,600	29,600	26,900	-18,300
Inflow from Foothills	2,100	2,100	2,100	2,100	2,100	2,100
Net Subsurface Inflow	28,900	21,400	16,700	17,000	12,300	14,900
Groundwater Pumping	417,200	401,600	399,000	398,200	395,600	334,300
Groundwater Storage Deficit[1]	5,500	2,700	1,500	1,600	400	-13,100

Notes: All Units are in acre-feet

[1] A negative value in "Groundwater Storage Deficit" indicates an annual increase in storage.

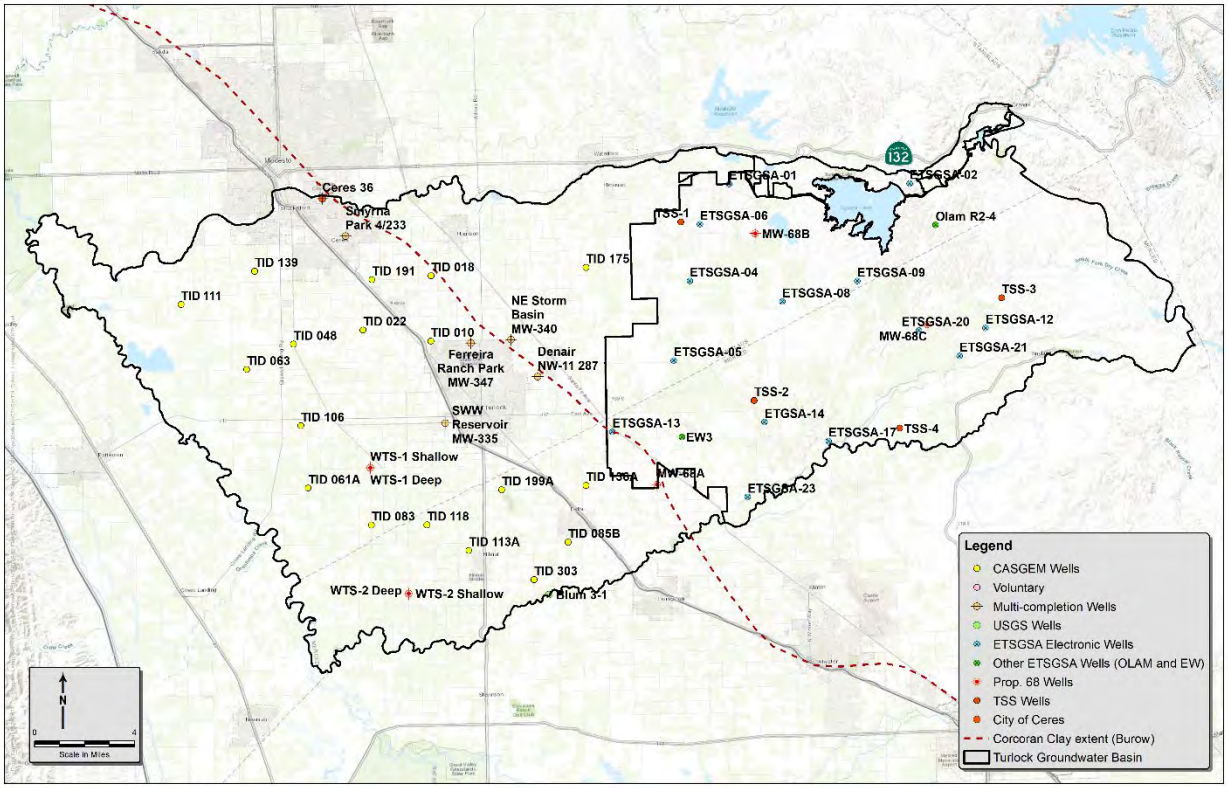
Term Definitions:

- Deep Percolation: inflow of water from the root/unsaturated zone to the aquifer
- Canal, Reservoir, & Direct Recharge: surface water contributions to the aquifer system from direct recharge projects and seepage from the Turlock and Merced Irrigation District conveyance systems, including the distribution lateral canals and Turlock Lake.
- Net Stream Seepage: net seepage inflow from the Tuolumne, Merced, and San Joaquin Rivers to the groundwater system
- Inflow from Foothills: subsurface inflow from the Sierra Nevada foothill watersheds
- Net Subsurface Inflow: combination of net subsurface inflows from the neighboring subbasins of Merced, Delta-Mendota, and Modesto Subbasins
- Groundwater Pumping: total groundwater pumped from the aquifer

8.5.2. Representative Hydrographs Scenarios 1-5

Figure 8-11 shows the location of the Monitoring Network wells that were used to evaluate the performance of the PMAs in each of the different scenarios.

Figure 8-11: Turlock Subbasin Monitoring Network



8.5.2.1. SMC1: Chronic Lowering of Groundwater Levels

Chapter 6: Sustainable Management Criteria ensure that groundwater levels throughout the subbasin do not exceed a given threshold set to protect the Subbasin from undesirable results resulting from the chronic lowering of groundwater levels (SMC1). **Chapter 5** defines undesirable results under SMC1 such that at no more than 33% of the representative monitoring wells shall exceed the 2015-low for a period longer than 3 years. Under Scenario 5, SGMA compliance was projected to be met throughout the simulation period. As shown in the figures below, simulated groundwater levels occasionally drop below the MT, but do not exceed the drought-time spatial or temporal limitations.

Note, the nine wells listed below (**Figures 8-13** through **8-21**) are not inclusive of all monitoring locations, rather this subset was included as they are considered representative of conditions throughout the Subbasin. Locations of these example representative hydrographs are shown in **Figure 8-12** below.

Figure 8-12: SMC1 Example Hydrographs

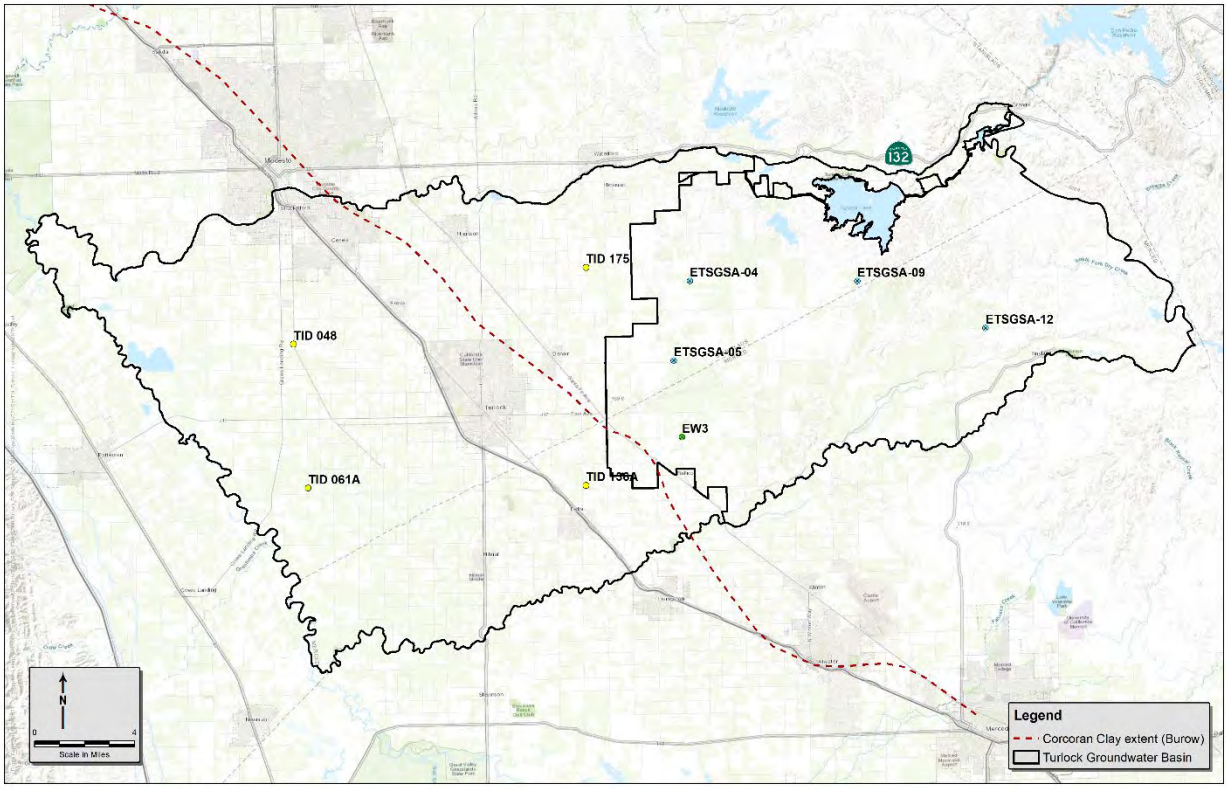


Figure 8-13: SMC1 Hydrograph ETSGSA-04

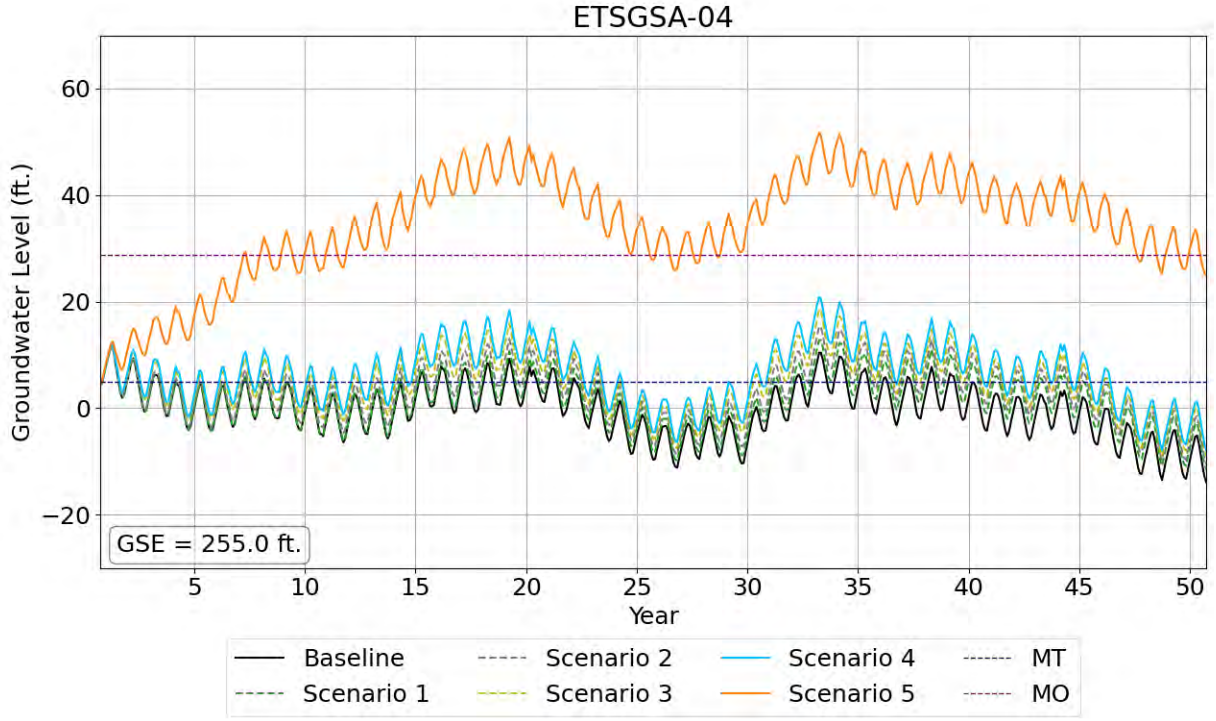


Figure 8-14: SMC1 Hydrograph ETSGSA-05

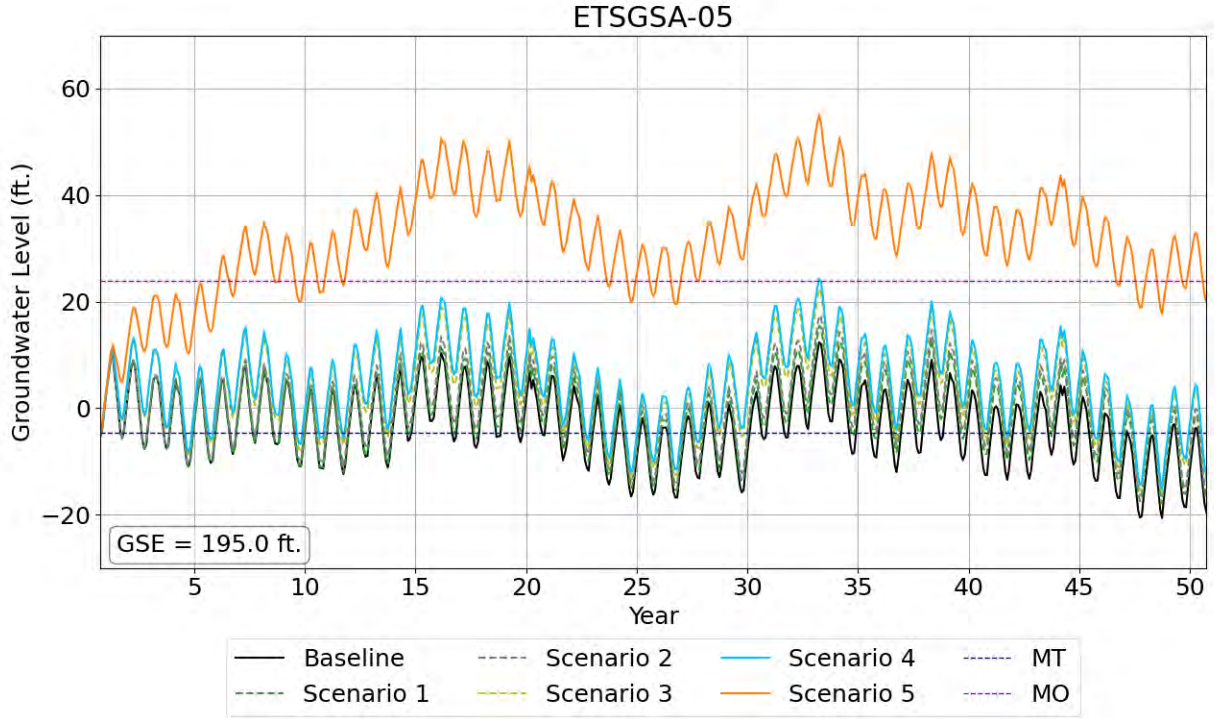


Figure 8-15: SMC1 Hydrograph ETSGSA-09

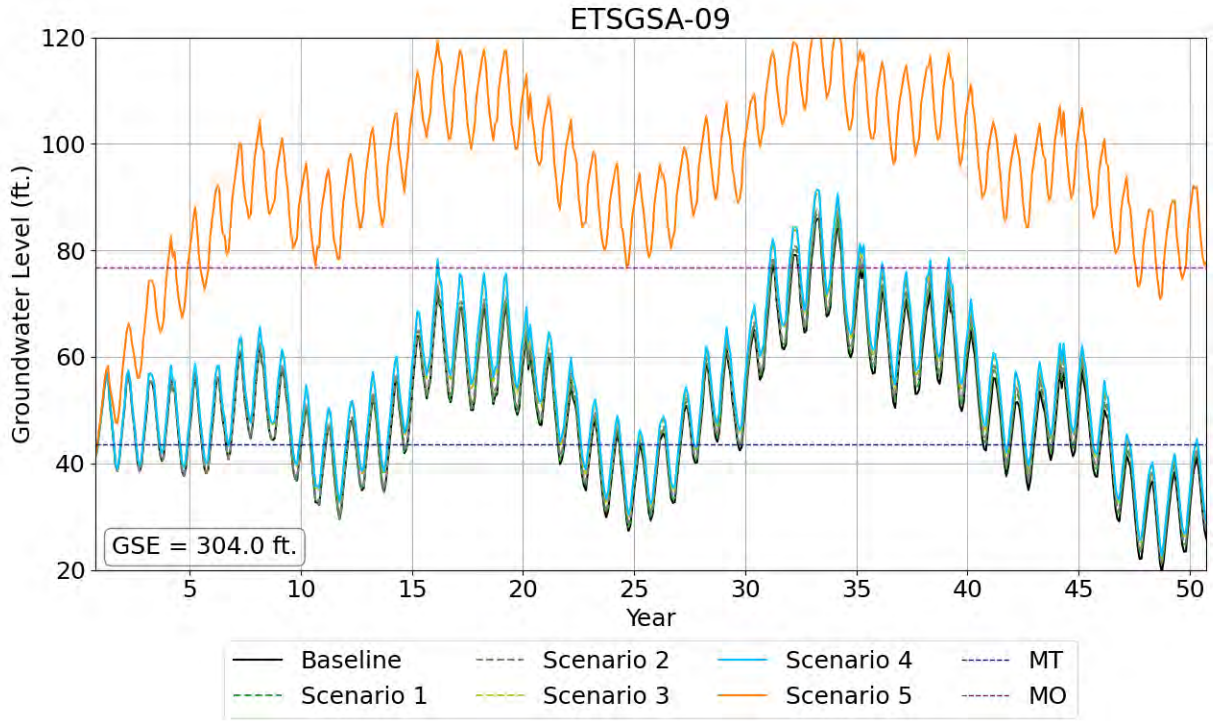


Figure 8-16: SMC1 Hydrograph ETSGSA-12

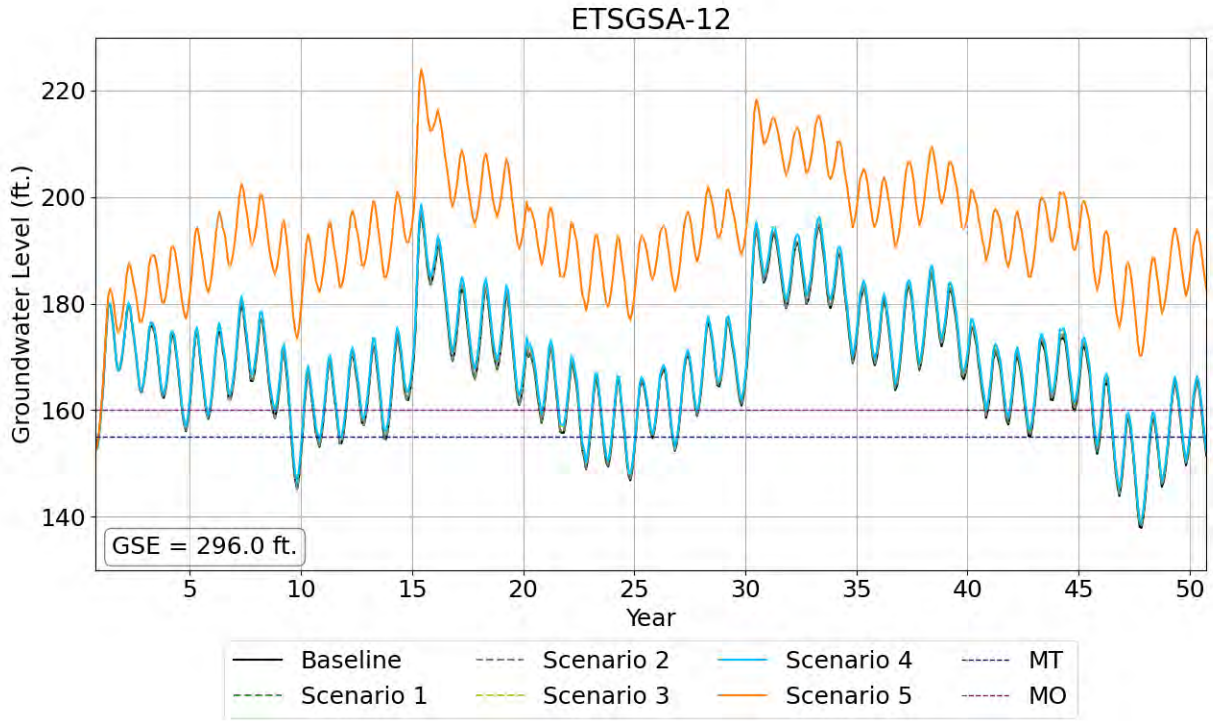


Figure 8-17: SMC1 Hydrograph EW3

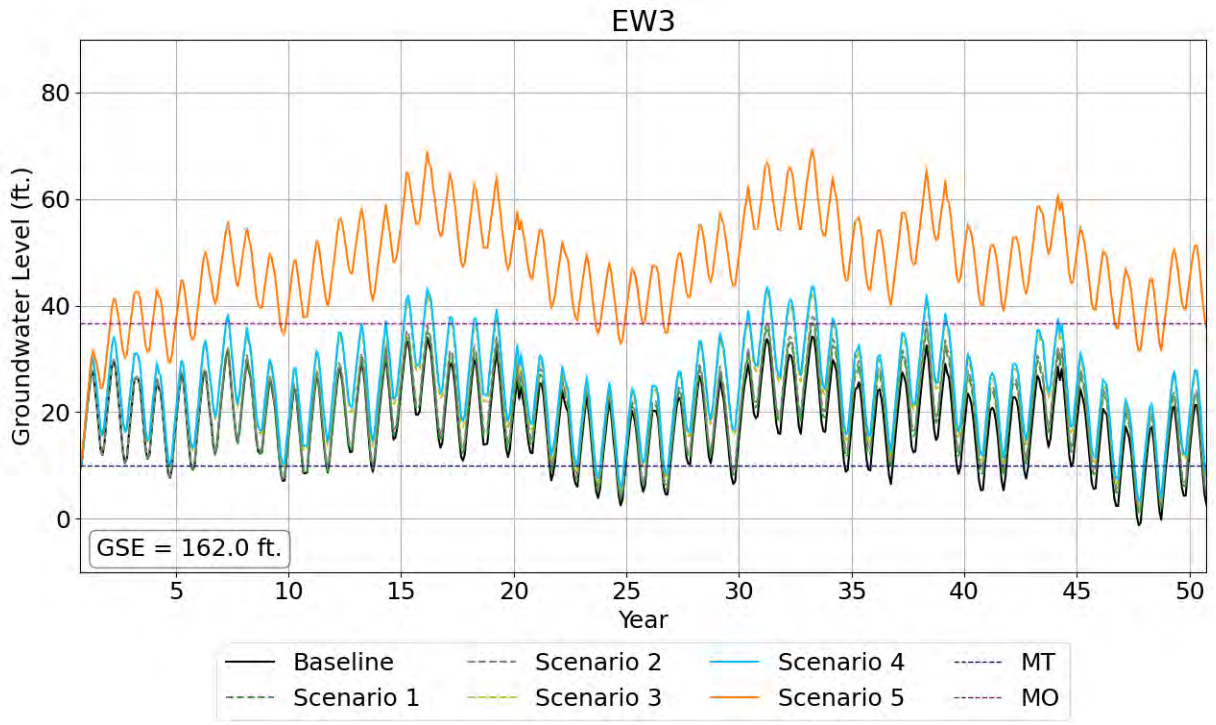


Figure 8-18: SMC1 Hydrograph TID-048

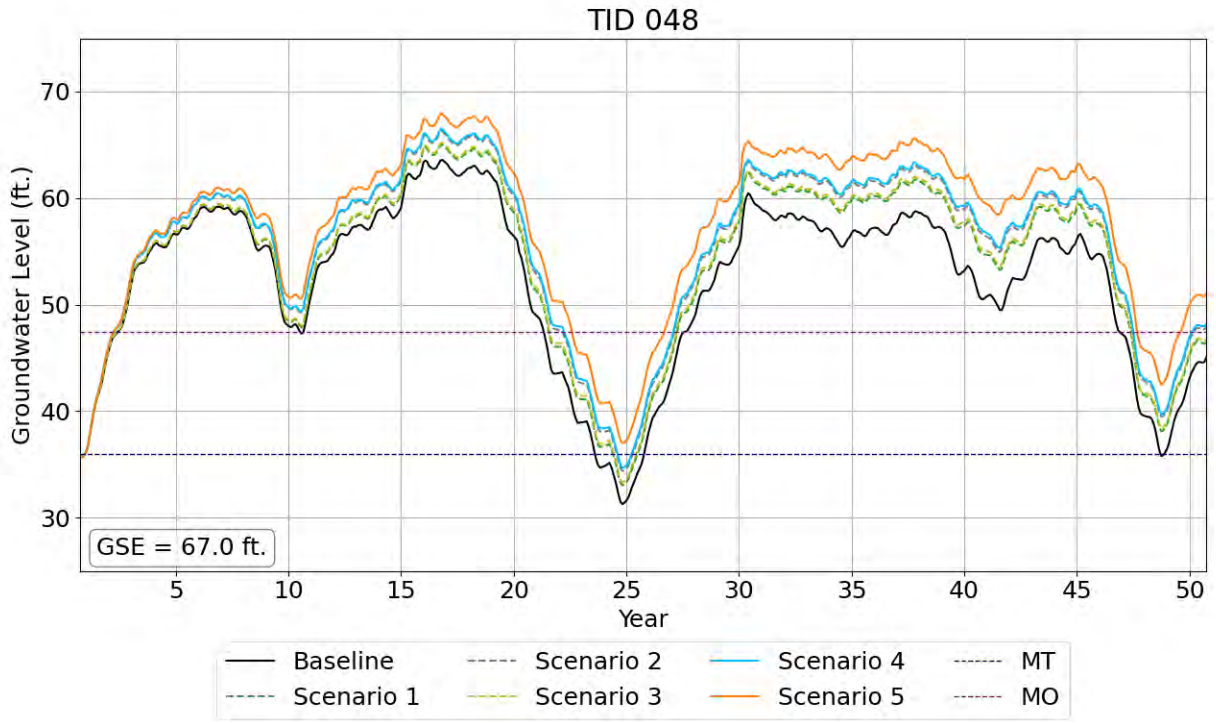


Figure 8-19: SMC1 Hydrograph TID-061A

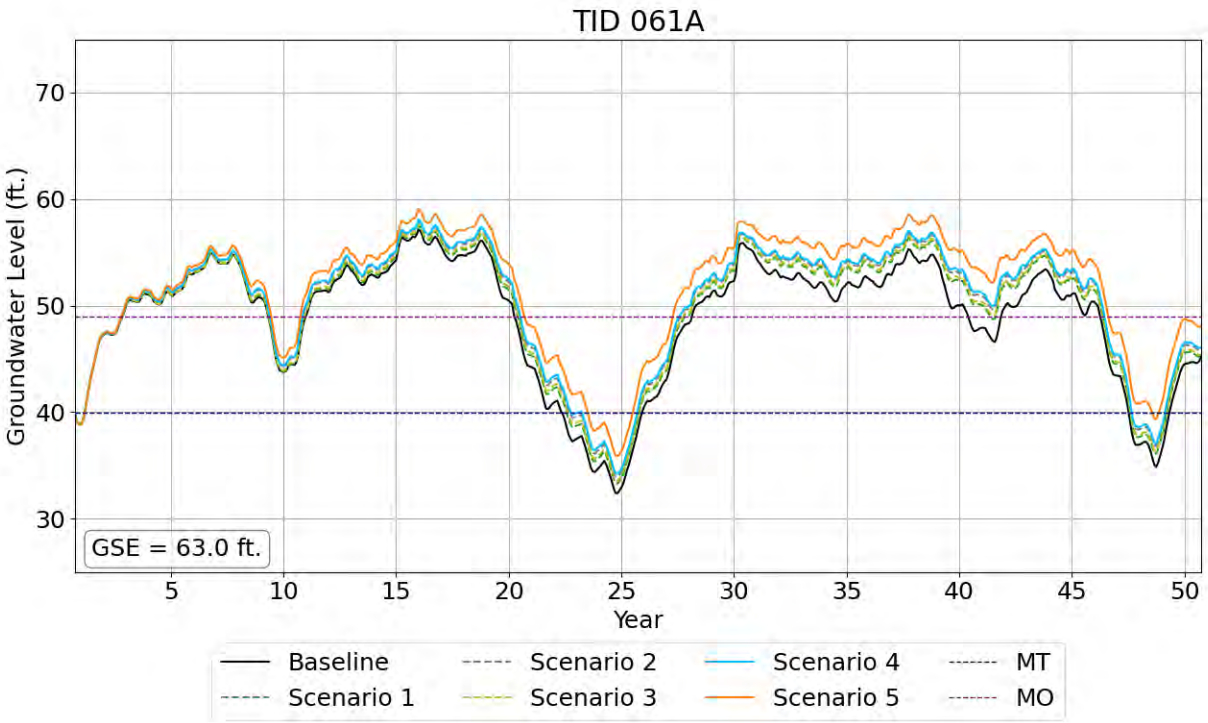


Figure 8-20: SMC1 Hydrograph TID-175

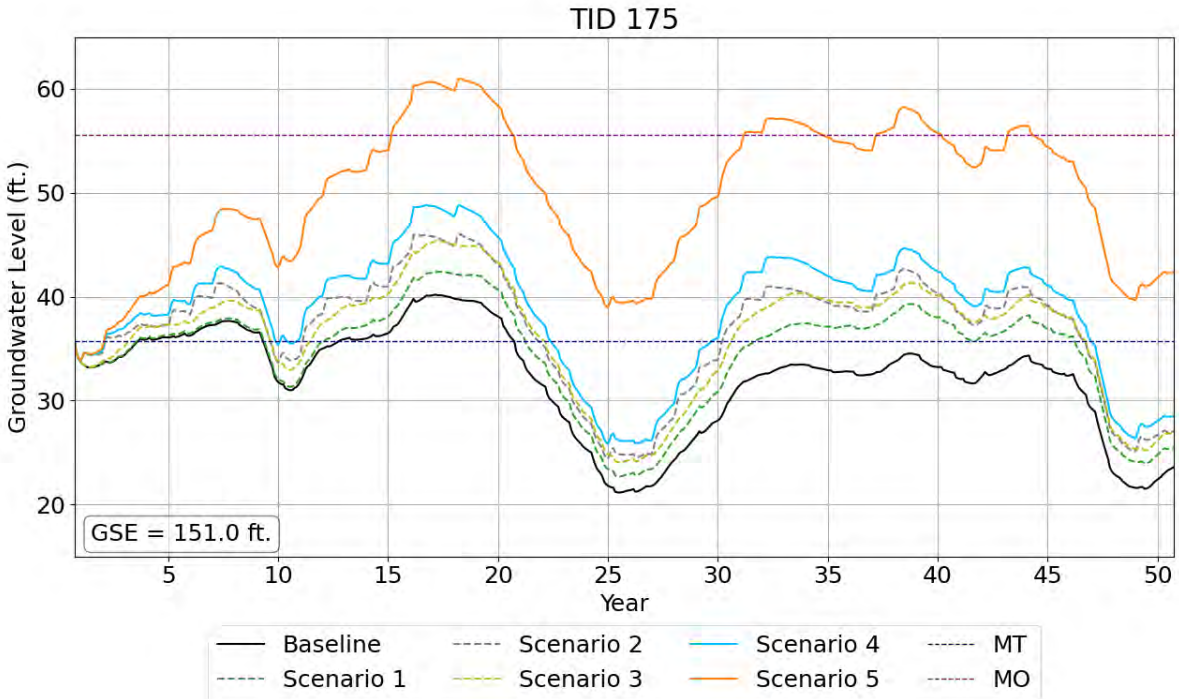
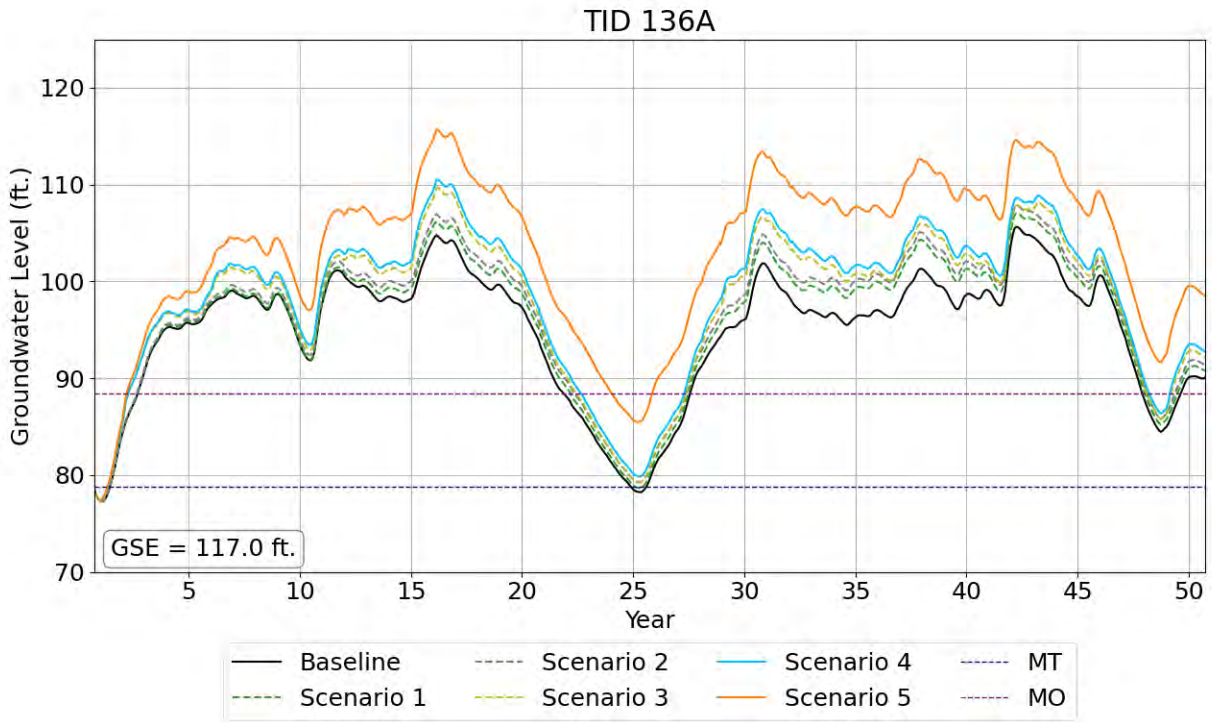


Figure 8-21: SMC1 Hydrograph TID-136A



8.5.2.2. SMC6: Interconnected Surface Water

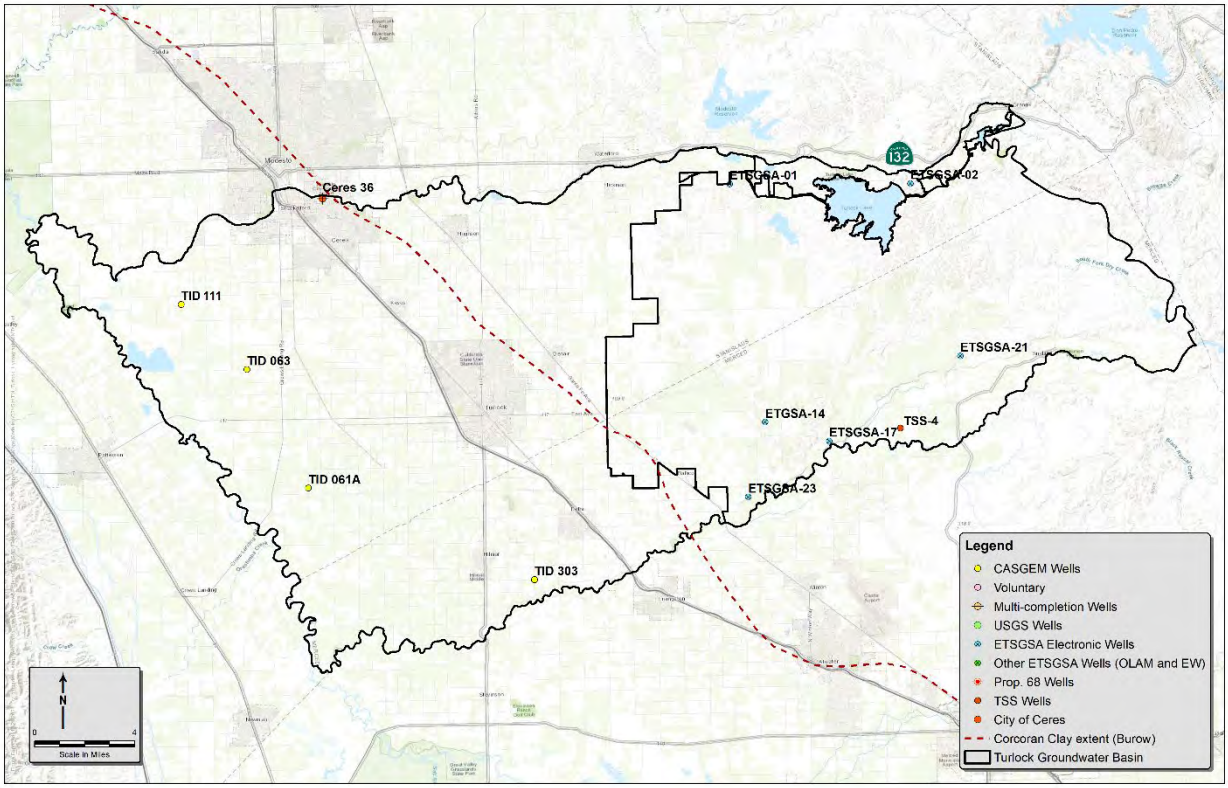
Figure 8-22 shows the current monitoring wells along the rivers. MTs were set at wells along each of the major rivers within the Turlock Subbasin to protect interconnected surface water system from significant and unreasonable depletions (SMC6). **Chapter 6**: Sustainable Management Criteria define an undesirable result such that groundwater levels at no more than 50% of the representative monitoring wells along each river boundary shall be below a given threshold as measured by two consecutive annual monitoring events. These thresholds were defined as:

- Tuolumne River: Fall 2015 groundwater levels
- San Joaquin River: Fall 2015 groundwater levels
- Merced River: Spring 2014 groundwater levels[40]

[40] Note that some of the MTs for wells near the Merced River are set for available wells with screen intervals up to over 100 feet below riverbed elevations without available vertical gradient data. These MTs may be subject to future adjustment as more data become available.

Under Scenario 5, SGMA compliance was met throughout the simulation period. As shown in the figures below, simulated groundwater levels occasionally drop below the MT, but do not exceed the drought-time spatial or temporal limitations.

Figure 8-22: SMC6 Monitoring Network



Interconnected Surface Water in the Tuolumne River

The monitoring wells ETSGSA-01 and ETSGSA-02 used to assess the groundwater levels near the Tuolumne River. **Figure 8-23** and **Figure 8-24** show the groundwater levels in these wells that result from Scenarios 1 through 5. Focusing on Scenario 5, groundwater levels are expected to increase up to 20 feet (ETSGSA-01) or 10 feet (ETSGSA-02) compared against the Baseline over the 50-year hydrologic period in the two wells. In both wells, the implementation of Scenario 5 conditions is expected to facilitate the compliance with the established MTs.

Figure 8-23: SMC6 Hydrograph ETSGSA-01

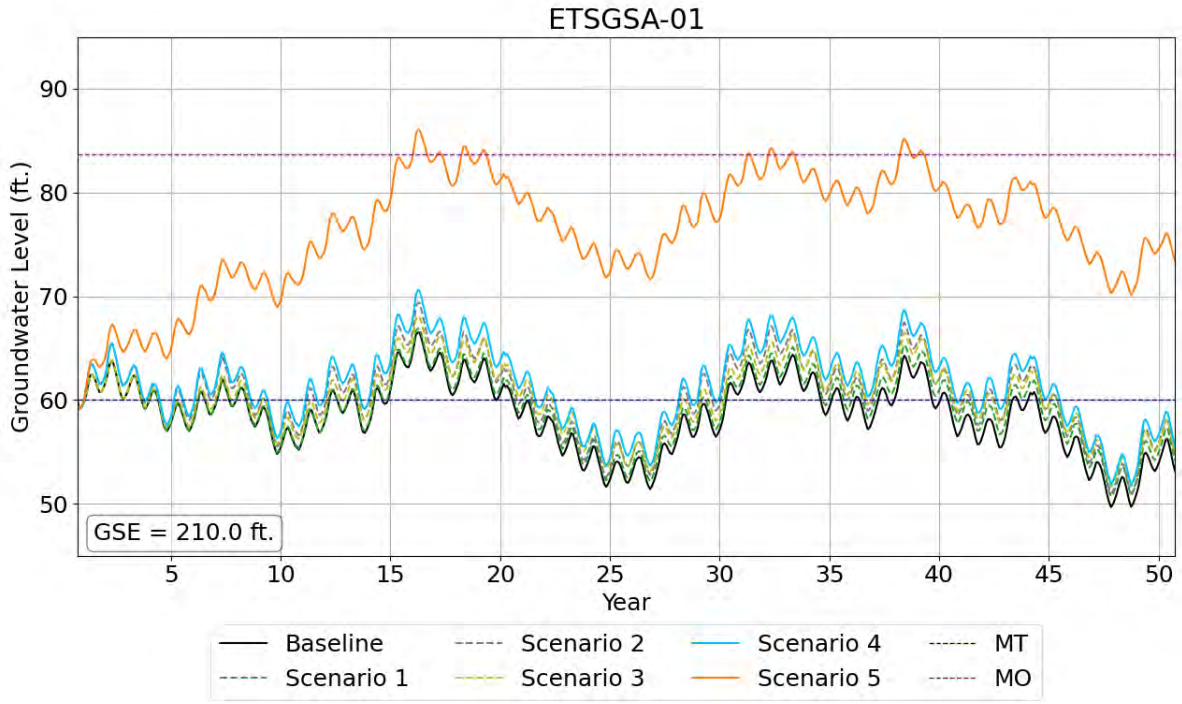
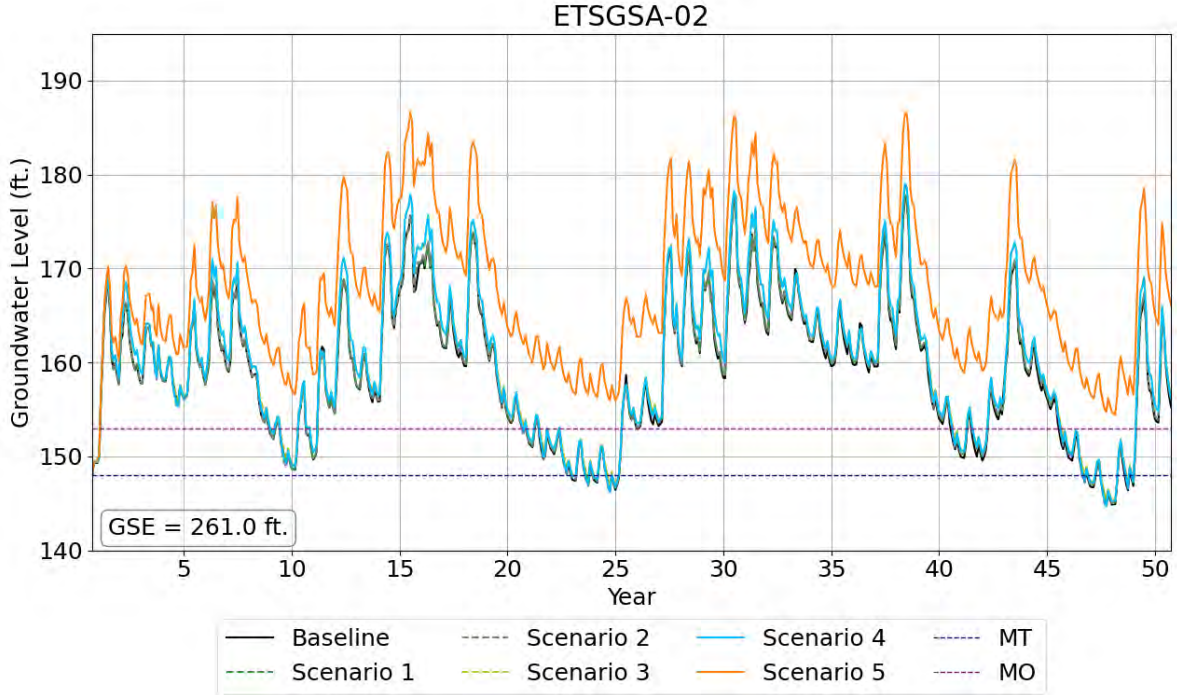


Figure 8-24: SMC6 Hydrograph ETSGSA-02



Interconnected Surface Water in San Joaquin River

The monitoring wells TID 061A, TID 063 and TID 111 are used to assess the groundwater levels near the San Joaquin River in the Turlock Subbasin. **Figure 8-25** through **Figure 8-27** show the groundwater levels in these wells expected to result from Scenarios 1 through 5. Focusing on Scenario 5, groundwater levels are predicted to increase up to 4-5 feet compared against the Baseline over the 50-year hydrologic period in the three wells. The implementation of conditions under Scenario 5 is expected to maintain groundwater levels such that MTs are met throughout the planning horizon.

Figure 8-25: SMC6 Hydrograph TID-061A

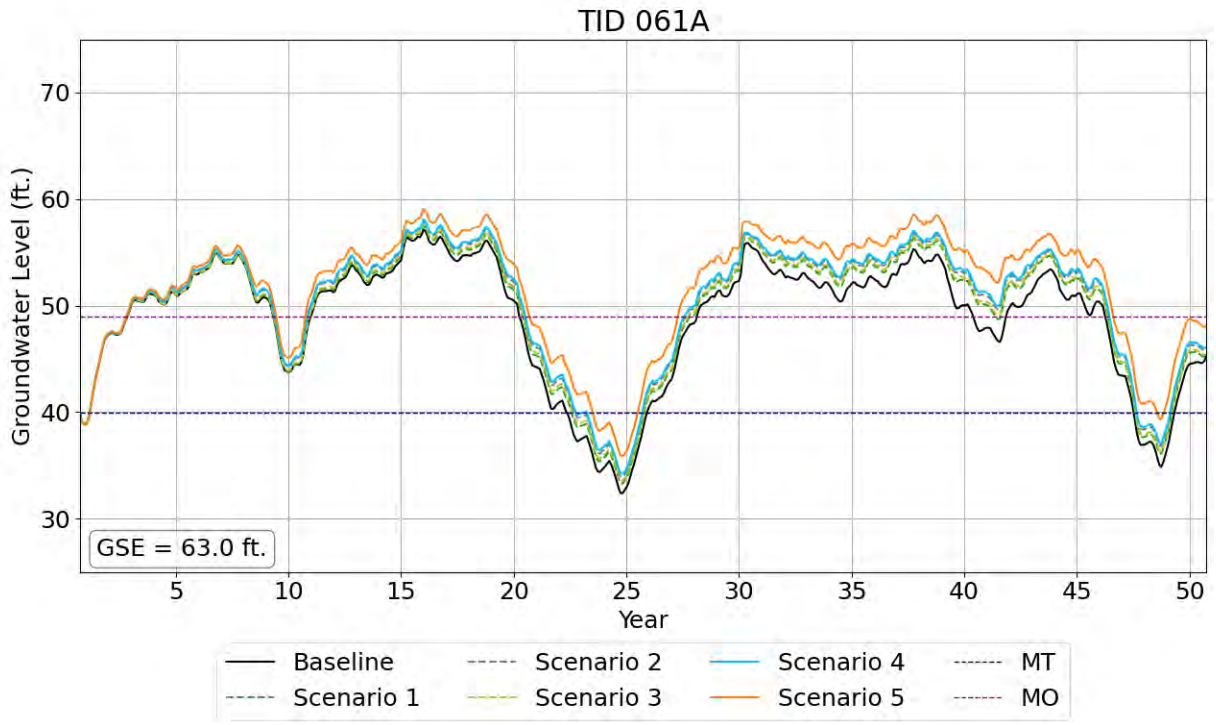


Figure 8-26: SMC6 Hydrograph TID_063

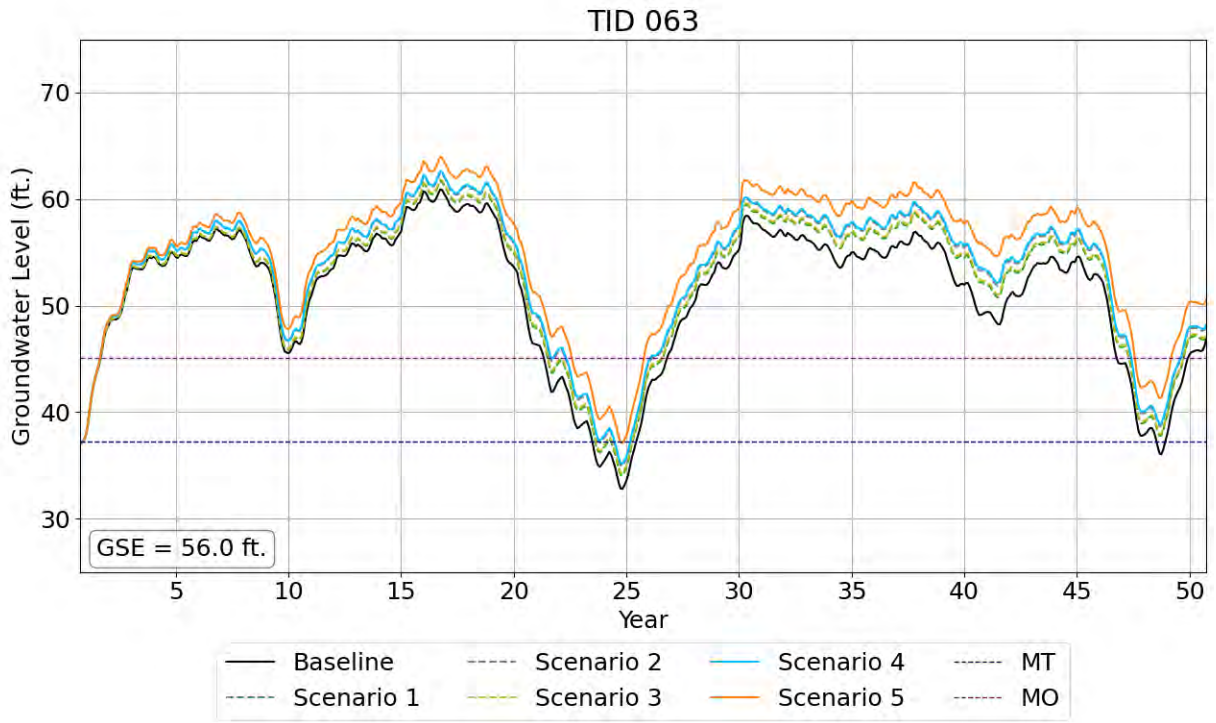
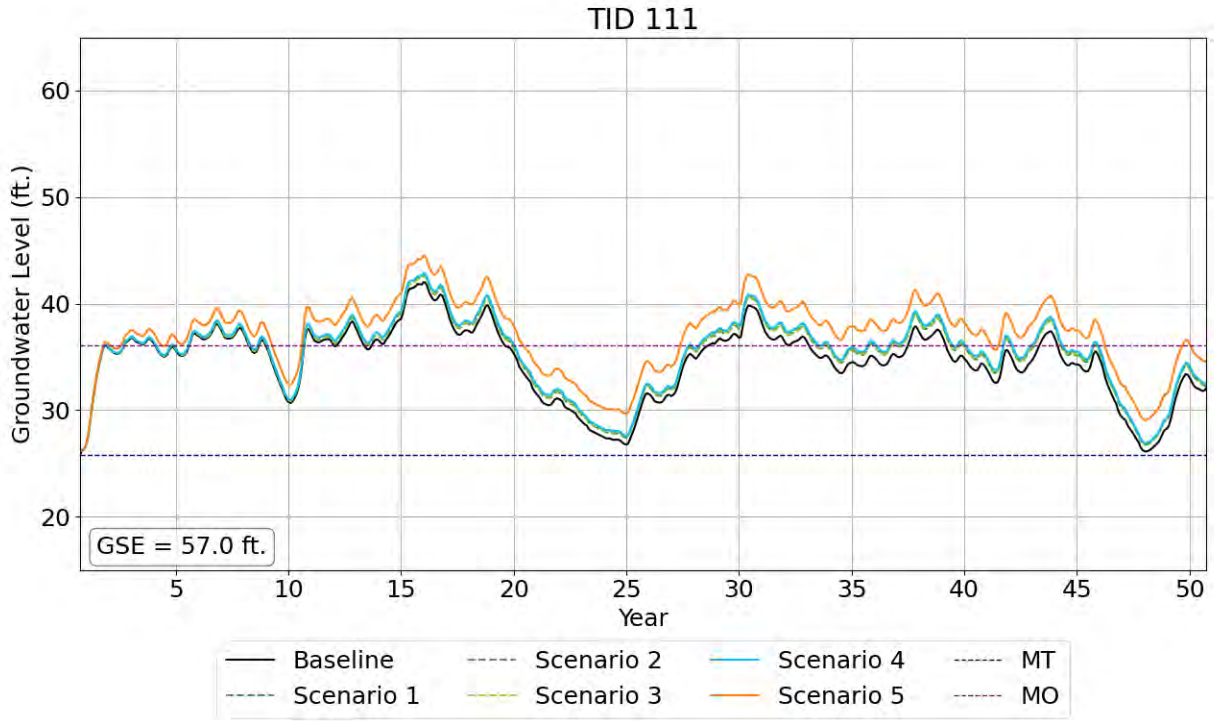


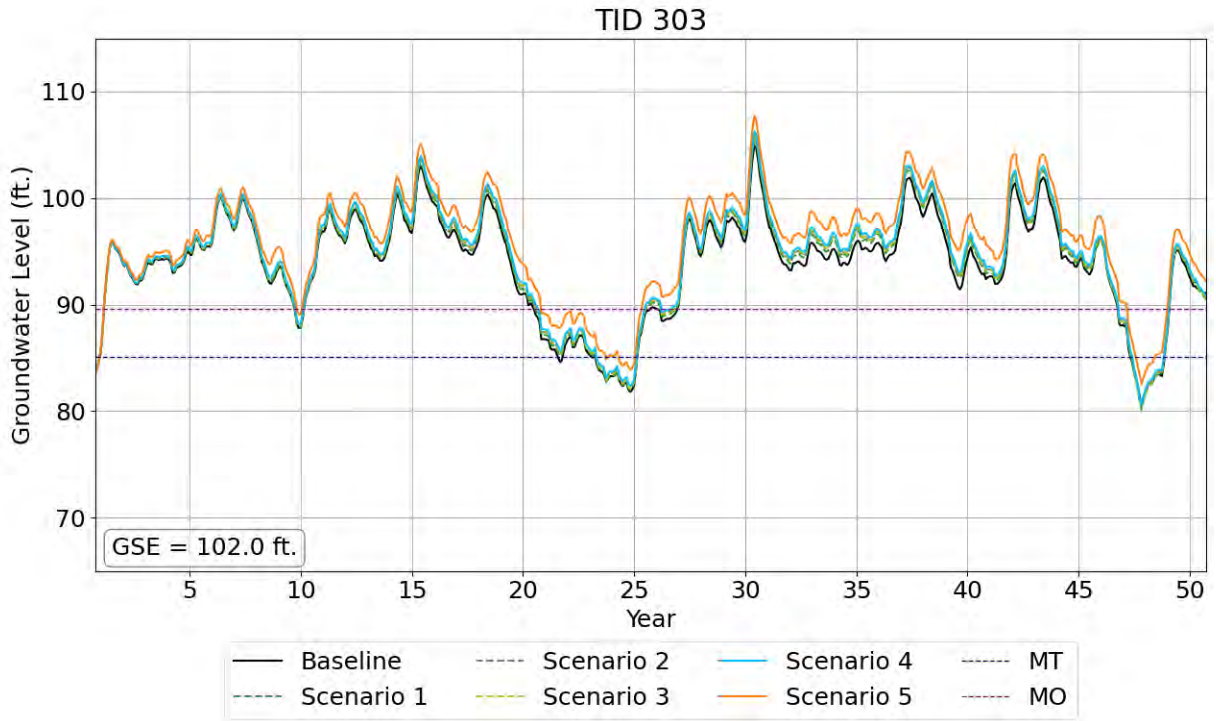
Figure 8-27: SMC6 Hydrograph TID-111



Interconnected Surface Water in Merced River

In contrast to MTs along the San Joaquin and Tuolumne River, MTs along the Merced River are set at Spring 2014 groundwater levels as described in **Chapter 6**.[41] The monitoring wells TID 303, ETSGSA-14, ETSGSA-17, ETSGSA-21, and ETSGSA-23 are used to assess the groundwater levels near the Merced River in the Turlock Subbasin. **Figure 8-28** though **Figure 8-32** show the groundwater levels in these wells projected result from Scenarios 1 through 5. Focusing on Scenario 5, groundwater levels are projected to increase from 2 ft (TID 303) up to 30 ft (ETSGSA-14 and ETSGSA-21) compared against the Baseline over the 50-year hydrologic period. Under Scenario 5 operations, conditions along the Merced River are projected to meet the MTs as outlined in **Chapter 6**: Sustainable Management Criteria.

Figure 8-28: SMC6 Hydrograph TID-303



[41] Note that some of the MTs for wells near the Merced River are set for available wells with screen intervals up to over 100 feet below riverbed elevations without available vertical gradient data. These MTs may be subject to future adjustment as more data become available.

Figure 8-29: SMC6 Hydrograph ETSGSA-14

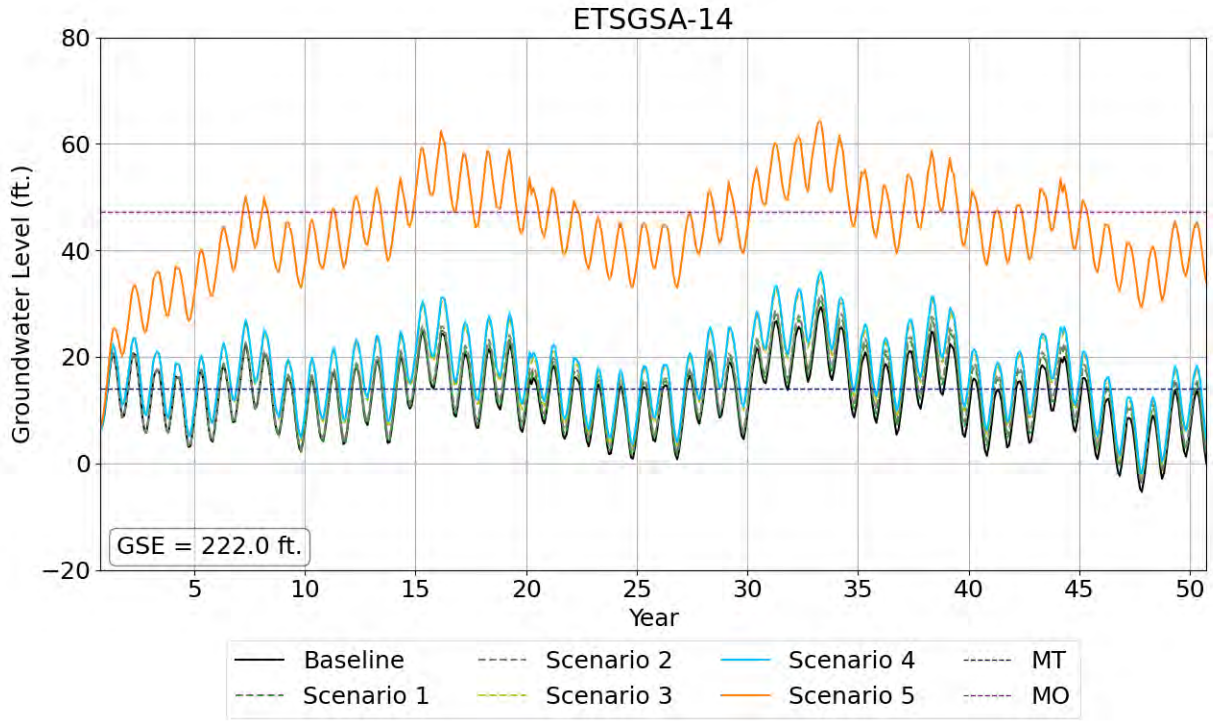


Figure 8-30: SMC6 Hydrograph ETSGSA-17

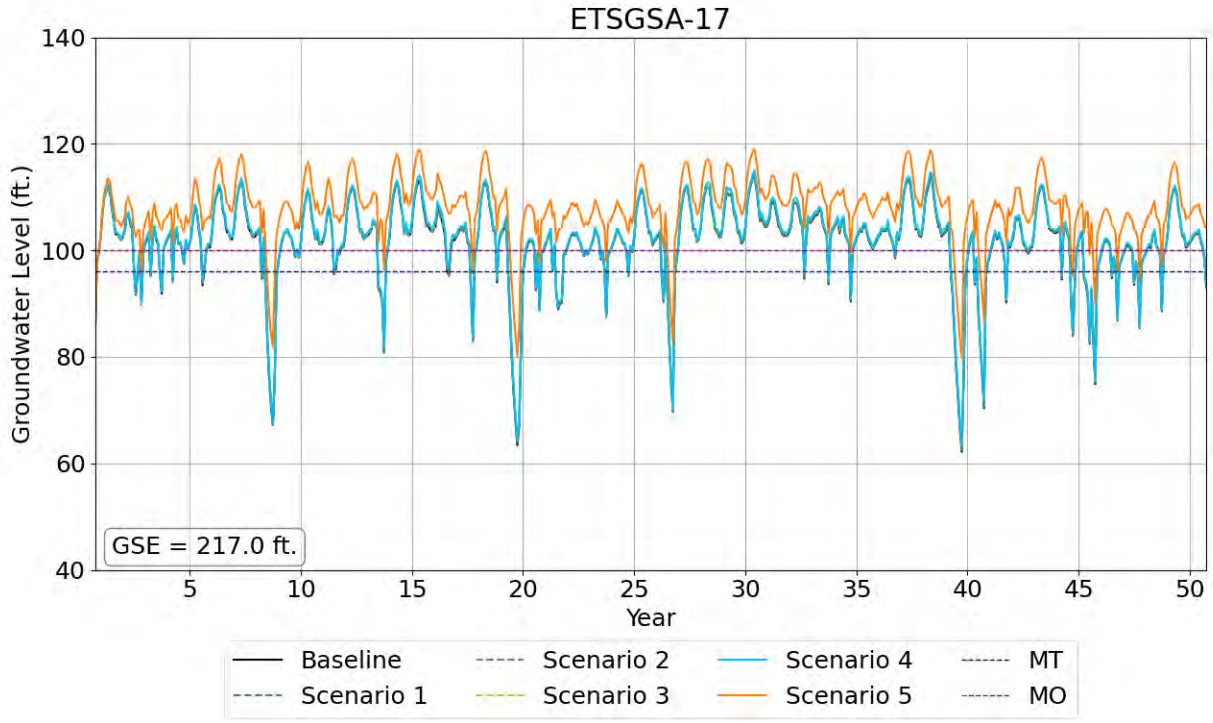


Figure 8-31: SMC6 Hydrograph ETSGSA-21

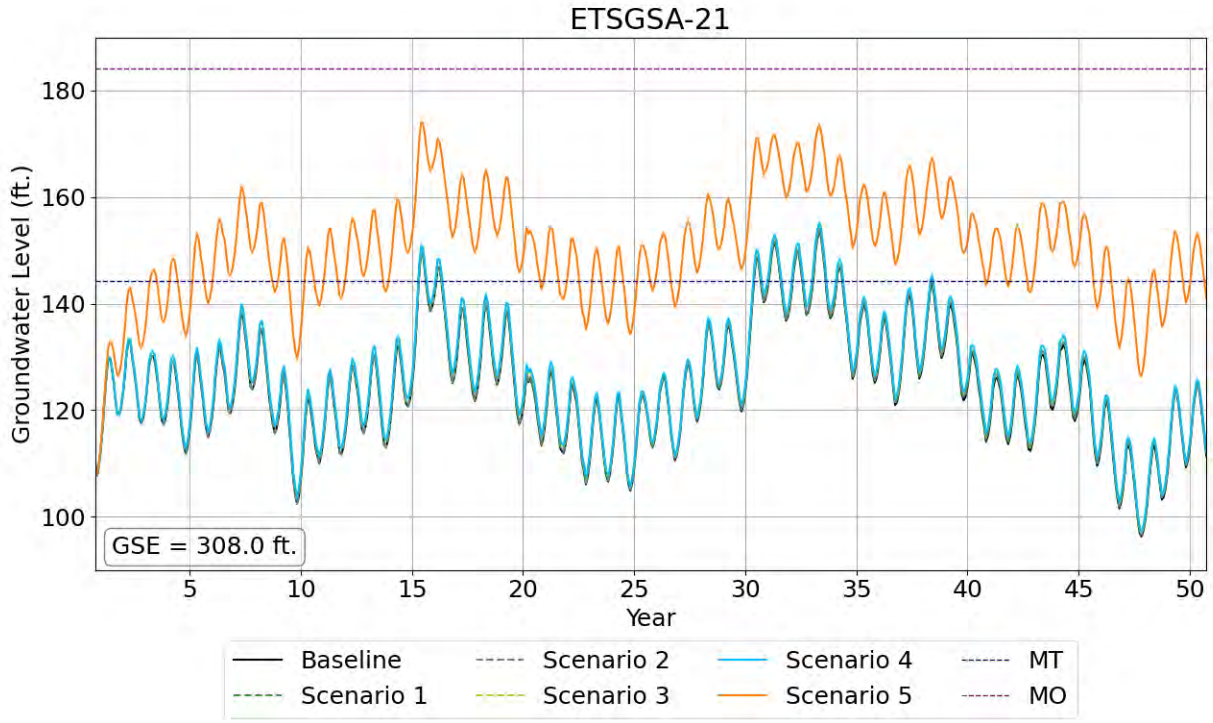
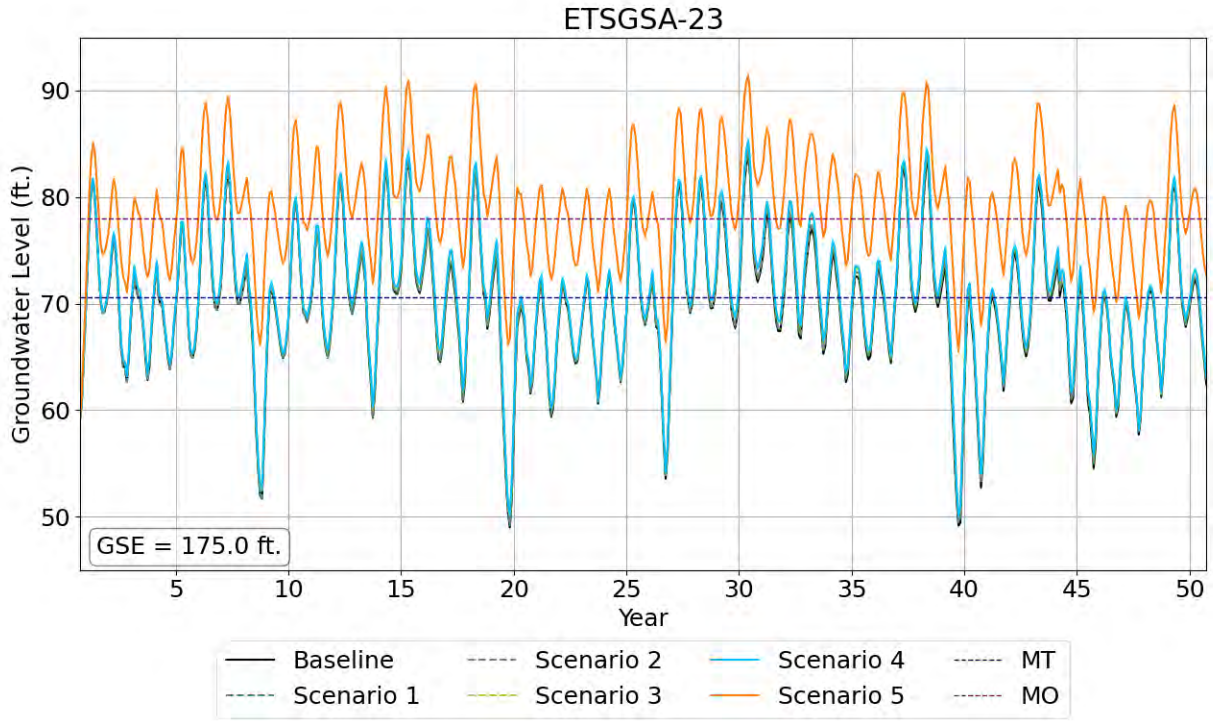


Figure 8-32: SMC6 Hydrograph ETSGSA-23



9. IMPLEMENTATION SUPPORT ACTIVITIES

This Chapter describes how the Turlock Subbasin GSP will be implemented. It provides a set of activities and actions in support of implementing the GSP between 2022 and 2042 but focuses on the most immediate activities in the first five years (between 2022 and 2027).

Implementing this GSP will require the following formative Implementation Support Activities (ISA), each of which is detailed in the subsequent subsections listed below. Estimates for ISA costs and schedule are summarized in **Sections 9.12 and 9.13**, respectively, at the end of the Chapter.

- Monitoring and reporting groundwater data (**Section 9.1**)
- Addressing identified data gaps including expanding and improving the existing monitoring networks (**Section 9.2**)
- Accounting mechanism for water supplies within the Subbasin (**Section 9.3**)
- Refining and implementing projects and management actions (adaptive management) (**Section 9.4**)
- Refine groundwater model incorporating new data and studies (**Section 9.5**)
- Develop action plan for exceedance of Minimum Thresholds (MTs) which may result in undesirable results (**Section 9.6**)
- Data Management System improvements (**Section 9.7**)
- Coordination and planning integration (**Section 9.8**)
- Well Registration and Management Program (**Section 9.9**)
- Developing financing strategies, including seeking grant funding to implement the GSP (**Section 9.10**)
- Updating Opti to include GSP Projects (**Section 9.11**)

The implementation plan in this Chapter is based on the current understanding of the Turlock Subbasin conditions and the current assessment of the projects and management actions (PMAs) described in **Chapter 8**. The understanding of the Subbasin's conditions and the details of the PMAs will evolve as the GSP is implemented, based on future data collection, model development, and input from stakeholders.

9.1. ISA 1: MONITORING, REPORTING, AND OUTREACH

During the first few years of implementation, the Turlock Subbasin GSAs will establish mechanisms and standard programs and practices to ensure the Subbasin is implementing the necessary monitoring, evaluating, and reporting of sustainability conditions. The Turlock Subbasin GSAs will hire consultants as necessary, negotiate agreements between agencies, and/or hire staff (or utilize GSA member agency staff) to implement the monitoring (**Section 9.1.1**), reporting (**Section 9.1.2**), and outreach (**Section 9.1.3**) functions described in more detail in the subsections below.

9.1.1. Monitoring

Monitoring of the five sustainability indicators which apply to the Subbasin will begin immediately upon adoption of the GSP. Most monitoring relies on existing monitoring programs, and therefore there is no need to initiate new programs. However, these programs will need to be coordinated to utilize the information to assess compliance with sustainable management criteria (SMC).

The Turlock Subbasin GSAs will coordinate the monitoring programs discussed in **Chapter 7** to track Subbasin conditions related to the sustainability indicators. Data compiled by the GSAs from the monitoring programs will be regularly evaluated to ensure progress is being made toward the sustainability goals or to identify if undesirable results are occurring or are expected to occur. Data will be maintained in the Data Management System (DMS). Data from the monitoring programs will be used by the Turlock Subbasin GSAs to guide decisions on PMAs and to prepare Annual Reports for stakeholders, member agencies, and DWR.

As described in **Chapter 7**, groundwater level monitoring networks were developed to monitor several sustainability indicators, including chronic lowering of groundwater levels, reduction of groundwater in storage, land subsidence, and depletions of interconnected surface water. The applicability and rationale for using groundwater elevations to monitor each of these four sustainability indicators is discussed in **Chapter 6**. The monitoring networks are composed of representative monitoring wells that will be used to monitor SMC for these sustainability indicators during the GSP implementation and planning horizon. There are 52 representative monitoring wells in the monitoring networks. Groundwater levels will be measured at the monitoring network wells twice a year, to capture the seasonal high and low groundwater elevations associated with the irrigation pumping cycle. In addition, the GSAs have identified an additional 52 wells, called SGMA monitoring wells, which will be monitored for groundwater levels but are not proposed to be used to monitor sustainability indicators. The protocols for data collection and monitoring are described in **Chapter 7**.

The monitoring network for degradation of water quality will be based on wells monitored by others and available at the State Water Resources Control Board (SWRCB) GeoTracker website (see **Section 9.1.1.3**).

9.1.1.1. Groundwater Elevation Monitoring

As described in **Chapter 7**, a monitoring network for the chronic lowering of groundwater levels sustainability indicator was developed for each principal aquifer. The monitoring network is composed of both existing and proposed wells. Existing wells include selected CASGEM wells, municipal multi-completion wells in the Cities of Ceres and Turlock and the town of Denair, a USGS well, and a series of active and inactive production wells and monitoring wells in the eastern Subbasin developed as part of the ETSGSA monitoring program. The monitoring network anticipates incorporation of new monitoring wells that will be constructed in Winter 2021/2022 with Proposition 68 grant funding from DWR and new monitoring wells within ETSGSA in 2022 and 2023 to be installed by well drilling

services funded through the DWR Technical Support Services (TSS) program. The monitoring network for chronic lowering of groundwater levels includes 18 wells in the Western Upper Principal Aquifer, 8 wells in the Western Lower Principal Aquifer, and 21 wells in the Eastern Principal Aquifer. Static groundwater elevations will be measured twice a year in these monitoring wells to represent seasonal high and seasonal low groundwater conditions. The monitoring network and activities are described in **Chapter 7** and summarized on **Tables 7-1** and **7-3** and illustrated on **Figures 7-1, 7-2**, and **7-3.**

9.1.1.2. Groundwater Storage Monitoring

As described in **Chapters 6** and **7**, the SMC for chronic lowering of groundwater levels will be used as a proxy for the reduction of groundwater in storage sustainability indicator. Accordingly, the groundwater elevation monitoring will also be used for monitoring reduction of groundwater in storage. Static groundwater elevations will be measured twice a year in these monitoring network wells to represent seasonal high and seasonal low groundwater conditions.

9.1.1.3. Groundwater Quality Monitoring

As described in **Chapters 6** and **7**, the SWRCB and other agencies have the primary authority for water quality and the GSAs do not intend to duplicate this authority. Accordingly, the monitoring network for this sustainability indicator will incorporate existing monitoring data. **Figure 7-4** illustrates the monitoring data available from January 2020 through May 2021. Every year, water quality data will be downloaded from GeoTracker (https://gamagroundwater.waterboards.ca.gov/gama/gamamap/public/) for the six constituents of concern (COCs): arsenic, nitrate, total dissolved solids (TDS), uranium, 1,2,3-trichloropropane (1,2,3-TCP), and tetrachloroethene (PCE). These data will be compared to their MCLs, and any new MCL exceedances will be evaluated to determine whether the exceedances were caused, or exacerbated, by GSA management of water levels or GSA projects and management actions. This analysis will include an assessment of whether GSA management of water levels or GSA projects and management actions are impacting the human fight to water. This analysis will be included in the GSP Annual Reports.

9.1.1.4. Land Subsidence Monitoring

As described in **Chapters 6** and **7**, the SMC for chronic lowering of groundwater levels will be used as a proxy for the land subsidence sustainability indicator. Accordingly, the groundwater elevation monitoring will also be used for monitoring land subsidence. Static groundwater elevations will be measured twice a year in these monitoring network wells to represent seasonal high and seasonal low groundwater conditions.

In addition, land subsidence will be monitored in the Subbasin by updating and evaluating vertical displacement data collected using Interferometric Synthetic Aperture Radar (InSAR) by TRE Altamira Inc., under contract with DWR, and available on the SGMA Data Viewer (https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer#landsub). This data will be downloaded and evaluated annually, and the analysis will be included in the GSP Annual Reports.

9.1.1.5. Interconnected Surface Water Monitoring

The monitoring network for depletions of interconnected surface water includes 12 well locations along the San Joaquin River, Tuolumne River, and Merced River. The wells are screened in the Western Upper Principal Aquifer and the Eastern Principal Aquifer and include wells from CASGEM, the ETSGSA monitoring program, City of Ceres (1 well), and a future TSS well cluster. Static groundwater elevations will be measured twice a year in these monitoring wells to represent seasonal high and seasonal low groundwater conditions. The monitoring network is summarized on **Table 7-2** and presented on **Figure 7-5**.

9.1.2. Reporting

SGMA regulations establish that reports must comply with DWR submittal requirements and that all transmittals must be signed by an authorized party. Data will be organized and made available to the public to document conditions within the Subbasin relative to the SMC established in **Chapter 6**. At a minimum, the following reports will be prepared:

- Annual Reports. SGMA Regulation §356.2 stipulates that Annual Reports will be submitted to DWR starting on April 1, 2022. Annual Reports provide key information to for both DWR and the GSAs to enable them to gage progress toward GSP implementation. The purpose of the report is to provide monitoring and total groundwater use data to DWR, compare monitoring data to the SMC, and adaptively manage actions and projects implemented to achieve sustainability. Annual Reports will also be available to stakeholders.
- Five-Year GSP Assessment Reports. Five-Year GSP Assessment Reports (also referred to as "Five-Year Updates" elsewhere in this GSP) will be prepared and provided to DWR starting in 2027. The Turlock Subbasin shall update and evaluate the GSP at least every 5 years to assess if it is achieving the sustainability goal of the Subbasin. The assessment will include a description of any significant new information that has become available since the GSP was adopted or amended, and whether the new information or understanding warrants changes to aspects of the GSP.
- GSP Periodic Evaluations and Amendment. While not required by SGMA or the regulations established to implement SGMA, the Turlock Subbasin GSAs may consider periodic evaluations or amendments to the GSP as necessary. Updates or amendments could include, but are not limited to, incorporating additional monitoring data, updating the SMC, and documenting any projects, management actions, or adaptive management activities. Updates to the model may result in updates to the water budgets (described in **Chapter 5**) that may warrant an amendment to the GSP. The DMS will also be routinely updated to include new information gathered from the monitoring networks and included in the Annual Reports and Five-Year GSP Assessment Reports.

9.1.3. Communication and Outreach

The Turlock Subbasin GSAs will utilize the monitoring data to routinely provide information to the public, including the disadvantaged and underrepresented communities within the Subbasin, about progress being made toward sustainability, challenges encountered, and the need to use groundwater efficiently. The Turlock Subbasin GSAs website will be maintained as a communication tool for posting data, reports, project information, meeting notices, and other pertinent information. Tools will be evaluated to make GSP monitoring data more accessible to stakeholders through the Subbasin website.

9.2. ISA 2: ADDRESSING IDENTIFIED DATA GAPS INCLUDING UPDATING AND IMPROVING THE EXISTING MONITORING NETWORK

While the Turlock Subbasin has a comprehensive monitoring network, improvement of the monitoring network for this GSP will assist in identifying and maintaining sustainable groundwater management in the Subbasin. There are areas of the Subbasin that could be improved through additional monitoring, even though overall monitoring well density is sufficient. Gaps are present spatially, with depth, and related to groundwater levels, subsidence, and surface water depletions (refer to **Section 7.3** for more information about data gaps). Specific activities are described in the subsections below for three individual areas of the Subbasin:

1. Western Lower Principal Aquifer (**Section 9.2.1**)
2. Western Tuolumne River, Merced River, and San Joaquin River (**Section 9.2.2**)
3. Eastern Aquifer (**Section 9.2.3**).

Network-wide data gaps are described in the following **Section 9.2.4**.

Existing wells will be preferentially selected to serve as new groundwater monitoring locations, where available and appropriate for this use. The use of existing monitoring wells is more cost effective than installation of new monitoring well facilities. However, in some cases new monitoring wells may be required, either due to an inability to gain access to a suitable existing well or due to the need for more detailed, depth-specific information that cannot be obtained from existing production wells.

9.2.1. Fill Data Gaps in Western Lower Principal Aquifer (Chronic Lowering of Water Levels, Reduction of Groundwater in Storage, Land Subsidence)

Additional monitoring sites may be added within the Western Lower Principal Aquifer to address needs related to chronic lowering of groundwater levels, reduction of groundwater in storage, and land subsidence. The Western Lower Principal Aquifer is located in the portion of the Turlock Subbasin underlain by the Corcoran Clay. Additional monitoring needs in this area are driven by the higher potential for subsidence due to the nature of subsurface materials and due to a relatively lower density of monitoring locations.

The first additional monitoring wells are in early planning stages, with funding planned in the WTSGSA budget over two fiscal cycles (2021-22 and 2022-23). The WTSGSA may seek grant funding for well installation, or if unavailable, will use GSA funds. Two multi-completion wells are planned. Specific locations for these monitoring wells have not been chosen, but it is anticipated that one set will be southwest of Ceres, and one will be near Delhi. Both will benefit the Western Lower Principal Aquifer. Once these initial wells are installed and initial data gathered over the first few years, the total number of wells needed would be analyzed and reassessed, with additional plans identified at that time. Additionally, installation of one or more extensometers may be considered, in coordination with neighboring Subbasins and with other partners, such as the USGS, DWR, and the California High Speed Rail Commission.

9.2.2. Fill Data Gaps Along Western Tuolumne River, Merced River, and San Joaquin River – Locations and Shallow Well Depths (Interconnected Surface Water)

Additional monitoring sites may be added within the vicinity of the Tuolumne River, Merced River, and San Joaquin River to address needs related to depletions of interconnected surface water. Existing monitoring wells near these rivers are generally screened at depths typical of domestic, agricultural, or urban groundwater pumping. These monitoring wells are useful for understanding the impacts of groundwater pumping on the aquifer system as a whole, but shallower monitoring wells are needed to better understand shallow groundwater flow near the river boundaries.

Wells would be placed to better understand shallow groundwater conditions, their relationship with stream stage, and their relationship with deeper groundwater conditions. Given the unique nature of these wells, all wells would likely be newly constructed. Exceptions exist where existing wells may be considered for inclusion, such as the City of Ceres which has shallow wells associated with groundwater contamination.

The first additional monitoring wells to be added to the monitoring network to address interconnected surface water are in early planning stages, with funding in the GSA budgets over two fiscal cycles (2021-22 and 2022-23) to design the wells. The GSAs may seek grant funding to install the wells, or if unavailable, will use GSA funds. A total of 8 shallow monitoring wells are planned. Locations will be coordinated with neighboring subbasins. The GSAs tentatively plan to install three wells along the Tuolumne River, three wells along the Merced River, and two wells along the San Joaquin River. However, the locations may change as sites are identified. Once these initial wells are installed and data gathered over the first few years, the total number of wells needed would be analyzed and assessed, with additional plans identified at that time.

9.2.3. Fill Data Gaps in Eastern Principal Aquifer – Additional Wells Near Failed Domestic Wells

Additional monitoring sites may be added within the vicinity of failed domestic wells (e.g., in the surrounding areas of Hughson, Hickman, and eastern Denair). These monitoring wells would be selected for depths of typical domestic wells to improve the ability to manage

groundwater conditions and avoid impacts to these users. They would be given highest priority for consideration of telemetry and public access, so domestic well users can assess their risk of well issues. Note that telemetry requires appropriate site locations and may not be possible at all locations.

The first additional monitoring well to be added to address this data gap is in early planning stages, with funding in the WTSGSA budget over two fiscal cycles (2021-22 and 2022-23). The WTSGSA may seek grant funding for well installation, or if unavailable, will use GSA funds. The WTSGSA tentatively plans to install one monitoring well in the Eastern Principal Aquifer area within the WTSGSA between Denair, Hughson, and Hickman. The exact location remains to be determined. Once this initial well is installed and initial data gathered, the total number of wells needed would be analyzed and assessed, with additional plans identified at that time.

9.2.4. Obtain Missing Information for Monitoring Network Sites

The ISAs described below cover other general improvements to monitoring well access as well as improving understanding of shallow groundwater conditions.

9.2.4.1. Obtain Long-Term Access Agreements for GSP Network Wells, As Needed.

Groundwater monitoring of private wells in the Subbasin has in many instances been performed on a "handshake" arrangement, where verbal or written agreements allow the monitoring, but no formal signed agreement exists. This ISA would involve coordination and outreach to obtain formal access agreements with property owners, including drafting access agreements, contacting property owners, and working to obtain signed agreements for existing monitoring wells (as needed) and any new monitoring wells identified.

9.2.4.2. Obtain Access to Available USGS Wells Drilled in The Subbasin

Similar to other access agreements described above, the GSAs do not have approvals from the USGS to access their wells or with the property owner to access the property on which USGS wells are located. Work under this ISA would include developing agreements or other approvals necessary with both the USGS and the property owners to enable the USGS wells to be used for long-term monitoring.

9.2.4.3. Improve Understanding of Shallow Groundwater Conditions and Operations to Control Shallow Groundwater Through Operation of Drainage Wells

In many areas of the WTSGSA, shallow groundwater can adversely impact crop production with drainage (through tile drains and drainage wells) used to counteract these impacts. Drainage water is pumped back into the canal system and is used for irrigation purposes downstream. However, under the GSP, areas with shallow groundwater conditions may have MTs within only a few feet of MOs, meaning the margin of operational flexibility is very narrow and both of these values are relatively close to the ground surface. This ISA proposes further evaluation of conditions in these shallow groundwater areas to develop an approach that enables water levels to be managed low enough so as not to adversely impact crops

while avoiding undesirable results and putting the water to use for irrigation. In addition to developing guidance on the management of shallow groundwater in this area, this may result in suggested modifications of the MTs and MOs in the western side of the Subbasin to be taken into consideration in future GSP updates.

9.3. ISA 3: ACCOUNTING MECHANISM FOR WATER SUPPLIES WITHIN THE SUBBASIN

The GSAs acknowledge that implementation of the GSP will require that an accounting of groundwater, surface water stored in basin aquifers and/or the sustainable yield of the basin ("Groundwater Accounting Structure") be allocated to each GSA. Each of the GSAs has performed a preliminary analysis of accounting for water in the Subbasin, however, they have not been able to agree to a final Groundwater Accounting Structure within the time available to include such a final framework in the GSP. The GSAs have entered into a Memorandum of Agreement (MOA) that commits them to resolve that issue immediately after the GSP is submitted to the DWR for review. The MOA and the First Amendment to the MOA are included in **Appendix I** of the GSP. As part of that MOA, the GSAs agreed to include accounting documents related to the concept of the Groundwater Accounting Structure, which are attached to the MOA in **Appendix I** as **EXHIBIT A-1** and **EXHIBIT A-2** for the WTS GSA and **EXHIBIT B-1** and **EXHIBIT B-2** for the ETS GSA.

The target timeline for resolving the different positions of the GSAs as set forth in the accounting Exhibits shall be the following:

- 6 months after submission of the GSP to DWR: GSAs pass a resolution or other action that documents the agreed upon the binding rules and allocations that shall apply to the Groundwater Accounting Structure in the Turlock Subbasin;
- Within one year after submission of the GSP to DWR: GSAs identify and obtain all outstanding information or data required, if any, to support the development of an agreed upon Groundwater Accounting Structure;
- Within 18 months after submission of the GSP to DWR: Each GSA provides its GSA counterpart a detailed accounting of all groundwater in the Subbasin, the groundwater budget, and any supporting data, models, calculations and evaluations, consistent with the agreed upon rules. The GSAs agree to a series of meetings to resolve any inconsistencies or differences between the GSA-level Groundwater Accounting Structures;
- 24 months after the submission of the GSP to DWR: GSAs pass a resolution or other action that documents an agreed upon and final Groundwater Accounting Structure.

Each GSA is committed to the development of a Groundwater Accounting Structure within the timelines above. If unforeseen circumstances arise that prevent the above actions to be achieved, either GSA may choose to extend the targeted deadline through a written agreement signed by both GSAs, follow the remedies identified in the MOA, initiate litigation, or adopt a separate GSP. To the extent the above process takes additional time or

steps, not contemplated in the process set forth above, the GSAs agree that no such additional time or process shall be used to support any claim to own or otherwise control water that would not otherwise be owned or controlled.

9.4. ISA 4: Implement Project and Management Actions including an Adaptive Management Approach

The PMAs identified in **Chapter 8** are key activities, projects, and management actions needed to ensure the Subbasin meets the sustainability goals and is able to achieve sustainability by 2042. The list of PMAs is currently considered sufficient for attaining sustainability within the Turlock Subbasin. Over the course of the 20-year implementation horizon, new or modified PMAs may be identified as technology evolves, better information and new data becomes available, and conditions change. As a result, as the GSAs refine the PMAs utilizing an adaptive management approach as described in **Chapter 8**, it must retain sufficient PMAs to account for the level of uncertainty in the Hydrologic Conceptual Model. The PMAs will be implemented in a coordinated fashion. Therefore, this ISA proposes ongoing implementation of an adaptive management strategy for managing the Subbasin which enables the Subbasin's approach to evolve as additional information becomes known, and as conditions change, to enable the PMAs to also evolve to ensure the Subbasin will continue meet its sustainability goals. Each GSA will develop its own management framework for progressing potential new projects from the conceptual and planning stages through implementation. New PMAs will be reported in Annual Reports and included in Five-Year GSP Assessment Reports.

To facilitate the efficient environmental review of projects under the California Environmental Quality Act (CEQA), a Programmatic Environmental Impact Report (PEIR) is being prepared. The PEIR will comprehensively analyze the basin-wide environmental effects of a broad range of GSP activities and projects. Once complete, it will allow the Turlock Subbasin GSAs a programmatic approach to assist their respective member entities to efficiently complete environmental documentation for their sponsored projects.

A Draft PEIR is already underway (October 2020 through September 2022) and is being funded by Proposition 68 (Round 3) grant funding. The Final PEIR will be developed to respond to comments and revisions after October 2022.

9.5. ISA 5: Develop Action Plan for Exceedance of Minimum Thresholds Which May Result in Undesirable Results

While a single exceedance of a MT at a well will not result in an undesirable result under the current SMC, this ISA proposes to develop an action plan that would review exceedances of MTs, as well as actions to understand the conditions and address issues as necessary to ensure it does not result in an undesirable result. Considerations when developing an action plan could include, but are not limited to:

- Identify the monitoring well(s) where an exceedance occurred, and investigate the area
- Communicate with other GSA
- Determine if undesirable results are actually occurring or have the potential to occur in the future
- Select appropriate management strategy for mitigation as necessary
- Consider institutional changes for future mitigation
- Consider if there is a need to improve monitoring. Is the monitoring well providing appropriate data to evaluate the respective SMC or should an alternative monitoring well be considered?
- Determine if an adjustment to the threshold is appropriate
- Recommend changes in the Five-Year GSP Assessment Report

9.6. ISA 6: REFINE GROUNDWATER MODEL INCORPORATING NEW DATA AND STUDIES

This ISA proposes updating the groundwater model periodically, as deemed to be appropriate by the GSAs, to reflect additional data and information as it becomes available to continue to improve the understanding of the Subbasin water resources and hydrogeology, transboundary flows, interconnected surface water, shallow and deep aquifer pumping, intra-basin flows, and other effects. Where appropriate, model refinement will be coordinated with adjoining subbasins. The model is expected to be used to help manage the Subbasin, providing valuable data on water budgets, sustainable yield, water movement, and achievement of SMCs. While the model meets the current needs, the model documentation section (**Appendix D**) identifies model uncertainties and limitation and includes recommendations for model improvements which the GSAs may consider in future years. Model updates are expected to occur along with corresponding Annual Report updates. The most current model is expected to be used to generate information to be included in the respective Annual Report.

Having an updated model will help the GSAs to address management questions and issues as they arise. Models may be used to evaluate management strategies and compliance with SGMA. Modeling can help to better understand movement of water between aquifers, movement between the aquifers and the rivers, as well as transboundary flows between the GSAs or neighboring subbasins. Modeling can also be used to evaluate the effectiveness of PMAs in achieving SMC by 2042.

9.7. ISA 7: FURTHER DEVELOP DATA MANAGEMENT SYSTEM (DMS)

The current repository of the data for the DMS is in the form of Excel and Access database, which has many limitations, including lack of integration, accessibility, and limitations on

data update. A full and integrated DMS may assist the GSP to organize the hydrologic and water supply data to meet the long-term needs of the GSP. This ISA proposes evaluating development of a DMS in a unified location for storage and access of data which would provide better data management and more transparent public understanding of groundwater in the Subbasin. Such a DMS can utilize the existing data that has been collected and verified. The DMS can also integrate with the C2VSimTM model to include baseline and scenario information from the model and provide a seamless environment for both observed and model data sets. The process to evaluate and develop an integrated DMS may include:

- Identification of objectives, DMS needs, and the appropriate platform
- Development of rules for upload, editing, and access
- Development of the integrated DMS
- Uploading data in the DMS
- Providing training on the use of the DMS
- Hosting and maintenance of the DMS

Features that may be considered for the improved DMS could include:

- Web-based platform with an interface suitable for use by the public and by the GSAs
- Variable permissions depending on the user, allowing entities to maintain control over their data while still allowing view access to a broader set of users
- Integration with the C2VSimTM model
- Development of a sustainability dashboard to allow users to quickly understand the status of the Subbasin as it relates to the SMC
- Ability to access the key underlying data used to develop conclusions in the GSP for transparency in the planning process

9.8. ISA 8: IMPROVE COORDINATION AND PLANNING INTEGRATION

Coordination, communication, outreach, and planning are all critical components of a successful GSP. Coordinating GSP implementation and updates with other local and regional planning efforts would ensure consistent use of data and information throughout the subbasin and region. Coordination may also identify projects with multiple benefits and potential funding opportunities. Various planning processes are described in the paragraphs below, though this is not an exhaustive list.

Integrated Regional Water Management Planning

The groundwater components of Integrated Regional Water Management Plans (IRWMPs) are closely related to the information and activities presented in this GSP. Coordination is necessary with the East Stanislaus IRWMP and Merced IRWMP to align the plans to meet

common goals of sustainable water management. This activity proposes coordination with both IRWMP groups to:

- Coordinate on projects and keep the associated projects lists consistent and up to date (see more information on the East Stanislaus IRWM Region Opti Database in **Section 9.11**)
- Discuss opportunities to improve water and groundwater management
- Seek opportunities to reduce duplication between the GSP and IRWMP efforts, which may include joint meetings, paired meetings, or other efforts to reduce cost and increase efficiency

Flood Management

Floods present a risk to life and property as well as an opportunity to capture water for groundwater recharge, resulting in potential benefits groundwater dependent ecosystems, and long-term water supplies. Coordination could include flood management entities at the federal, state, and local level to identify areas of common interest with the GSP.

Ecosystem Identification and Planning Processes

Coordination with ecosystem identification and planning processes (e.g., habitat conservation plans) to improve the understanding of ecosystems within the Subbasin would help to ensure the GSP is consistent with other ecosystem programs and processes. This additional information could assist in identification of groundwater dependent ecosystems and can help prioritize management of ecosystems to protect high-value areas based on the presence of special status species or other unique characteristics.

Urban Water Management Planning

Urban water management planning processes should be coordinated with GSP development and implementation to ensure water supply needs and projections, conservation practices and other data and information are consistent between both planning processes. Other opportunities to coordinate include, but are not limited to, existing and future projects, as well as climate change analyses and potential impacts on water supply availability. Utilizing consistent data and information can reduce cost and ensure water needs for the Subbasin are accurately and consistently reflected in all planning processes.

Agricultural Water Management Planning

Agricultural water management planning processes should be coordinated with GSP development and implementation to ensure water supply needs and projections, conservation practices, and other data and information are consistent between both planning processes. Other opportunities to coordinate include, but are not limited to, existing and future projects, as well as climate change analyses and potential impacts on water supply availability. Utilizing consistent data and information can reduce cost and ensure water needs for the Subbasin are accurately and consistently reflected in all planning processes.

Land Use Planning

There is no comprehensive map of areas favorable to recharge in the Subbasin. This component of ISA 8 would develop such a map, identifying individual components (e.g., soil, location relative to the Corcoran Clay, and water quality concerns) and showing overall favorability. The intent of the map would be to allow coordination with land use agencies. This coordination may result in reserving lands for recharge purposes, setting guidelines for development to avoid recharge impacts (e.g., stormwater capture, pervious surfaces, etc.), or other policy decisions. Further, the map could facilitate locating recharge projects and monitoring wells for water levels and water quality.

The effort may take a variety of forms, including a GIS overlay analysis or use of an existing platform such as GRAT (Groundwater Recharge Assessment Tool) being developed under the Proposition 68 grant for the Subbasin.

9.9. ISA 9: WELL REGISTRATION AND MANAGEMENT

The GSAs may develop a well registration and management program which may include a variety of components to enable the GSAs to better understand where wells are located, and how they are constructed, and operated. Such a program could include data housed within the DMS and would facilitate outreach efforts should there be a need to develop targeted outreach to specific types of stakeholders or in specific areas of the subbasin. Data and information gathered would help to improve the understanding of the subbasin and improve the groundwater model. Potential components of the program are described in the subsections below.

9.9.1. Well Registration Program

Details on individual wells are often poorly understood in the Subbasin and in much of the State of California. This ISA would develop a well registration program where well owners would provide information on their wells. This information would be cataloged by the GSAs and may be combined with metering programs and other efforts to manage the subbasin. The Domestic Well Mitigation Program, described within the PMAs Chapter (Management Action 7, see **Section 8.4.3**) of this document could be a component of this larger program.

Well registration programs are, by their nature, challenging to implement without adequate incentives for well owners to participate. The program could take a variety of forms as determined by each GSA, depending on the need and ultimate use for information to be collected through the program. These forms could include different well types for inclusion (e.g., domestic and/or agricultural), different data collected (e.g., location, construction, well setting, pump capacity, water levels), development of a master GIS map of wells, and others. The program could start with new wells and expand to include existing wells.

9.9.2. Well Permitting Program

This program proposes coordinating with the Counties regarding new well permits to ensure new wells are consistent with the GSP. The program could include review guidelines, well standards, and BMPs to avoid undesirable results. Well registration and meters may be considered on new wells to assist in improving the understanding of water use within the Subbasin and implementing programs and practices to avoid undesirable results.

9.10. ISA 10: DEVELOP FINANCING STRATEGIES, INCLUDING SEEKING GRANT FUNDING

Ongoing implementation of the GSP, Annual Reporting, monitoring, and other efforts described earlier in this Chapter will be funded through the GSAs. Each GSA was formed by a Joint Powers Agreement (JPA), which provides funding through member agency dues. In addition, SGMA allows GSAs to generate funds through a variety of other means. The Memorandum of Agreement (MOA) between the ETSGSA and the WTSGSA lays out a cost share agreement between the GSAs for sharing administrative costs for development and implementation of the GSP. The MOA also allows for project specific agreements to be implemented as needed to fund specific projects.

It is also important to note that the GSP projects identified in **Chapter 8** include project proponents that will be responsible for implementing their respective projects. The GSAs are envisioned to support efforts to implement the projects, which may include pursuing grant funding as appropriate, but the GSA is not the responsible agency unless identified as such. Any changes as the projects identified in Group 3 are further refined will be updated in Annual Reports and Five-Year GSP Assessment Reports as appropriate.

The WTSGSA JPA member agencies includes an irrigation district, cities, counties, county water districts, and community services districts. Each agency has the means to fund activities of those agencies. Pursuant to the WTSGSA JPA, administrative costs are funded through membership dues and fees to member agencies to fund the annual budget. In addition, the many of the member agencies are project proponents for the projects identified in **Chapter 8.** Each project description in **Chapter 8** includes information regarding how it is anticipated to be funded. Past WTSGSA funding discussions focused on developing the GSP using existing funding mechanisms. Once the GSP is adopted, the WTSGSA could consider other funding mechanisms within its authority, as needed to achieve the sustainability goals and objectives.

The ETSGSA JPA member agencies includes water districts and counties. Each agency has a means to fund activities of those agencies. ETSGSA administrative costs are funded primarily through fees on certain lands within the ETSGSA's service area pursuant to a Proposition 218 election. In addition, pursuant to the ETSGSA JPA, contributions are also collected from its member agencies to fund the annual budget. Some of the member agencies are also project proponents for the projects identified in **Chapter 8.** Each project description in **Chapter 8** includes information regarding how it is anticipated to be funded. Past ETSGSA

funding discussions focused on developing the GSP using existing funding mechanisms. Once the GSP is adopted, the ETSGSA could consider other funding mechanisms within its authority, as needed to achieve the sustainability goals and objectives.

To keep costs low while achieving objectives, under this ISA the GSAs would continuously monitor federal, state, and other grant opportunities and apply for grants as appropriate to fund GSP Projects and ISAs. Focusing on multi-benefit projects as well as projects that benefit DACs would be advantageous in identifying additional funding sources as well as widen the benefits provided by such projects.

While broadly implementing projects that improve water supplies and water quality will benefit the Subbasin and those that rely upon it, consideration will also be given to more targeted support for sustainable groundwater supplies for underrepresented communities and DACs as appropriate. Items related to this are included under the Domestic Well Mitigation Program Management Action (see **Section 8.4.3**).

9.11. ISA 11: UPDATING OPTI TO INCLUDE GSP PROJECTS

The East Stanislaus IRWM Region covers both the Turlock and Modesto Subbasins and uses an Opti database to store a living list of projects for the IRWM as well as the Stanislaus Multi-Agency Regional Storm Water Resource Plan. This ISA proposes to expand the East Stanislaus IRWM Region Opti Database to include PMAs listed in this GSP. The database would represent an extension of the DMS specifically as it relates to containing a list of the GSP's PMAs. The database would be maintained and updated as a living list of PMAs, reflecting the current status of each project and continually adjusting as needed to meet changing basin conditions.

To facilitate this change, a new query would be added to the project entry form to identify if the project is connected to the groundwater system and the GSP. If yes, additional questions would be required, such as identifying the applicable sustainability indicators or other GSP-specific information.

Once the East Stanislaus IRWM Region Opti Database is expanded to include GSP PMAs, the Turlock GSAs will view the database as a "living" document. The list of PMAs maintained in the database will be revised periodically and reflect, at any time in the future, the list of PMAs associated with this GSP. When revised, the PMA list will be approved by the Turlock Subbasin GSAs or other body, as appropriate, following updating. As such, the list of PMAs maintained in the database is considered to be the official Turlock GSP PMA list; no formal GSP adoption or re-adoption will be required for PMA list updating.

9.12. IMPLEMENTATION SUPPORT ACTIVITIES COSTS

The ISAs described above will incur costs which will require funding. The primary activities that will incur costs are listed and summarized in **Table 9-1**.

Table 9-1: Implementation Support Activities Costs

Implementation Support Activity	Estimated Cost (One-Time Cost)	Range of Estimated Annual Costs (Low)	(High)	Assumptions
ISA 1: Monitoring, Reporting, and Outreach	N/A	$50,000	$75,000	**Monitoring:** - Monitoring: Assumes costs for monitoring GW levels. Does not include costs for new well installation. First year cost is at the higher end due to initial set up needs. - Costs will be borne by each GSA separately.
	N/A	$50,000	$100,000	**Annual Report Preparation:** - Includes data compiling and reporting on 1) General Information, 2) Basin Conditions, and 3) Plan Implementation Progress. - First year cost include setting up baseline measurements for WQ data, as well as set up of templates, coordination and outreach. - Costs for year 2 may need to be at the higher end as well to complete WQ baseline refinement, and additional coordination. - Year 3 and beyond tend to be at the lower range, assuming no major requests to change template, format, data/analysis needs after DWR review is completed. This cost does NOT include the cost of model update to support the Annual Report. Model update cost is included in ISA 6.
	$300,000 to $600,000	N/A	N/A	**5-year GSP Assessment Report:** - Assume a total cost of approx. $300,000 to $600,000 - Based on the conditions of the first 5 years and trends achieving sustainability, subsequent costs may vary. - Includes data compiling and reporting on progress for each relevant sustainability indicator, plan implementation progress and updates, monitoring network updates and progress in addressing data gaps, description of new information, amendments, and coordination.
	N/A	$50,000	$80,000	**Ongoing Outreach Needs:** - Assumes costs for creating communication materials, website updates (incl. maintenance and hosting), -conducting 2 public workshops per year, and focused outreach as needed to implement management actions. - Costs will be incurred by each GSA individually.
ISA 2: Addressing Identified Data Gaps Including Updating and Improving the Existing Monitoring Network	$771,260 budgeted between two GSAs for the 2021-2022 and 2022-2023 fiscal cycles to design wells (GSAs may seek grant funding to install wells or if unavailable, will fund themselves)	$80,000	$100,000	Once initial wells are installed over the first few years, the total number of wells needed will be analyzed and assessed, with additional plans identified and budgets developed at that time. Cost estimate assumes data gaps for GW levels, GW quality, and streamflow. Additional cost needs to be considered for other data types, such as land subsidence, surveys for geometry of streams and/or channels to support ISW evaluation, and further characterization of GDEs. This could include studies as well to address gaps in our understanding of the subbasin. One time costs (referenced currently) include currently budgeted well installations. Additional one time costs for well installations or other monitoring network needs will be determined once the initial set of wells are installed.
ISA 3: Accounting Mechanism for Water Supplies within the Subbasin	Initial estimate is $50,000 - $75,000 to develop accounting mechanisms.	$5,000	$10,000	This includes negotiation, technical work, and development of a framework and agreements for the groundwater accounting of the Subbasin. Additionally, set up of tools (perhaps in coordination with the DMS) to support the water accounting. Groundwater accounting mechanism will be incorporated into the water budget and annual reporting processes.
ISA 4: Implement Project and Management Actions including an Adaptive Management Approach	Initial estimate of $150,000 to $300,000 to establish Extraction Reporting Program, Pumping Management Program, Extraction Fee Program and Pumping Credit/Carry-Over tracking system in ETSGSA.	$15,000	$30,000	Includes estimated costs to develop Management Action programs and coordinate PMAs at a high level (across all PMAs) outside of administration of each individual PMA, including analysis of phasing of projects based on adaptive management approach and incremental analysis of the benefits on a phased basis. Administrative costs for ongoing implementation of Management Actions will depend on the scope and structure adopted by each GSA and will be determined as these programs are developed. The costs provided to not include establishment of a Groundwater Credit Market/Trading Program. The need and costs of such a program would be evaluated during implementation. Details on individual PMAs are provided in Chapter 8
ISA 5: Develop Action Plan for Exceedance of Minimum Thresholds Which May Result in Undesirable Results	$50,000.00	$10,000.00	$25,000.00	This includes development of an action to be implemented in the event of exceedance of a minimum threshold, including coordination and outreach with the GSAs, growers and private well owners, and neighboring subbasins, confirmation and investigation of causes, and implementation of mitigating actions based on threshold triggers. Cost for ongoing implementation of this item can vary widely, and are presented for planning purposes. Initial cost is to develop the plan. Annual costs include ongoing implementation of the plan.
ISA 6: Refine Groundwater Model Incorporating New Data and Studies	N/A	$30,000	$80,000	**Annual Report Support:** This includes use and updating of the model for supporting the annual report, which is the lower cost range for years 2 and beyond. The upper cost range is for the first year, which includes setting up the data collection templates and coordination.
	TBD (However, a cost of $100,000 to $300,000, depending on the scope is a reasonable range for planning)	N/A	N/A	**Model Refinement Activities:** This can be a one time cost of model update, refinements, upgrade, and re-calibration to support the 5-year GSP assessment and update. The details of level of effort for these refinements and upgrades will need to be developed depending on the scope of work and information and data available. Could include development of tools separate from the model to address specific data needs.
ISA 7: Further Develop Data Management System	Development cost is based on the scope and features. However, a budget of $55,000 to $70,000 is reasonable for planning purposes.	N/A	N/A	**DMS Development Cost:** Consider opportunities for DMS build on existing work in and outside the basin and ensure interbasin coordination. Cost assumes the following features which were in the original scope of the GSP: 1- Identify goals and objectives of DMS 2- Select DMS software package 3- Migrate GSP data to the software package 4- Develop custom reporting for GSP 5- Enhance select custom functionalities 6- Prepare user manual
	N/A	$15,000	$25,000	**DMS Annual Maintenance Cost:** Annual maintenance cost for a typical DMS, including data screening and update, hosting, routine feature updates
ISA 8: Improve Coordination and Planning Integration	N/A	$15,000	$30,000	Coordination among the GSAs, interbasin coordination with Modesto, Merced, and Delta-Mendota Subbasins, and coordination with water management groups and County Planning.
ISA 9: Well Registration and Management	TBD	TBD	TBD	This cost will depend on the number of wells, activities needed to outreach and encourage registration, tools to be developed to facilitate the registration. There will be a one-time cost to set up the system, and an annual maintenance cost to facilitate and monitor, as well as integrate with the DMS
ISA 10: Develop Financing Strategies, Including Seeking Grant Funding	$20,000 to $50,000 for planning purposes	$10,000	$30,000	This is a cost on "As-Needed" basis. Depending on the scope of projects to be included in the grant funding applications and the grant requirements.
ISA 11: OPTI Project List	$2,000	TBD	TBD	One time cost to develop place to include list in system. Ongoing costs for uploading/updating list, and GSA approval process.
TOTAL ESTIMATED COSTS	**$1.5 - $2.2 million**	**$330,000**	**$585,000**	**One time cost of $1.5 to $2.2 million is estimated for key implementation support activities including establishment of several programs associated with Management Actions described in Chapter 8. A range of annual costs for GSP implementation is estimated to range from $330,000 to $585,000.**

NOTES:
Additional annual costs will be incurred for GSA Administration, legal issues, etc. and are not included here.
Costs could be born by each GSA as they deem the need in some cases.

9.13. IMPLEMENTATION SCHEDULE

The ISAs described above will be implemented according to the schedule summarized in **Table 9-2**.

Table 9-2: Implementation Support Activities Schedule

Implementation Support Activity	Schedule				
	Year 1	Year 2	Year 3	Year 4	Year 5
ISA 1: Monitoring, Reporting, and Outreach	Annual Monitoring				
	Annual Reporting				
	Communication and Outreach				
ISA 2: Addressing Identified Data Gaps Including Updating and Improving the Existing Monitoring Network	Install Monitoring Wells			--	--
	Additional Investigations (as needed)				
ISA 3: Accounting Mechanism for Water Supplies within the Subbasin	Develop Groundwater Accounting Framework		Implement Annual Groundwater Accounting		
ISA 4: Implement Project and Management Actions including an Adaptive Management Approach	Develop Demand Reduction and Management Programs			Implement Programs	
	Develop Domestic Well Mitigation Program		Implement Domestic Well Mitigation Program		
ISA 5: Develop Action Plan for Exceedance of Minimum Thresholds Which May Result in Undesirable Results	Develop Plan	Implement Plan (if needed)			
ISA 6: Refine Groundwater Model Incorporating New Data and Studies	--	--	Model Refinements		Update Forecasts
	Annual Updates and Reporting Support				
ISA 7: Further Develop Data Management System	Develop DMS		--	--	--
	Ongoing Data Management				
ISA 8: Improve Coordination and Planning Integration	Ongoing Coordination				
ISA 9: Well Registration and Management	Outreach and Planning	Voluntary Program	Expanded Program	Ongoing Implementation	
ISA 10: Develop Financing Strategies, Including Seeking Grant Funding	Ongoing Planning and Strategy Implementation				
ISA 11: Updating Opti to Include GSP Projects	Implement	Update as needed			

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January 2022

Turlock Subbasin

Groundwater Sustainability Plan

Appendices

Appendix A

Resolutions to Form Groundwater Sustainability Agencies Under SGMA

West Turlock Subbasin Groundwater Sustainability Agency and

East Turlock Subbasin Groundwater Sustainability Agency

RESOLUTION NO. 2017-01

RESOLUTION APPROVING THE WEST TURLOCK SUBBASIN GROUNDWATER SUSTAINABILITY AGENCY'S ELECTION TO BE THE GROUNDWATER SUSTAINABILITY AGENCY FOR THE LANDS WITHIN THE BOUNDARY OF THE WEST TURLOCK SUBBASIN GROUNDWATER SUSTAINABILITY AGENCY

WHEREAS, the Sustainable Groundwater Management Act (SGMA) was signed into law on September 16, 2014 and adopted as California Water Code, section 10720, et. seq.; and

WHEREAS, the purpose of SGMA is to provide sustainable management of groundwater basins and enhance local management of groundwater through empowering local management agencies with the authority, technical, and financial assistance necessary to sustainably manage groundwater; and

WHEREAS, Water Code section 10723(a) authorizes any combination of local agencies having water or land management authority overlying a basin to elect to be the groundwater sustainability agency for that basin; and

WHEREAS, the West Turlock Subbasin Groundwater Sustainability Agency (WTSGSA) was formed as a joint powers authority pursuant to Government Code section 6500, et. seq., by agencies that qualify to be groundwater sustainability agencies (Members); and

WHEREAS, the respective service areas of the WTSGSA Members are located in the Turlock Groundwater Subbasin as defined in the California Department of Water Resources Bulletin 118; and

WHEREAS, WTSGSA membership was extended to all agencies that have water and/or land management authority within the boundary of the WTSGA; and

WHEREAS, the WTSGSA is committed to sustainable management of its groundwater resources; and

WHEREAS, retaining local jurisdiction and control over groundwater management is beneficial to the health, safety, and water supply reliability of the Members of the WTSGSA and their respective customers and constituents; and

WHEREAS, adoption of this Resolution does not constitute a project under the California Environmental Quality Act because it does not result in any direct or indirect physical change in the environment; and

WHEREAS, pursuant to Water Code section 10723 and Government Code section 6066, notices of a public hearing regarding the adoption of a resolution to elect to become a groundwater sustainability agency were published on February, 16 and 23, 2017 in the Modesto Bee and Merced Sun-Star, and on February 15 and 22, 2017 in the Turlock Journal; and

WHEREAS, on March 1, 2017, the WTSGSA held a public hearing in Merced County to receive comments prior to the WTSGSA considering to be a Groundwater Sustainability Agency; and

WHEREAS, on March 2, 2017, the WTSGSA held an additional public hearing in Stanislaus County during a special meeting of the WTSGSA and considered the adoption of this RESOLUTION.

NOW, THEREFORE, BE IT RESOLVED by the Board of Directors of the WTSGSA that:

1. The WTSGSA elects to be the Groundwater Sustainability Agency and intends to undertake sustainable groundwater management within its boundary area; and

2. The WTSGSA Board authorizes the Chair of the Technical Advisory Committee or his designee to notify the California Department of Water Resources of the WTSGSA's decision, by providing a copy of this RESOLUTION and other relevant information necessary to the California Department of Water Resources within 30 days, and otherwise comply with the requirements of Water Code section 10723.8(a).

Moved by Director Odom, seconded by Director Young, that the foregoing resolution be adopted.

Upon roll call, the following vote was had:

Ayes:	Directors Alvarez, Jorritsma, Chiesa, Pareira, Alternate Director Bublak, Young, Odom, Worsham and Alamo
Noes:	None
Absent:	Directors Soiseth and Vierra

The President declared the resolution adopted.

I, Dorinda Soiseth, Interim Secretary to the Board of Directors of the WEST TURLOCK SUBBASIN GROUNDWATER SUSTAINABILITY AGENCY, do hereby CERTIFY that the foregoing is a full, true and correct copy of a resolution duly adopted at a special meeting of said Board of Directors held the 2nd day of March, 2017.

Interim Secretary to the Board of Directors
of the West Turlock Subbasin
Groundwater Sustainability Agency

EAST TURLOCK SUBBASIN GROUNDWATER SUSTAINABILITY AGENCY JOINT POWERS AUTHORITY
RESOLUTION NO. 2016-17-01

RESOLUTION OF THE EAST TURLOCK GROUNDWATER SUSTAINABILITY AGENCY JOINT POWERS AUTHORITY DECLARING ITS INTENTION TO BECOME A GROUNDWATER SUSTAINABILITY AGENCY UNDER THE SUSTAINABLE GROUNDWATER MANAGEMENT ACT FOR THE TURLOCK SUBBASIN

WHEREAS, on September 16, 2014, Governor Jerry Brown signed into law Senate Bills 1168 and 1319 and Assembly Bill 1739, known collectively as the Sustainable Groundwater Management Act (SGMA); and

WHEREAS, SGMA went into effect on January 1, 2015; and

WHEREAS, SGMA requires all high and medium priority groundwater basins, as designated by the California Department of Water Resources (DWR) Bulletin 118, to be managed by a Groundwater Sustainability Agency (GSA); and

WHEREAS, the Central Valley Groundwater Basin (Basin) has been designated by DWR as a high priority basin; and

WHEREAS, SGMA authorizes any local agency overlying the Basin to elect to become a GSA within the Basin; and

WHEREAS, the East Turlock Subbasin Groundwater Sustainability Agency Joint Powers Authority (ETS GSA JPA) was formed on March 7, 2017 by and through that Governance Agreement; and

WHEREAS, the ETS GSA JPA is comprised of local agencies as defined under the SGMA and are therefore eligible to serve as a GSA within the Basin, or to form an independent Joint Powers Agency to serve as a GSA within the Basin; and

WHEREAS, Section 10723.2 of the SGMA requires that a GSA consider the interests of all beneficial uses and users of groundwater, as well as those responsible for implementing groundwater sustainability plans; and

WHEREAS, Section 10723.8 of the SGMA requires that a local agency electing to be a GSA to notify the DWR of its election and intention to undertake sustainable groundwater management within a basin; and

WHEREAS, the ETS GSA JPA held a public hearing on March 30 and March 31, 2017 in Stanislaus and Merced Counties, respectively, and on March 31, 2017 in Merced County, after publication of notice pursuant to Government Code section 6066 to consider the adoption of this Resolution; and

WHEREAS, the ETS GSA JPA wishes to exercise the powers and authorities of a GSA granted by the SGMA;

NOW, THEREFORE, BE IT RESOLVED that the ETS GSA JPA hereby elects to become a groundwater sustainability agency for that portion of the Turlock Subbasin lying within its boundaries; and

BE IT FURTHER RESOLVED that the ETS GSA JPA will develop an outreach program to include all stakeholders to ensure that all beneficial uses and users of groundwater are considered; and

BE IT FURTHER RESOLVED that the ETS GSA JPA has been authorized to submit to the DWR a notice of intent to undertake sustainable groundwater management in accordance with the SGMA (Part 2.74 of the Water Code); and

BE IT FURTHER RESOLVED that such notification shall include the boundaries of the Turlock Subbasin that the ETSGSA JPA intends to manage, a copy of this resolution, a list of interested parties developed pursuant to Section 10723.2 of the SGMA, and an explanation of how their interests will be considered in the development and operation of the GSA and the development and implementation of the ETSGSA JPA's groundwater sustainability plan.

On motion by Member CHIESA and seconded by Member ULRICH, the forgoing resolution was passed and adopted on March 31, 2017 by the following vote.

AYES – Members Rossini, ~~Pareira~~, Chiesa, Ulrich, and ElTal
NOES – none
ABSTAINS – none
ABSENT – ~~none~~ PAREIRA

By: _____
Al Rossini, Chair

ATTEST:

By: _____
Secretary

Appendix B

Joint Powers Agreements (JPAs)

West Turlock Subbasin Groundwater Sustainability Agency and

East Turlock Subbasin Groundwater Sustainability Agency

Joint Powers Agreement Forming the West Turlock Subbasin Groundwater Sustainability Agency

This joint powers agreement ("Agreement") is made and entered into by and among the agencies that have executed this Agreement, as identified in Exhibit A, which are referred to herein individually as a "Party" and collectively as "Parties."

Recitals

WHEREAS, the Parties desire to enter into this Agreement for the purposes of forming a joint powers agency to serve as a groundwater sustainability agency within the Turlock Subbasin, DWR Basin No. 5-022 ("Turlock Subbasin"); and

WHEREAS, each of the Parties to this Agreement is a public agency with either water supply, water management, or land use responsibilities within the Turlock Subbasin; and

WHEREAS, pursuant to the Joint Exercise of Powers Act (Chapter 5 (commencing with Section 6500) of Division 7 of Title 1 of the California Government Code), two or more public agencies may by agreement jointly exercise any power held in common by agencies entering into such an agreement; and

WHEREAS, on September 16, 2014 Governor Jerry Brown signed into law Senate Bills 1168 and 1319 and Assembly Bill 1739, known collectively as the Sustainable Groundwater Management Act ("the Act"); and

WHEREAS, the Act went into effect on January 1, 2015; and

WHEREAS, the Act (i) requires sustainable management of certain groundwater basins, (ii) enhances local management of groundwater, (iii) requires local agencies to establish minimum standards for sustainable groundwater management, and (iv) provides local groundwater agencies with the authority, and the technical and financial assistance necessary to sustainably manage groundwater; and

WHEREAS, the Parties intend for the joint powers agency formed pursuant to this Agreement to become a groundwater sustainability agency prior to July 1, 2017 within the boundaries provided in Exhibit B within the Turlock Subbasin as defined in Article 2, section 2.2; and

WHERAS, following a public hearing held at its first joint powers agency meeting, this joint powers agency shall consider a resolution to elect to become a groundwater sustainability agency pursuant to California Water Code section 10723(b); and

WHEREAS, California Water Code section 10720.7 requires all basins designated as high- or medium-priority basins by California Statewide Groundwater Elevation Monitoring program ("CASGEM") to be managed under groundwater sustainability plans or coordinated groundwater sustainability plans pursuant to the Act; and

WHEREAS, this joint powers agency's service area overlies portions of the Turlock Subbasin, a CASGEM-designated high-priority basin; and

WHEREAS, the Parties, acting through and by this Agreement intend to work cooperatively with other groundwater sustainability agencies operating in the Turlock Subbasin to manage the Subbasin in a sustainable fashion pursuant to the requirements set forth in the Act; and

WHEREAS, the Parties agree and endeavor to develop a groundwater sustainability plan that is as equitable as possible to all Members, provided the respective Members' impact on groundwater sustainability. Further, all Members agree to work collaboratively to develop a Groundwater Sustainability Plan that is focused on allowing all Members to operate and continue providing service while achieving sustainability, to the extent feasible.

NOW, THEREFORE, in consideration of the promises, terms, conditions, and covenants contained herein, the Parties hereby incorporate the recitals listed above into this Agreement and agree as follows.

Article 1. Definitions

As used in this Agreement, unless context requires otherwise, the meanings of the terms set forth below shall be as follows:

1.1. "Act" refers to the Sustainable Groundwater Management Act.

1.2. "Agency" means the West Turlock Subbasin Groundwater Sustainability Agency, which is the agency formed by this agreement.

1.3. "Agreement" means this joint powers agreement, which creates the West Turlock Subbasin Groundwater Sustainability Agency.

1.4. "Associate Member" means a Party that satisfies the requirements of Article fourteen (14) (Membership) of this Agreement, but cannot otherwise vote or appoint a Member to the Governing Board.

1.5. "CASGEM" is the California Statewide Groundwater Elevation Monitoring program administered by the Department of Water Resources.

1.6. "Committee" shall mean any committee established pursuant to Article thirteen (13) of this Agreement.

1.7. "Effective Date" means the date on which the last Party executes this Agreement.

1.8. "Fiscal Year" means July 1 through June 30.

1.9. "Governing Board" means the governing body of the Agency.

1.10. "Board Member" or "Board Members" mean members of the Agency's Governing Board.

1.11. "Member's Governing Body" means the Board of Directors or other voting body that controls the individual public agencies that are members of the Agency.

1.12. "Member" means a Party that satisfies the requirements of Article fourteen (14) (Membership) of this Agreement and is not an Associate Member.

1.13. "Special Project" means a project undertaken by some, but not all Members of the Agency.

1.14. "State" means the State of California.

Article 2. Creation of a Separate Entity

2.1. Agency Separate from Members. Upon the effective date of this Agreement, the West Turlock Subbasin Groundwater Sustainability Agency is hereby created. Pursuant to the provisions of Article I, Chapter 5, Division 7 of Title 1 of the California Government Code, commencing with Section 6500, the Agency shall be a public agency separate from its members. The principle offices shall be located within the boundaries set forth in Exhibit B as defined in Article 2, Section 2.2 or at such other place as the Governing Board shall determine.

2.2. Boundaries. The boundaries of the Agency shall generally be as follows: on the north, the boundary shall be the Tuolumne River; bounded on the south by the Merced River; on the west by the San Joaquin River; and on the east by the eastern jurisdictional boundary of Turlock Irrigation District's Irrigation Service Area. Attached hereto and incorporated herein is Exhibit B, a map showing the boundaries of the Agency.

Article 3. Term

3.1. Effective Dates. This Agreement shall become effective upon execution by all of the Parties and shall continue in full force and effect until terminated pursuant to the provisions of Article 18 (Withdrawal and Termination).

3.2. Amendment. The Members intend to revisit the provisions and terms of this Agreement after the Agency submits a groundwater sustainability plan to the Department of Water Resources. This provision shall not limit or otherwise constrain the authority of the Members to amend this Agreement by mutual agreement of the Members prior to the submission of the groundwater sustainability plan.

Article 4. Purpose of the Agency

4.1. Agreement Purpose. The purpose of this Agreement is to create a joint powers agency separate from its Members that will elect to become a groundwater sustainability agency prior to July 1, 2017 for a portion of the Turlock Subbasin as defined in Article 2, section 2.2.

4.2. Collaboration. The Agency will collaborate with other groundwater sustainability agencies within the Turlock Subbasin to develop, adopt and implement a single groundwater sustainability plan or coordinated groundwater sustainability plans for the Turlock Subbasin in order to satisfy the Act's requirements.

4.3. Outreach. The Agency will involve the public and area stakeholders through outreach and engagement in developing, implementing, monitoring and administering a single groundwater sustainability plan or coordinated groundwater sustainability plans for the Turlock Subbasin.

4.4. Coordination. The Agency will strive to achieve intra-basin coordination and cooperate with other groundwater sustainability agencies operating in the Turlock Subbasin in order to satisfy the requirements of the Act, in addition to striving to achieve inter-basin coordination with the neighboring Delta-Mendota, Modesto and Merced Subbasins.

Article 5. Powers of the Agency

5.1. Restrictions on Exercise of Powers. In accordance with California Government Code section 6509, the following powers shall be subject to the restrictions upon the manner of exercising such powers pertaining to Turlock Irrigation District.

5.2. Powers. Subject to the limitations addressed herein, the Agency shall have the power, in the name of the Agency, to exercise the common powers of the Members, including but not limited to, the following:

5.2.1. Employ agents, consultants, advisors, independent contractors, and employees.

5.2.2. Make and enter into contracts with public or private entities, including the State of California and the United States, and one another.

5.2.3. Acquire, hold, and convey real and personal property.

5.2.4. Incur debts, obligations, and liabilities.

5.2.5. Borrow money.

5.2.6. Accept contributions, grants, or loans from any public or private agency or individual in the United States or any department, instrumentality, or agency thereof for the purpose of financing its activities.

5.2.7. Invest money that is not needed for immediate necessities, as the Governing Board determines advisable, in the same manner and upon the same conditions as other local entities in accordance with section 53601 of the California Government Code.

5.2.8. Sue and be sued; provided that a Member may determine not to participate in the affirmative litigation.

5.2.9. Undertake all other acts reasonable and necessary to carry out the purpose of this Agreement.

5.2.10. Employ or retain full-time or part-time supporting staff.

5.2.11. Exercise and/or delegate all additional powers granted to groundwater sustainability agencies by the Act upon successful election to be a groundwater sustainability agency within the Turlock Subbasin.

5.2.12. Exercise and/or delegate all additional powers granted to groundwater sustainability agencies by the Act upon submittal to the Department of Water Resources of a single groundwater sustainability plan or coordinated groundwater sustainability plans to manage the entire Turlock Subbasin.

5.3. Monetary Obligations. Except as otherwise provided in this agreement, the Agency shall not have the power to bind any Member to any monetary obligation by this Agreement other than through approval pursuant to sections 11.2, 11.3, 11.6 and 18.3.

5.4. Water Rights. The Agency and all of its Members confirm that nothing contained herein shall grant the Agency any power to alter any water right, contract right, or any similar right held by its Members, or amend any Member's water delivery practice, course of dealing, or conduct without the express consent of the holder thereof.

Article 6. Agency Governing Board

6.1. Membership of Governing Board. The Agency shall be governed by a Governing Board consisting of one (1) Board Member representing each Member, except for Associate Members, which have no seat on the Governing Board.

6.2. Requirements. Each Board Member must be appointed by one of the Members. Each Board Member shall certify to the Secretary in writing that he or she has been appointed to be a Board Member by the appointing Member.

6.3. Alternate Board Members. Each Member shall appoint one Alternate Board Member. The Alternate Board Member must meet the requirements set forth in section 6.2. Alternate Board Members have no vote at Governing Board meetings if the Board Member is present. If the Board Member is not present, the Alternate Board Member shall be entitled to participate in all respects as a regular Board Member.

6.4. Removal of Board Members. Board Members and Alternate Board Members shall serve at the pleasure of their appointing Member's Governing Board and may be removed or replaced at any time. A Board Member that no longer meets the qualifications set forth in section 6.2 is automatically removed from the Agency Governing Board. Upon removal of a Board Member, the Alternate Board Member shall serve as a Board Member until a new Board Member is appointed by the Member. Members must submit any changes in Board Member or Alternate Board Member positions to the Secretary in writing and signed by the Member.

Article 7. Associate Members

7.1. Associate Member. The Board may allow certain Members to participate in the Agency as Associate Members. Associate Members shall be entitled to participate in the meetings and discussions of the Governing Board but Associate Members shall not have the power to vote on any action to be taken by the Agency or to become an officer of the Agency. Any Member that is not able or chooses not to fund its proportional share of the budget shall be eligible to become an Associate Member.

7.2. Bound by Agency Decisions. Associate Members, regardless of the lack of voting authority, shall be bound by the decisions and actions of the Governing Board on behalf of the Agency.

7.3 Addition of Associate Members. The Governing Board may appoint any local agency, as defined in California Water Code section 10721(n), as an Associate Member upon an affirmative vote pursuant to section 11.3.

Article 8. Officers

8.1. Officers. The Governing Board shall select a Chair, Vice Chair, Secretary, and any other officers as determined necessary by the Governing Board. The Secretary of the Board is not required to be a member of the Governing Board, but instead, can be a member of the staff of one of the Members.

8.1.1. The Chair shall preside at all Governing Board Meetings.

8.1.2. The Vice Chair shall act in place of the Chair at meetings should the Chair be absent.

8.1.3. The Secretary shall keep minutes of all meetings of the Governing Board and shall, as soon as possible after each meeting, forward a copy of the minutes to each member and alternate of the Governing Board.

8.1.4. All Officers shall be chosen at the first Governing Board meeting and serve a term of two (2) years. An Officer may serve for multiple consecutive terms. Any Officer may resign at any time upon written notice to the Governing Board. Upon vacancy of an Officer position, the Governing Board shall appoint a replacement Officer who shall complete the vacant Officer position's term.

Article 9. Treasurer, Controller, and Legal Counsel

9.1. Treasurer and Controller. The Turlock Irrigation District shall act as treasurer and controller for the Agency, until such time as the Agency appoints an independent treasurer and controller. The controller of the Agency shall cause an independent audit of the Agency's finances to be made by a certified public accountant in compliance with California Government Code section 6505. The treasurer of the Agency shall be the depositor and shall have custody of all Agency funds from whatever source. The controller of the Agency shall draw warrants and pay demands against the Agency when the demands have been approved by the Agency or any authorized representative. The treasurer and controller shall comply strictly with the provisions of statutes relating to their duties found in Chapter 5 (commencing with section 6500) of Division 7 of Title 1 of the California Government Code and those duties and provisions adopted by the Agency.

9.2. Legal Counsel. The Governing Board shall appoint legal counsel as it deems appropriate.

Article 10. Executive Director

10.1. Appointment. The Governing Board may appoint an Executive Director at the time and with the specific compensation for his or her services, as determined by the Governing Board. Prior to such appointment, the Board may establish a committee, pursuant to section 13.1 of this Agreement, which will generally perform duties similar to those described in section 10.2 of this agreement.

10.2. Duties. The Executive Director shall be the chief administration officer of the Agency, shall serve at the pleasure of the Governing Board, and shall be responsible to the Governing Board for the proper and efficient administration of the Agency. The Executive Director shall have the powers designated in the Agency Bylaws.

10.3. Staff. The Executive Director shall employ additional full-time and/or part-time employees, assistants, and independent contractors that may be necessary to accomplish the purposes of the Agency,

subject to the approval of the Governing Board for any contract in excess of a specified dollar amount as determined by the Governing Board.

Article 11. Governing Board Voting

11.1. Quorum. A majority of Board Members shall constitute a quorum for the transaction of business. In the absence of a quorum, any meeting of the Board may be adjourned by a majority present, but no other business may be transacted.

11.2. Approval Requirements. Except as provided in sections 11.3 and 11.4 below, action of the Board shall require the affirmative vote of a majority of Board Members voting.

11.3 Approval of High Threshold Matters. Action of the Board on high threshold matters, which include the annual budget, approval of any bond or debt instrument, approval of a contract exceeding $100,000, approval of Membership, approval of a groundwater sustainability plan, involuntary termination, Exhibit D, and approval of extraction limitation for any Member or category of membership shall require the affirmative vote of at least two-thirds of the voting Members.

11.4 Authority to Vacate Approval. Members identified in Exhibit C have the authority to vacate the approval of any item approved pursuant to sections 11.2 or 11.3, except approvals pursuant to section 18.2, which there is no authority to vacate. In order to vacate the approval of an item passed pursuant to section 11.2 or 11.3, the Member shall notify the Board that it is vacating the approval after such approval has been made, but prior to adjournment of the meeting in which the approval took place. The effect of such notice shall nullify the Board action and approval. When an approval is vacated pursuant to this section, the Members agree to further discuss the matter and work toward resolution of any outstanding difference of opinion.

Article 12. Agency Meetings

12.1. Initial Meeting. The initial meeting of the Agency's Governing Board shall be called by Turlock Irrigation District and held within the Agency's boundary within 30 days of the effective date of this Agreement. A public hearing, pursuant to California Water Code section 10723(b), will be held at this meeting. A draft resolution electing to be the West Turlock Subbasin Groundwater Sustainability Agency will be presented as an action item at this meeting.

12.2. Time and Place. The Governing Board shall meet at least quarterly at a time and place set by the Governing Board, and at such other times as determined by the Governing Board and listed in the Agency's bylaws.

12.3. Conduct. All meetings of the Governing Board shall be noticed, held, and conducted in accordance with the Ralph M. Brown Act. Board Members and Alternate Board Members may use teleconferencing in connection with any meeting in conformance with and to the extent authorized.

Article 13. Committee Formation

13.1. Internal Committee Formation. The Governing Board shall establish internal committees from time to time. Each internal committee shall be comprised of representatives of the Members, Associate Members, or a combination of both, shall exist for the term specified in the action establishing the committee,

shall meet as directed by the Governing Board, and shall make recommendations to the Governing Board on the various activities of the Agency. The Governing Board may delegate authority to the internal committee to administer or implement Agency activities.

13.2. External Advisory Committee Formation. The Governing Board may establish one or more advisory committees comprised of diverse social, cultural, and economic elements of the population and area stakeholders within the Agency's boundary. The Governing Board shall encourage the active involvement of the advisory committee(s) prior to and during the development and implementation of the Turlock Subbasin groundwater sustainability plan or coordinated Turlock Subbasin groundwater sustainability plans. The Governing Board will ensure that at least one (1) member from the Governing Board or Agency employee attends and participates in each advisory committee meeting.

Article 14. Membership

14.1. Initial Members. The initial Members of the Agency shall be identified in Exhibit A as long as they have not, pursuant to the provisions thereof, withdrawn from this Agreement in accordance with the terms thereof.

14.2. New Members. Additional Parties may join this Agreement and become a Member provided that the prospective new member, (a) is eligible to join a groundwater sustainability agency as provided by the Act, (b) possesses powers common to all other Members, (c) receives an affirmative vote as defined in Article 11, (d) pays all previously incurred costs that the Governing Board determines to have benefited their agency, (e) pays all applicable fees and charges, and (f) agrees in writing to the terms and conditions of this Agreement.

14.3. Associate Member Conversion to Full Membership. Associate Members may become full voting Members of the Agency upon (a) affirmative vote as defined in Article 11.3, (b) payment of all previously incurred costs that the Governing Board determines have benefited the Associate Member and have not yet been paid, and (c) agreement in writing to the terms of Governing Board members in this Agreement.

Article 15. Specific Projects

15.1. Projects. The Agency intends to carry out activities in furtherance of its purposes and consistent with the powers established by the Agreement with the participation of all Members.

15.2. Member Specific Projects. In addition to the general activities undertaken by all Members of the Agency, the Agency may initiate specific projects or litigation that involves less than all Members. No Member shall be required to be involved in a Project that involves less than all the Members.

15.3. Project Agreement. Prior to undertaking any project or litigation that does not involve all Member Agencies, and subject to potential Board disapproval pursuant to section 15.4, the Members electing to participate in the Project shall enter into a Project Agreement. A Member may elect not to participate in a specific project or litigation matter by providing notice to the Governing Board and not entering into the Project Agreement specific to the matter in which the Member has elected not to participate. Each Project Agreement shall provide the terms and conditions by which the Members that enter into the Project Agreement will participate in the Project. All assets, rights, benefits, and obligations attributable to the Project

shall be allocated to those Members that have entered into the Project Agreement. Any debts, liabilities, obligations, or indebtedness incurred by the Agency in regard to a particular Project shall be paid by those Members who have executed the Project Agreement in accordance with the terms thereof and those Members who have not executed the Project Agreement shall not be responsible for the payment of those debts, liabilities, and obligations. Further, to the extent the Project is litigation, the Members who chose not to enter into the Project Agreement shall not be named or otherwise listed in the pleadings or appear on litigation materials.

15.4. Governing Board Approval. The Governing Board shall have the authority to disapprove any Project Agreement upon a determination that the Project Agreement has specific, substantial adverse impacts upon Members that have not executed the Project Agreement.

Article 16. Budget and Expenses

16.1. General Operating Budget. The Governing Board shall approve an initial budget at its first meeting and an annual budget before the beginning of each fiscal year thereafter. The general operating budget shall be funded by the Parties in the proportion designated in Exhibit D. Whenever the proportion of funding changes, the allocation shall take effect the fiscal quarter after the revision to Exhibit D is finalized.

16.2. Membership Annual Fees. Both Members and Associate Members shall pay annual membership fees as set forth in Exhibit E at the beginning of the Agency's fiscal year.

16.3. Reserve Funds. Membership annual fees from Members and Associate Members shall be deposited in the Agency's general operating fund. This fund shall have a reserve maximum that is established as part of the annual budget process. If the maximum reserve is met, the Agency shall not continue to collect annual fees in excess of the reserve, but will proportionally credit the funding agencies and waive collection of membership annual fees, or a portion thereof, in order to not exceed the reserve.

16.4 Special Project Funding. For projects in which not all Members participate or that are not otherwise funded by the general operating budget, the Members participating in the project shall agree to allocate funding prior to beginning the project.

16.5. Agency Contributions. Each of the Parties may, but are not required to, contribute additional money, office space, furnishings, equipment, supplies, or services as their respective Governing Boards may deem appropriate.

16.6. Grants and Other Funding Funds may be derived through State and Federal grants, or other available sources. The Agency may also apply for available State and Federal funds and shall make new and additional applications from time to time as appropriate. The Agency may also establish and collect fees, leases, or rents as may be authorized by law under the common powers of all the Parties.

16.7. Public and Private Donations. The Agency may accept and expend funds from public or private sources subject to the legal restrictions which are set forth in the common powers of the Parties for the purpose of carrying out its powers, duties, responsibilities, and obligations specified in this Agreement.

16.8. Budget Consistency. The Agency shall be limited to the making of expenditures or incurring of liabilities in the amount of the appropriations allowed by the budget as adopted and revised by the Agency.

16.9. Scope of Budget and Expenses. The General Operating Budget of the Agency will be limited to covering costs of operating the Agency pursuant to this Agreement. However, as will be more fully developed and set forth in the groundwater sustainability plan, the Agency does not anticipate the General Operating Budget as funded by weighted voting shares will be required or responsible for funding specific sustainability implementation projects or programs that will be implemented in geographic regions specific to individual Members. Rather, this Agreement anticipates that implementation of sustainability programs will be funded by the specific Member(s) that are responsible for implementing such actions in their respective local service area or geographic region. After the development of the groundwater sustainability plan, the General Operating Budget will only be responsible for funding general Agency operation; it will not fund the implementation of the groundwater sustainability plan.

Article 17. Liability and Indemnification

17.1. Liability. In accordance with California Government Code Section 6508.1, the debts, liabilities, and obligations of the Agency shall be the debts, liabilities, and obligations of the Agency alone, and not the Members.

17.2. Indemnification. The members of the Governing Board, officers, and employees of the Agency shall use ordinary care and reasonable diligence in the exercise of their powers, and in the performance of their duties pursuant to this Agreement. They shall not be liable to the Parties to this agreement for any mistake of judgment or any other action made, taken, or omitted by any agent, employee, or independent contractor selected with reasonable care, nor for loss incurred through the investment of the Agency's funds, or failure to invest the same.

17.3. No Responsibility for Others. To the extent authorized under California law, no Board Member, officer, or employee of the Agency shall be responsible for any action made, taken, or omitted, by any other Board Member, officer or employee.

17.4. Defense and Insurance. The funds of the Agency shall be used to defend, indemnify, and hold harmless the Agency and any Board Member, officer, or employee of the Agency for actions taken in good faith and within the scope of his or her authority. The Agency shall further hold harmless and indemnify the Members, including their officers and employees, from any claim or liability arising from acts or omissions of the Agency within the scope of this Agreement. Nothing herein shall limit the right of the Agency to purchase insurance or to create a self-insurance mechanism to provide coverage for the foregoing indemnity.

Article 18. Withdrawal and Termination

18.1. Withdrawal. A Member or Associate Member may unilaterally withdraw from this Agreement without causing or requiring termination of this Agreement, effective after the Member has obtained alternative coverage under the Sustainable Groundwater Management Act through another groundwater sustainability agency, and upon sixty (60) days written notice to the Governing Board.

18.2. Involuntary Termination. Upon a determination by the Governing Board that the actions of a Member (i) fail to comply with the terms of this Agreement, or (ii) conflict with or undermine the functioning of the Agency or the preparation and implementation of the GSP, the Governing Board may in its discretion terminate that Member's membership in the Agency, provided that prior to any vote to remove a Member

involuntarily all of the Members shall meet and confer regarding all matters related to the proposed removal. Such an action shall require an affirmative vote pursuant to section 11.3.

18.3. Effect of Withdrawal or Involuntary Termination. To the extent a Member withdraws or is involuntarily terminated from this Agreement and that withdrawal results in a violation of the Act, the remaining Members invoke section 10735.2(e) of the Water Code to ensure any probationary status that results from the withdrawal is limited to the area that is no longer covered by this Agreement. Pursuant to Water Code section 19735.2(e), the remaining Members and the geographic areas managed by these Members will be excluded from any such resulting probationary status.

18.4. Rights of Member to Become GSA in Event of Withdrawal or Termination. Upon withdrawal or involuntary termination of a Member, or termination of this Agreement pursuant to Article 18.66, whether occurring before or after June 30, 2017, the withdrawing or terminated Member will retain all rights and powers to become or otherwise participate in a GSA for the lands within its boundaries. In such event the Agency and its remaining Members (i) shall not object to or interfere with the lands in the withdrawing or terminated Member's boundaries being in a GSA, as designated by the withdrawing or terminated Member or otherwise, (ii) shall facilitate such transition to the extent reasonably necessary, and (iii) shall withdraw from managing that portion of the Subbasin within the boundaries of the withdrawing or terminating Member and shall so notify the California Department of Water Resources.

18.5. Obligations Upon Withdrawal. Any Member who withdraws shall remain obligated to pay its share of all debts, liabilities, and obligations of the Agency incurred or accrued prior to the effective date of such withdrawal, other than debts, liabilities, and obligations incurred pursuant to any Project Agreement to which the withdrawing Member is not a participant. Any payment that has been made by a withdrawing Member and is not obligated toward a debt or liability will be refunded to the Member upon withdrawal.

18.6. Termination of Agency. This Agreement may be rescinded and the Agency terminated by unanimous written consent of all Members, except during the outstanding term of any Agency indebtedness. Nothing in this Agreement shall prevent the Members from entering into other joint exercise of power agreements.

18.7. Disposition of Agency Assets upon Termination.

18.7.1. Surplus Funds. Upon termination of this Agreement, any reserves or surplus money on-hand shall be returned to the Members in the same proportion said Members have funded such reserves or surplus, in accordance with California Government Code section 6512.

18.7.2. Agency Property. The Agency shall first offer any assets of the Agency for sale to the Members on terms and conditions determined by the Governing Board. If no such sale to Members is consummated, the Board shall offer the assets of the Agency for sale to any non-member for good and adequate consideration on terms and conditions determined by the Governing Board.

Article 19. Miscellaneous

19.1. Notices. Notices hereunder shall be sufficient if delivered via electronic mail, First-Class mail or facsimile transmission to the addresses following the Party signature blocks hereafter.

19.2. Bylaws. At, or as soon as practicable after the first Governing Board meeting the Governing Board shall draft and approve Bylaws of the Agency to govern day-to-day operations of the Agency.

19.3. Amendment. This Agreement may be amended at any time, by mutual agreement of the Members, provided that before any amendments shall be operative or valid, it shall be reduced to writing and signed by all Members hereto.

19.4. Severability. If any provision of this Agreement is determined to be invalid or unenforceable, the remaining provisions will remain in force and unaffected to the fullest extent permitted by law and regulation.

19.5. Execution in Counterparts. The Parties intend to execute this Agreement in counterparts. It is the intent of the Parties to hold one (1) counterpart with single original signatures to evidence the Agreement. After the Agreement is executed, each Party shall be delivered an originally executed counterpart with all Party signatures.

IN WITNESS WHEREOF, the Parties hereto execute this Agreement on the last date written beside each Party representative's signature.

Dated: November 28, 2016

CITY OF CERES

By:_____
CHRIS VIERRA, Mayor

ATTEST:

By:_____
Diane Nayares-Perez, City Clerk

Approved as to Form:

By:_____
Tom Hallinan, City Attorney

Joint Powers Agreement
Forming the West Turlock Subbasin Groundwater Sustainability Agency

IN WITNESS WHEREOF, the Parties hereto execute this Agreement on the last date written beside each Party representative's signature.

"City"
City of Hughson

By: _____
Daniel J. Schroeder, City Attorney

Date: 1-10-17

By: _____
Raul Mendez, City Manager

Date: 1-18-17

By: _____
Susana Diaz, Deputy City Clerk

Date: 1-18-17

IN WITNESS WHEREOF, the City of Modesto, a municipal corporation, has authorized the execution of this Joint Powers Agreement forming the West Turlock Subbasin Groundwater Sustainability Agency in duplicate by its City Manager and attestation by its City Clerk under authority of Resolution No. 2016-480, adopted by the Council of the City of Modesto on the 6th day of December, 2016.

CITY OF MODESTO,
a municipal corporation

By _____
JAMES N. HOLGERSSON, City Manager

ATTEST:

By _____
STEPHANIE LOPEZ, City Clerk

(Seal)

APPROVED AS TO FORM:
ADAM U. LINDGREN, City Attorney

By _____
JOSE M. SANCHEZ, Assistant City Attorney

IN WITNESS WHEREOF, the Parties hereto execute this Agreement on the last date written beside each Party representative's signature.

CITY OF TURLOCK

By: _____ Date: 12/14/16

Gary Soiseth
Mayor

CERTIFICATION:

I, Lori R. Martin, City Clerk of the City of Waterford, County of Stanislaus, State of California, do hereby certify, that this is a true and correct copy of Waterford City Council Resolution 2016-100. A Resolution of the City Council of the City of Waterford Approving the Signature of the Joint Powers Agreement and Participation as a member of the West Turlock Sub Basin Groundwater Sustainability Agency, passed and adopted on the 1st day of December, 2016.

DATED: December 6, 2016

Lori R. Martin

Lori R. Martin, MMC
City Clerk

Joint Powers Agreement
Forming the West Turlock Subbasin Groundwater Sustainability Agency

IN WITNESS WHEREOF, the Parties hereto execute this Agreement on the last date written beside each Party representative's signature.

CITY OF WATERFORD

DocuSigned by:
By: Tim Ogden
Tim Ogden
City Manager

Date: 12/2/2016

Joint Powers Agreement
Forming the West Turlock Subbasin Groundwater Sustainability Agency

IN WITNESS WHEREOF, the Parties hereto execute this Agreement on the last date written beside each Party representative's signature.

Delhi County Water District

By: _____ Date: 12/6/16

Jim Clarot
Board President

Joint Powers Agreement
Forming The West Turlock Subbasin Groundwater Sustainability Agency

IN WITNESS WHEREOF, the Parties hereto execute this Agreement on the last date written beside each Part representative's signature.

Denair Community Services District

By: _____ Date November 15, 2016

Ronald C. Allen, Chairman
Denair Community Services District

Joint Powers Agreement
Forming the West Turlock Subbasin Groundwater Sustainability Agency

IN WITNESS WHEREOF, the Parties hereto execute this Agreement on the last date written beside each Party representative's signature.

Hilmar County Water District

By: _____ Date: 12-6-16

Joe Gomes
President of the Board of Directors

I hereby certify that the foregoing resolution was adopted by the Keyes Community Services District Board of Directors at its meeting on November 22, 2016.

AYES: Parker, Bernal, Alexander, Jones, Landers

NOES:

ABSENT:

ABSTENTION:

Johnathon Parker

President, Board of Directors

ATTEST:

Michelle Harris

Michelle Harris

Secretary, Board of Directors

I, Michelle Harris, Secretary of Keyes Community Services District, do hereby certify that the foregoing is a full, true, and correct copy of a resolution of the Keyes Community Services District duly passed and adopted at a regular meeting of the Board of Directors thereof held on the 22nd day of November 2016.

Dated: November 22, 2016

Michelle Harris

Secretary

Keyes Community Services District

Name of Member: County of Merced

By: _____ Date: DEC 6 2016
[Signature]

Name Hubert "Hub" Walsh, Jr.
Title: Chairman

APPROVED AS TO FORM:

By: _____ Date: 12/5/16
[Signature]
Jeffrey B. Grant

Counsel Name: James N. Fincher
Title: Merced County Counsel

IN WITNESS WHEREOF, the Parties hereto execute this Agreement on the last date written beside each Party representative's signature.

COUNTY OF STANISLAUS

By: _____
Vito Chiesa
Chairman of the Board of Supervisors

ATTEST:

By: _____
Elizabeth A. King
Clerk of the Board of Supervisors

APPROVED AS TO FORM:

By: _____
Thomas Boze
~~Deputy~~ County Counsel
Assistant

IN WITNESS WHEREOF, the Parties hereto execute this Agreement on the last date written beside each Party representative's signature.

Stevinson Water District

By: _____ 12/13/16

Jason Jasper
President

Joint Powers Agreement
Forming the West Turlock Subbasin Groundwater Sustainability Agency

IN WITNESS WHEREOF, the Parties hereto execute this Agreement on the last date written beside each Party representative's signature.

TURLOCK IRRIGATION DISTRICT

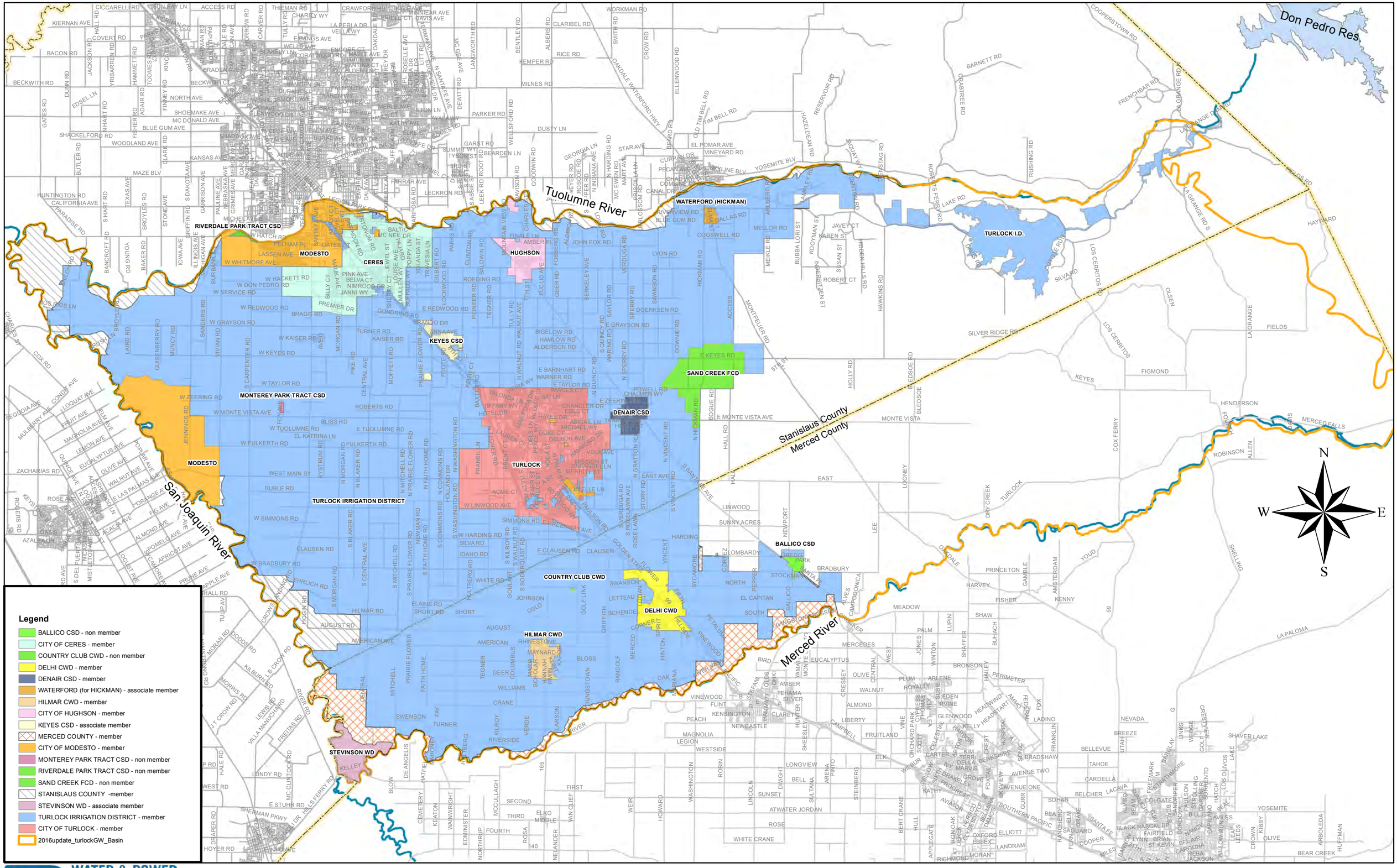
By: Casey Hashimoto Date: 12-8-16

Casey Hashimoto
General Manager

Exhibit A

Members and Associate Members

Agency Name	Membership Status
City of Ceres	Member
City of Hughson	Member
City of Modesto	Member
City of Turlock	Member
Delhi County Water District	Member
Denair Community Services District	Member
Hilmar County Water District	Member
Merced County	Member
Stanislaus County	Member
Turlock Irrigation District	Member
City of Waterford (for Hickman)	Associate Member
Stevinson Water District	Associate Member
Keyes Community Services District	Associate Member



WATER & POWER
Serving Central California since 1887

West Turlock Subbasin Agencies

0 3.5 7 14 Miles

Exhibit B

Exhibit C

Agencies with Authority to Vacate Approval

Agency Name	Membership Status
City of Turlock	Member
Turlock Irrigation District	Member

Exhibit D

Proportional Funding of General Operating Budget

Agency	Membership Status	Acreage (Acres)	Acreage Percentage	Production (AF)	Production Percentage	Average Percentage	Percentage with Multiplier for Urban 25%	Funding Percentage
Turlock Irrigation District	Member	164,627	79.30%	126,565	67.45%	73.37%	69.39%	40.15%
City of Turlock	Member	11,014	5.31%	22,804	12.15%	8.73%	10.91%	40.15%
Stanislaus County	Member	8,393	4.04%	13,091	6.98%	5.51%	5.21%	5.21%
City of Ceres	Member	5,925	2.85%	9,612	5.12%	3.99%	4.98%	4.98%
City of Modesto	Member	8,528	4.11%	1,788	0.95%	2.53%	3.16%	3.16%
Merced County	Member	4,936	2.38%	7,805	4.16%	3.27%	3.09%	3.09%
Delhi CWD	Member	1,582	0.76%	1,725	0.92%	0.84%	1.05%	1.05%
City of Hughson	Member	1,134	0.55%	1,479	0.79%	0.67%	0.83%	0.83%
Denair CSD	Member	669	0.32%	1,507	0.80%	0.56%	0.70%	0.70%
Hilmar CWD	Member	791	0.38%	1,280	0.68%	0.53%	0.66%	0.66%
	TOTAL:	207,598	100.00%	187,655	100.00%	100.00%	100.00%	100.00%

Notes:
1) Members have the obligation to fund their proportional share of the general operating budget per the "Funding Percentage"
2) Turlock Irrigation District and the City of Turlock have an equal proportional share of the general operating budget per the "Funding Percentage"

City of Waterford for Hickman	Associate	148	0.07%	190	0.10%	0.09%
Keyes CSD	Associate	483	0.23%	1,040	0.55%	0.39%
Stevinson WD	Associate	1,101	0.53%	0		

Note:
1) Associate Members have no obligation to fund their proportional share of the general operating budget

Exhibit E

Annual Membership Fees

Agency Name	Membership Status	Annual Fees
City of Ceres	Member	$10,000
City of Hughson	Member	$10,000
City of Modesto	Member	$10,000
City of Turlock	Member	$10,000
Delhi County Water District	Member	$10,000
Denair Community Services District	Member	$10,000
Hilmar County Water District	Member	$10,000
Merced County	Member	$10,000
Stanislaus County	Member	$10,000
Turlock Irrigation District	Member	$10,000
City of Waterford for Hickman	Associate Member	$2,000
Stevinson Water District	Associate Member	$2,000
Keyes Community Services District	Associate Member	$2,000

East Turlock Subbasin Groundwater Sustainability Agency (ETS GSA)
Joint Powers Agreement

This Joint Powers Agreement ("Agreement") is made and entered into by and among the agencies that have executed the Agreement, as identified in Exhibit A, which are referred to herein individually as a "Party" and collectively as "Parties."

Recitals

WHEREAS, each of the Parties to this Agreement is a local government entity with either water supply, water management, or land use responsibilities within Turlock Subbasin (DWR# 5-22.03) and over and within the boundary of its eastern portion known as the East Turlock Subbasin (ETS); and

WHEREAS, pursuant to the Joint Exercise of Powers Act (Chapter 5, commencing with Section 6500 of Division 7 of Title 1 of the California Government Code), two or more public agencies may by agreement jointly exercise any power held in common by agencies entering into such an agreement; and

WHEREAS, on September 16, 2014, Governor Jerry Brown signed into law Senate Bills 1168 and 1319 and Assembly Bill 1739, known collectively as the Sustainable Groundwater Management Act (the Act); and

WHEREAS, the Act went into effect on January 1, 2015; and

WHEREAS, the Act (i) requires sustainable management of certain groundwater basins, (ii) enhances local management of groundwater, (ii) requires local government to establish minimum standards for sustainable groundwater management, and (iv) provides local groundwater agencies with the authority and the technical and financial assistance necessary to sustainably manage groundwater; and

WHEREAS, the Parties intend for the joint powers agency formed pursuant to this Agreement to become the East Turlock Subbasin Groundwater Sustainability Agency (ETS GSA) prior to July 1, 2017 within the boundaries provided in Exhibit B; and

WHEREAS, at or following the first meeting of the ETS GSA, this agency will hold a public hearing and consider a resolution to elect to become a groundwater sustainability agency pursuant to California Water Code section 10723(b); and

WHEREAS, California Water Code section 10720.7 requires all basins designated as high-or-medium priority basins by California Statewide Groundwater Elevation Monitoring program (CASGEM) to be managed under groundwater sustainability plans pursuant to the Act; and

WHEREAS, this joint powers agency's service area overlies portions of the Turlock Subbasin (DWR# 5-22.03), a CASGEM designated medium priority basin; and

WHEREAS, the Parties, acting through and by this Agreement intend to work cooperatively with other groundwater sustainability agencies operating in the Turlock Subbasin to manage the Subbasin in a sustainable fashion pursuant to the requirements set forth in the Act.

WHEREAS, the Parties will endeavor to develop a basin-wide groundwater sustainability plan (GSP) that is as equitable as possible to all Members, considering the respective Members' impact on groundwater sustainability. Further, all Members are committed to working cooperatively to develop a GSP that is focused on allowing Members to operate and continue providing services while achieving sustainability, to the extent feasible.

NOW, THEREFORE, in consideration of the promises, terms, conditions, and covenants contained herein, the Parties hereby agree as follows.

Article 1. Definitions

As used in this Agreement, unless context requires otherwise, the meanings of the terms set forth below shall be as follows:

1.1. "Act" refers to the Sustainable Groundwater Management Act.

1.2. "Agency" means the East Turlock Subbasin Groundwater Sustainability Agency Joint Powers Authority (ETS GSA), which is formed by this Agreement.

1.3. "Agreement" means this Joint Powers Agreement, which creates the ETS GSA joint powers agency.

1.4. "Associate Members" shall mean all parties named in or added per Article 7 of this Agreement. Associate Members may be governmental or non-governmental entities.

1.5 "CASGEM" is the California Statewide Groundwater Elevation Monitoring program administered by the Department of Water Resources.

1.6. "Committee" shall mean any committee established pursuant to Article thirteen (13) of this Agreement.

1.7. "Effective Date" means the date on which the last Party executes this Agreement.

1.8. "Fiscal Year" means July 1 through June 30.

1.9. "Governing Board" means the governing body of the Agency.

1.10. "Board Member" or "Board Members" means members of the Agency's Governing Board.

1.11. "Member's Governing Body" means the Board of Directors or other voting body that controls the individual public agencies that are members of the Agency.

1.12. "Member" means a public entity, including each of the Parties that satisfies the requirements of Article fourteen (14) (Membership) of this Agreement.

1.13. "Special Project" means a project undertaken by some, but not all Members of the Agency.

1.14. "State" means the State of California

1.15. The "ETS GSA" is the anticipated groundwater sustainability agency to be formed by future action of the Agency upon fulfillment of the requirements set forth in California Water Code section 10723.8.

Article 2. Creation of a Separate Entity

2.1. Upon the effective date of this Agreement, the East Turlock Subbasin Groundwater Sustainability Agency Joint Powers Authority (Agency) is hereby created. Pursuant to the provisions of Article I, Chapter 5, Division 7 of Title 1 of the California Government Code, commencing with section 6500, the Agency shall be a public agency separate from its members. The principle offices shall be located at Eastside Water District, P.O. Box 280, Denair, CA 95316, or at such other place as the Governing Board shall determine.

2.2. The boundaries of the Agency shall be generally described as the land overlying the eastern portion of the Turlock Subbasin. This boundary is also generally described as follows: the west boundary being generally the major north-south boundary of the Turlock Irrigation District; the Tuolumne River being the north boundary; the common Stanislaus County Merced County, Tuolumne County, and Mariposa County as generally the east boundary; and the Merced River being the south boundary. Attached hereto and incorporated herein is Exhibit B, a map showing the boundaries of the Agency.

Article 3. Term

3.1. This Agreement shall become effective upon execution by last of each of the Parties and shall continue in full force and effect until terminated pursuant to the provisions of Article 18 (Termination and Withdrawal).

Article 4. Purpose of the Agency

4.1. The purpose of this Agreement is to create a joint powers agency separate from its Members that will elect to be the Groundwater Sustainability Agency for the eastern portion of the Turlock Subbasin, as further defined in Article 2, Section 2.2.

4.2. To collaborate with other groundwater sustainability agencies within the Turlock Subbasin to develop, adopt, and implement a single Groundwater Sustainability Plan for the Turlock Subbasin in order to implement the Act's requirements and achieve the sustainably goals as outlined in the Act.

4.3. To involve the public and area stakeholders through outreach and engagement in developing, implementing, monitoring, and administering a single groundwater sustainability plan for the Turlock Subbasin.

4.4. To coordinate and cooperate with other neighboring Groundwater Sustainability Agencies operating in or adjoining to the Turlock Subbasin in order to meet the sustainability requirements outlined in the Act.

Article 5. Powers of the Agency

5.1. Powers. The Agency is hereby authorized, in its own name, to do all acts necessary for carrying out the purposes of this agreement. Upon successfully electing to be a Groundwater Sustainability Agency, the Agency is hereby authorized to exercise the common powers of its members and all additional powers granted to Groundwater Sustainability Agencies in the Act.

5.2. The Agency shall not have the power to bind any Member to any monetary obligation whatsoever by this Agreement other than that authorized by the Members per this Agreement.

5.3. The Agency and all of its Members confirm that nothing contained herein shall grant the Agency any power to alter or impose an obligation of any kind on any water right, contract right, or any similar right held by its Members, or amend or obligate a Member's water delivery practice, course of dealing, or conduct without the express consent of the holder thereof.

Article 6. Agency Governing Board

6.1. Membership of Governing Board. The Agency shall be governed by a Governing Board consisting of one (1) Board Member representing each Member, except for Associate Members, which have no seat on the Governing Board.

6.2. Requirements. The Board Members may be directors, officers, appointments, or employees of the Members. Each Board Member shall certify to the Secretary in writing that he or she has been appointed to be a Board Member by the Member and that he or she meets the qualifications established by this section 6.2.

6.3. Alternate Board Member. Each Member may appoint one Alternate Board Member for each Board Member it appoints. Alternate Board Members shall have no vote if the Board Member is present. If the Board Member is not present, the Alternate Board Member appointed by the Member to act in his/her place may cast a vote.

6.4. Removal of Board Members. Board Members and Alternate Board Members serve at the pleasure of their respective Members and may be removed or replaced at any time. Upon removal of a Board Member, the Alternate Board Member shall serve as Board Member until a new Board Member is appointed by the Member. A replacement should be appointed to fill the unexpired term of the previous Board Member within ninety (90) days of the date that such position becomes vacant. Members must submit any changes in Board Member or Alternate Board Member positions to the Secretary in writing and signed by the Member.

6.5. Terms of Office. The term of office for each Member of the Agency's Governing Board is four (4) years. For the purpose of providing staggered terms of office, the term of the initial representatives appointed by Eastside Water District and Ballico-Cortez Water District shall be for a period of two (2) years. The term of office for each representative appointed by all other parties shall be for a period of four (4) years.

Article 7. Associate Members

7.1. Associate Member. The Governing Board may accept associate members to the Agency. Associate Members shall have a specific defined interest in the Act within the boundaries of the ETS GSA acceptable and as determined by the Governing Board. Associate Members shall be entitled to participate in the meetings and discussions of the Governing Board but Associate Members shall not have the power to vote on any action to be taken by the Agency or to become an officer of the Agency. Any Member that is not able or chooses not to fund its proportional share of the budget may be eligible to become an Associate Member.

7.2. Bound by Agency Decisions. Associate Members, regardless of lack of voting authority, may be bound by the decisions and actions of the Governing Board on behalf of the Agency.

7.3. Removal or Addition of Associate Members. The Governing Board may remove any Associate Member or appoint any associate member upon an affirmative vote from three quarters of Board Members.

Article 8. Officers

8.1. Officers. The Governing Board shall select a Chair, Vice-Chair, Secretary, and any other officers as determined necessary by the Governing Board. The Secretary of the Board is not required to be a member of the Governing Board, but instead, can be a member of the staff of one of the Members.

8.1.1. The Chair shall preside at all Governing Board Meetings.

8.1.2. The Vice-Chair shall act in place of the Chairman at meetings should the Chairman be absent.

8.1.3. The Secretary shall be responsible for minutes of all meetings of the Governing Board and assure that a copy of the minutes is provided to each member and alternate of the Governing Board.

8.1.4. All Officers shall be chosen at the first Governing Board meeting and serve a term for two (2) years. An Officer may serve for multiple consecutive terms. Any Officer may resign at any time upon written notice to the Chair.

Article 9. Treasurer, Controller, and Legal Counsel

9.1. Treasurer and Controller. The Agency Governing Board shall appoint one of its members to act as treasurer and controller for the Agency. The controller of the Agency shall cause an independent audit of the Agency's finances to be made by a certified public accountant in compliance with California Government Code section 6505. The treasurer of the Agency shall be the depositor and shall have custody of all money of the Agency from whatever source. The controller of the Agency shall draw warrants and pay demands against the Agency when the demands have been approved by the Agency or any authorized representative pursuant to any delegation of Agency adopted by the Agency. The Treasurer and Controller shall comply strictly with the provisions of statutes relating to their duties found in Chapter 5 (commencing with section 6500) of Division 7 if Title 1 of the California Government Code.

9.2. Legal Counsel. The Governing Board shall appoint legal counsel as it deems appropriate.

Article 10. Executive Director

10.1. Appointment. The Governing Board may hire an Executive Director who shall be compensated for his or her services, as determined by the Governing Board.

10.2. Duties. The Executive Director shall be the chief administration officer or the Agency, shall serve at the pleasure of the Governing Board, and shall be responsible to the Governing Board for the proper and efficient administration of the Agency. The Executive Director shall have the powers designated in the Agency Bylaws.

10.3. Staff. The Executive Director shall employ such additional full-time and or part-time employees, assistants, and independent contractors that may be necessary from time to time to accomplish the purposes of the Agency, subject to the approval of the Governing Board.

10.4 Staffing Provided by Members. Members may provide Agency staff on a voluntary or reimbursement basis, subject to Governing Board approval.

Article 11. Governing Board Voting

11.1. Quorum. A majority of the Board Members shall constitute a quorum for purposes of transacting business. In the absence of a quorum, any meeting of the Board may be adjourned from time to time by a majority present, but no other business may be transacted.

11.2. Approval Requirements. Except as provided in sections 11.3 and 11.4 below, action of the Board shall require the affirmative vote of a majority of Board Members voting.

11.3. Approval of High Threshold Matters. Action of the Board on high threshold matters, which include the annual budget, approval of any bond or debt instrument, approval of a contract exceeding $100,000 , approval of Membership, approval of a groundwater sustainability plan, involuntary termination, Exhibit D, approval of extraction limitation for any Member or category of membership, imposition of fees and assessments, and revision of weighted voting proportions, shall require the affirmative vote of at least two-thirds of the voting Members.

11.4. Option for Approval by Weighted Vote. Notwithstanding section 11.2 or 11.3, any Board Member counted as constituting a quorum may demand that approval of any matter be subject to additional approval by weighted voting. Such a demand may be made prior to or after the Board votes on an item. If the demand is made after a vote of the Board pursuant to section 11.2, the demand must be made prior to adjournment of the meeting in which the vote took place. The effect of the demand on the vote is to nullify the Board action and vote, until such time as the action is approved by weighted vote, if ever.

11.5. Weighted Vote. Each Board Member's weighted vote is set forth in Exhibit C. Exhibit C will be reviewed and updated at the end of each calendar year, or when demanded by any voting Member.

11.6. Approval by Weighted Voting. After a demand for weighted voting is invoked, pursuant to section 11.4, action of the Board shall require the affirmative vote of: (1) a majority weighted vote of Board Members voting on the item; AND (2) a majority of Board Member votes that are voting on the item, pursuant to section 11.2 or 11.3.

Article 12. Agency Meetings

12.1. Initial Meeting. The initial meeting of the Agency's Governing Board shall be called by Eastside Water District and held in either Stanislaus or Merced County, California within sixty days of the effective date of this Agreement. A public hearing, pursuant to California Water Code section 10723(b) may be held at this meeting. A draft resolution forming the ETS GSA will be presented as an action item at this meeting.

12.2. Time and Place. The Governing Board shall meet at least quarterly at a time and place set by the Governing Board, and at such other times as determined by the Governing Board.

12.3. Conduct. All meetings of the Governing Board shall be noticed, held, and conducted in accordance with the Ralph. M. Brown Act to the extent applicable. Board Members and

Alternate Board Members may use teleconferencing in connection with any meeting in conformance with and to the extent authorized.

Article 13. Committee Formation

13.1. Internal Committee Formation. There may be established such internal committees as the Governing Board shall determine from time to time. Each such internal committee shall be comprised of representatives of the Members and/or Associate Members, shall exist for the term specified in the action establishing the committee, shall meet as directed by the Governing Board, and shall make recommendations to the Governing Board on the various activities of the Agency. The Governing Board may delegate authority to the internal committee to administer or implement Agency activities.

13.2. External Advisory Committee Formation. The Governing Board may establish one or more advisory committees comprised of diverse social, cultural, and economic elements of the population and area stakeholders within the Agency's boundary. The Governing Board shall encourage the active involvement of the advisory committee(s) prior to and during the development and implementation of the Groundwater Sustainability Plan. The Governing Board will ensure that at least one (1) member from the Governing Board or Agency employee attends and participates in each advisory committee meeting.

Article 14. Membership

14.1. Initial Members. The initial Members of the Agency shall be the Parties hereto and listed in Exhibit A, as long as they have not, pursuant to the provisions thereof, withdrawn from this Agreement in accordance with the terms thereof.

14.2. New Members. Additional Parties may join this Agreement and become a Member provided that the prospective new member, (a) is eligible to join a Groundwater Sustainability Agency as provided by the Act, (b) possesses powers common to all other Members, (c) receives an affirmative vote from a majority of Board Members, (d) pays all previously incurred costs that the Governing Board determines have resulted in benefit to their agency, (e) pays all applicable fees and charges, and (f) agrees in writing to the terms and conditions of this Agreement.

14.3. Associate Member Conversion to Full Membership. Associate Members may become full voting Members of the Agency upon (a) affirmative vote from a majority of Board Members, (b) payment of all previously incurred costs that the Governing Board determines have resulted in benefit to the Associate Member and have not yet been paid, and (c) agreement to the terms of Governing Board members in this Agreement.

Article 15. Specific Projects

15.1. Projects. The Agency intends to carry out activities in furtherance of its purposes and consistent with the powers established by the Agreement with the participation of all Members.

15.2. Member Specific Projects. In addition to the general activities undertaken by all Members of the Agency, the Agency may initiate specific projects or litigation that involves less than all Members. No Member shall be required to be involved in a Project that involves less than all the Members.

15.3. Project Agreement. Prior to undertaking any project or litigation that does not involve all Member Agencies, the Members electing to participate in the Project shall enter into a Project Agreement. A Member may elect not to participate in a specific project or litigation matter by providing notice and not entering into the Project Agreement specific to the matter in which the Member has elected not to participate. Each Project Agreement shall provide the terms and conditions by which the Members that enter into the Project Agreement will participate in the Project. All assets, rights, benefits, and obligations attributable to the Project shall be assets, rights, benefits, and obligations of those Members which have entered into the Project Agreement. Any debts, liabilities, obligations, or indebtedness incurred by the Agency in regard to a particular Project shall be the debts, liabilities, obligations, and indebtedness of those Members who have executed the Project Agreement in accordance with the terms thereof and shall not be the debts, liabilities, obligations, and indebtedness of those Members who have not executed the Project Agreement. Further, to the extent the Project is litigation, the Members who have not entered into the Project Agreement shall not be named or otherwise listed in the pleadings and/or appear on litigation materials.

15.4. Governing Board Approval. The Governing Board shall have the authority to disapprove any Project Agreement upon a determination that the Project Agreement has specific, substantial adverse impacts upon Members that have not executed the Project Agreement.

Article 16. Budget and Expenses

16.1. General Operating Budget. The Governing Board shall approve an initial budget at its first meeting and an annual budget before the beginning of each fiscal year thereafter. The general operating budget shall be funded by the Parties in the proportion designated in Exhibit D. Whenever the proportion of funding changes, the allocation shall take effect the fiscal quarter after the revision to Exhibit D is finalized.

16.2. Membership Annual Fees. Members shall pay annual membership fees as set forth in Exhibit E, which may be updated from time to time by the Governing Board at the beginning of the Agency's fiscal year.

16.3. Reserve Funds. Membership annual fees shall be deposited in the Agency's general operating fund. This fund shall have a reserve maximum that is established as part of the annual budget process. If the maximum reserve is met, the Agency shall not continue to collect annual fees in excess of the reserve, but will proportionally credit the funding agencies and waive collection of membership annual fees, or a portion thereof, in order to not exceed the reserve.

16.4. Special Project Funding. For projects in which not all Members participate or that are not otherwise funded by the general operating budget, the Members participating in the project shall agree to allocate funding prior to beginning the project.

16.5. Agency Contributions. Each of the Parties may, but are not required to, contribute additional money, office space, furnishings, equipment, supplies, or services as their respective Governing Boards may deem appropriate.

16.6. Grants and Other Funding. Funds may also be derived through State and Federal grants, or other available sources. The Agency may also apply for available State and Federal funds and shall make new and additional applications from time to time as appropriate. The Agency may also establish and collect various fees, leases, or rents as may be authorized by law under the common powers of all the Parties.

16.7. Public and Private Donations. The Agency may accept and expend funds from public or private sources subject to the legal restrictions which are set forth in the common powers of the Parties for the purpose of carrying out its powers, duties, responsibilities, and obligations specified in this Agreement.

16.8. Budget Consistency. The Agency shall be limited to the making of expenditures or incurring of liabilities in the amount of the appropriations allowed by the budget as adopted and revised by the Agency.

16.9. Scope of Budget and Expenses. The General Operating Budget of the Agency will be limited to covering costs of operating the Agency pursuant to this Agreement. However, as will be more fully developed and set forth in the groundwater sustainability plan, the Agency does not anticipate the General Operating Budget as funded by weighted voting shares will be required or responsible for funding specific sustainability implementation projects or programs that will be implemented in geographic regions specific to individual Members. Rather, this Agreement anticipates that implementation of sustainability programs will be funded by the specific Member(s) that are responsible for implementing such actions in their respective local service area or geographic region. After the development of the groundwater sustainability plan, the General Operating Budget will only be responsible for funding general Agency operation; it will not fund the implementation of the groundwater sustainability plan.

Article 17. Liability and Indemnification

17.1. Liability. In accordance with California Government Code section 6508.1, the debts, liabilities, and obligations of the Agency shall be the debts, liabilities, and obligations of the Agency alone, and not the Members.

17.2. Indemnification. The members of the Governing Board, officers, and employees of the Authority shall use ordinary care and reasonable diligence in the exercise of their powers, and in the performance of their duties pursuant to this Agreement. They shall not be liable to the parties

to this agreement for any mistake of judgment or any other action made, taken, or omitted by any agent, employee, or independent contractor selected with reasonable care, nor for loss incurred through the investment of the Agency's funds, or failure to invest the same.

17.3. To the extent authorized under California law, no Board Member, officer, or employee of the Agency shall be responsible for any action made, taken, or omitted, by any other Board Member, officer or employee. The Agency shall further hold harmless and indemnify the Members and Associate Members, including their officers and employees, from any claim or liability arising from acts or omissions of the Agency within the scope of this Agreement.

17.4. The funds of the Agency shall be used to defend, indemnify, and hold harmless the Agency and any Board Member, officer, or employee of the Agency for actions taken in good faith and within the scope of his or her authority. Nothing herein shall limit the right of the Authority to purchase insurance or to create a self-insurance mechanism to provide coverage for the foregoing indemnity.

Article 18. Withdrawal and Termination

18.1. Withdrawal. A Member may unilaterally withdraw from this Agreement without causing or requiring termination of this Agreement, effective upon sixty (60) days written notice to the remaining Members.

18.2. Effect of Withdrawal. A Member may unilaterally withdraw from this Agreement without causing or requiring termination of this Agreement, effective upon sixty (60) days written notice to the remaining Members. Upon withdrawal, a Member agrees that it has a continuing obligation to comply with the Act and shall, if prior to June 30, 2017, and prior to the ETS GSA becoming an exclusive GSA, notify DWR that it shall act as its own GSA or join an alternate GSA that has entered into or will enter into a Coordination Agreement with the Agency in order to avoid an adverse effect upon the continuing Members. Until July 1, 2017, either Merced County or Stanislaus County may also elect to cover the area of the withdrawing Member. If after July 1, 2017, that withdrawing Member shall remain subject to the terms of the GSP that is prepared by the Agency so as to not put the Turlock Subbasin in jeopardy, unless a mutually agreed upon resolution is reach between the ETS GSA, DWR, and the withdrawing Member. This obligation shall survive withdrawal from this Agreement, is for the express benefit of the remaining Members, and is subject to the indemnification provisions of Section 17.2 of this Agreement. A withdrawing Member shall in all events remain liable for its proportionate share of (i) the amount of any fiscal year budget approved prior to the date the withdrawing Member provides its notice of withdrawal; and (ii) any call for funds or assessment levied by the Authority prior to the date the withdrawing Member provides its notice of withdrawal.

18.3. Termination of Agency. This Agreement may be rescinded and the Agency terminated by unanimous written consent of all Members, except during the outstanding term of any Agency indebtedness. Nothing in this Agreement shall prevent the Members from entering into other joint exercise of power agreements.

18.4. Disposition of Agency Assets upon Termination.

18.4.1. Surplus Funds. Upon termination of this Agreement, any reserves or surplus money on-hand shall be returned to the Members in the same proportion said Members have funded such reserves or surplus, in accordance with California Government Code section 6512.

18.4.2. Agency Property. The Agency shall first offer any assets of the Agency for sale to the Members on terms and conditions determined by the Governing Board. If no such sale to Members is consummated, the Board shall offer the assets of the Agency for sale to any non-member for good and adequate consideration on terms and conditions determined by the Governing Board.

Article 19. Miscellaneous

19.1. Notices. Notices hereunder shall be sufficient if delivered via electronic mail, First-Class mail or facsimile transmission to the addresses following the Party signature blocks hereafter.

19.2. Bylaws. At, or as soon as practicable after the first Governing Board meeting the Governing Board shall draft and approve Bylaws of the Agency to govern day-to-day operations of the Agency.

19.3. Amendment. This Agreement may be amended at any time, by mutual agreement of the Members, provided that before any amendments shall be operative or valid, it shall be reduced to writing and signed by all Members hereto.

19.4. Severability. If any provision of this Agreement is determined to be invalid or unenforceable, the remaining provisions will remain in force and unaffected to the fullest extent permitted by law and regulation.

19.5. Execution in Counterparts. The Parties intend to execute this Agreement in counterparts. It is the intent of the Parties to hold one (1) counterpart with single original signatures to evidence the Agreement and to thereafter forward other original counterparts on a rotating basis for all signatures. Thereafter, each Party shall be delivered an originally executed counterpart with all Party signatures.

IN WITNESS, WHEREOF, the Parties hereto execute this Agreement on the last date written beside each Party representative's signature.

Note: The remaining pages of this Agreement consist of five (5) signature pages; one from each of the Members, and five (5) Exhibit pages; one for each of the Exhibits (A through E).

IN WITNESS WHEREOF, the Parties hereto execute this Agreement on the last date written beside each Party representative's signature.

COUNTY OF STANISLAUS

By: _____
Vito Chiesa
Chairman of the Board of Supervisors

ATTEST:

By: _____
Elizabeth A. King
Clerk of the Board of Supervisors

APPROVED AS TO FORM:

By: _____
Thomas Boze
~~Deputy~~ Assistant County Counsel

IN WITNESS WHEROF, the Parties hereto execute this Agreement on the last date written beside each Party representative's signature.

Merced Irrigation District

By: _____ Date: 3/30/17
John Sweigard, General Manager

Name of Member: County of Merced

By: _____ Date: FEB 2 1 2017
[Signature]

Name Daron McDaniel
Title: Chairman

APPROVED AS TO FORM:

By: _____ Date: 2/17/17
[Signature] Jeffrey B. Grant

Counsel Name: James N. Fincher
Title: Merced County Counsel

IN WITNESS WHEROF, the Parties hereto execute this Agreement on the last date written beside each Party representative's signature.

Eastside Water District

By: _____ Date: 3-7-17

Al Rossini, President

IN WITNESS WHEROF, the Parties hereto execute this Agreement on the last date written beside each Party representative's signature.

Ballico-Cortez Water District

By: Dirk Ulrich

Dirk Ulrich, President

Date: 12-21-16

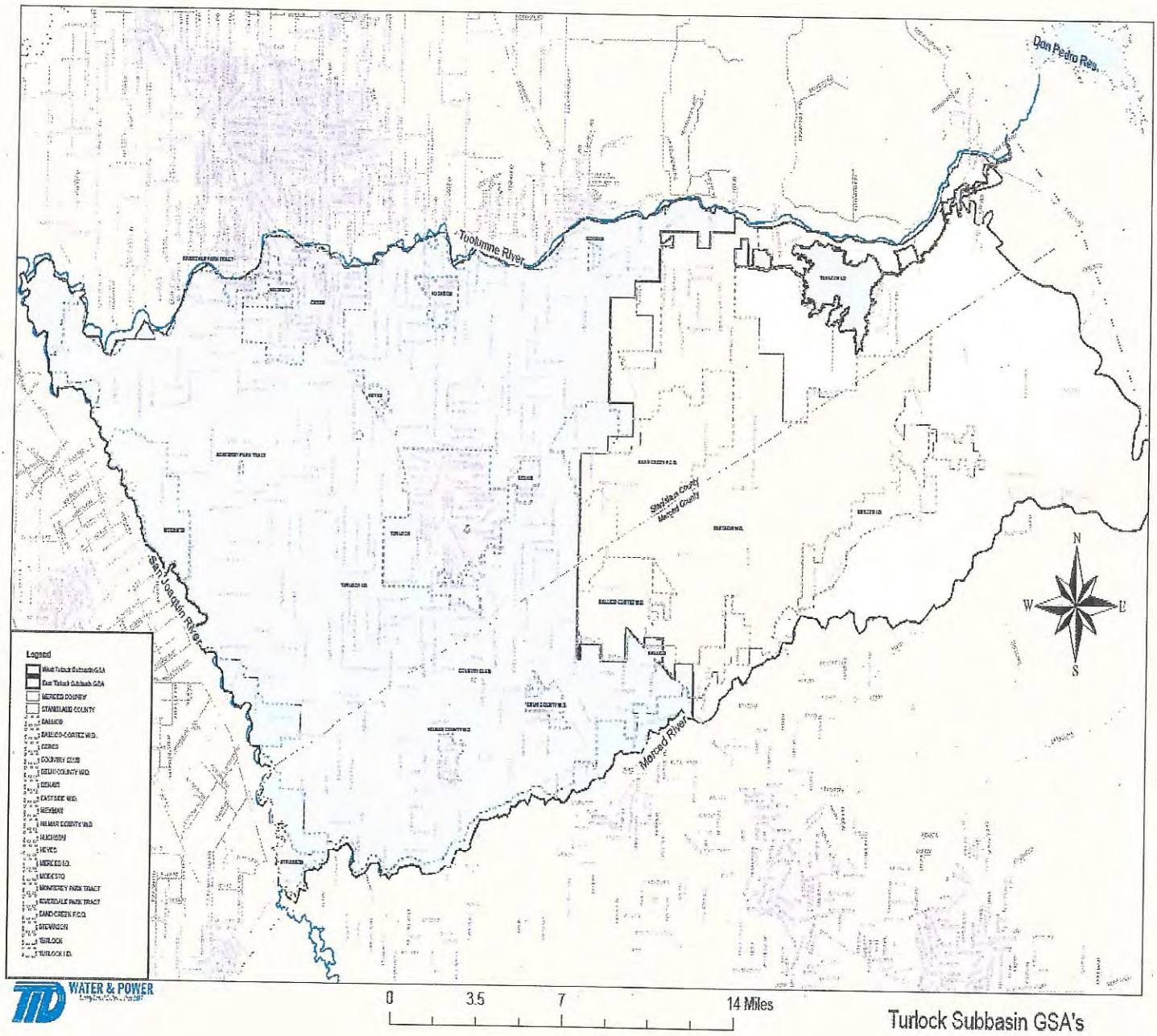
Exhibit A

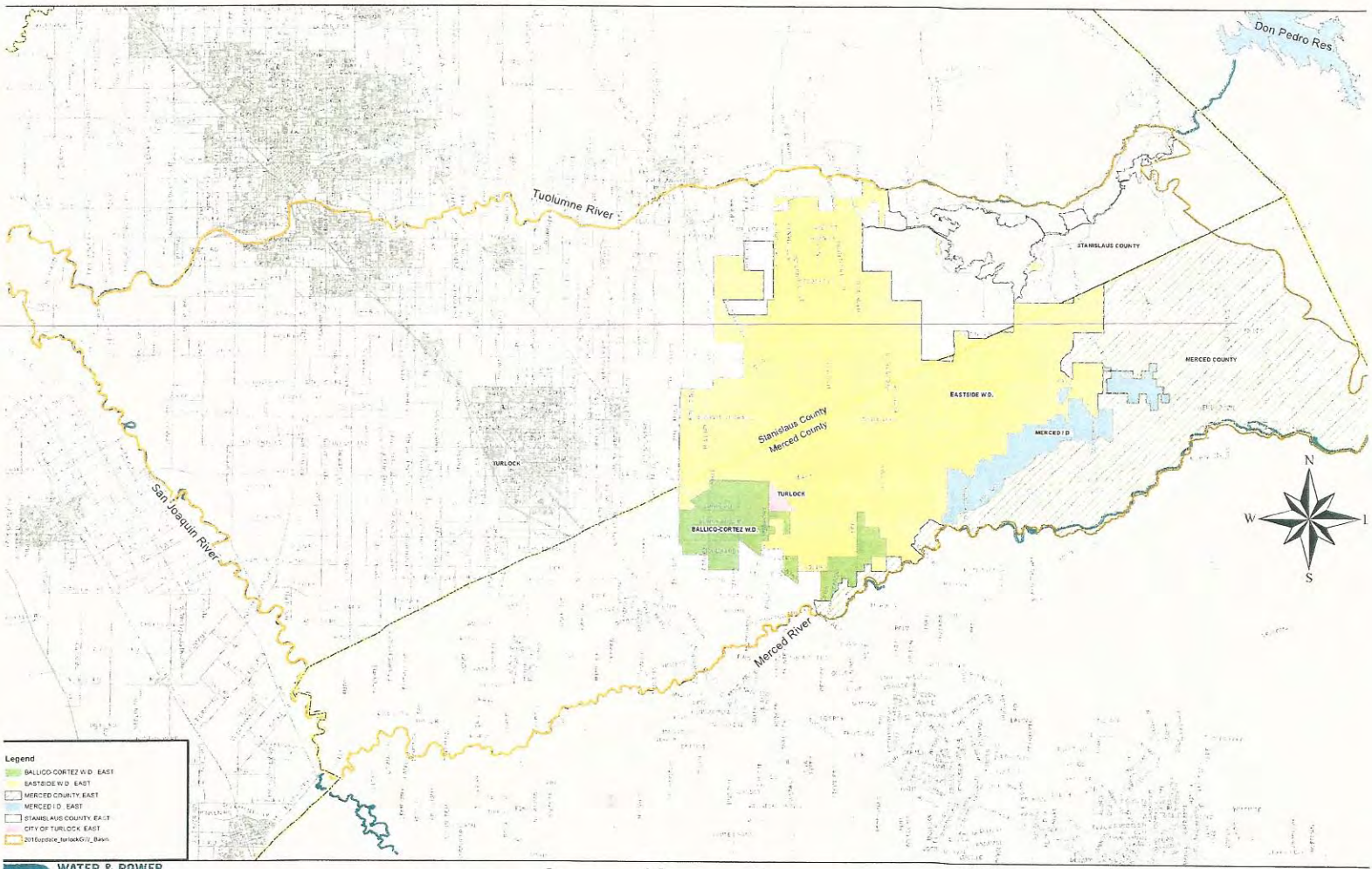
Members and Proposed Associate Members

Name	Membership Status
Ballico-Cortez Water District	Member
Eastside Water District	Member
Merced County	Member
Merced Irrigation District	Member
Stanislaus County	Member
City of Turlock	Proposed Associate Member
Eastside Water Quality Coalition	Proposed Associate Member
Sand Creek Flood Control District	Proposed Associate Member

Exhibit B

ETS GSA Boundary Map





WATER & POWER

East Turlock Subbasin Agencies

0 3.5 7 14 Miles

Exhibit B

Exhibit C

ETS GSA Initial Proposed Vote Weighting

East Turlock Subbasin Groundwater Sustainability Agency (ETS GSA) Member	Production Per TGBA Roadmap (12/15/16)	Percentage of ETS GSA Weighted Vote
Ballico Cortez WD	**20,197**	**6.62 %**
Eastside WD	**164,696**	**53.95%**
Merced County	**77,765**	**25.47%**
Merced ID	**118**	**0.04%**
Stanislaus County	**45,524**	**13.93%**
TOTAL	**305,300**	**100%**

Exhibit D

ETS GSA Proportional Funding of General Operating Budget

Member	Production (AF)	Production Percentage	Funding Percentage
Ballico Cortez WD	20,197	6.62%	6.62%
Eastside WD	164,696	53.95%	53.95%
Merced County	77,765	25.47%	25.47%
Merced ID	118	0.04%	0.04%
Stanislaus County	45,524	13.93%	13.93%
TOTAL	305,300	100%	100%

Exhibit E

ETS GSA Annual Membership Fees

Member	Annual Membership Fee (%)	Fee Based on $25,000 Budget ($)
Ballico Cortez WD	6.62	1,422
Eastside WD	53.95	12,242
Merced County	25.47	6,999
Merced ID	0.04	503
Stanislaus County	13.93	3,833
TOTAL	100	25,000

BYLAWS FOR THE

WEST TURLOCK SUBBASIN GROUNDATER SUSTAINABILITY AGENCY

ADOPTED

JUNE 1, 2017

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PREAMBLE

These Bylaws are adopted and effective as of June xxx, 2017, pursuant to the Joint Powers Agreement of the WEST TURLOCK SUBBASIN GROUNDATER SUSTAINABILITY AGENCY (Agreement).

ARTICLE 1. THE AGENCY

1.1 NAME OF AGENCY. The name of the Agency created by the Agreement shall be the West Turlock Subbasin Groundwater Sustainability Agency (Agency).

1.2 OFFICE OF AGENCY. The principal physical office of the Agency shall be at the Turlock Irrigation District, 333 E. Canal Drive, Turlock, CA 95380, and the principal mailing address shall be at Turlock Irrigation District, P O Box 949, Turlock, CA 95381, or at such other location as the Board may designate by resolution.

1.3 POWERS. The powers of the Agency shall be as set forth in Article 5 of the Agreement.

ARTICLE 2. BOARD OF DIRECTORS

2.1 BOARD OF DIRECTORS. The Agency shall be governed by a Board of Directors (Board) as set forth in Article 6 of the Agreement.

2.2 PROCEDURE FOR APPOINTMENT OF BOARD MEMBERS

2.2.1 Appointment. Each Member Agency is responsible for appointing a Board Member and an Alternate Board Member, pursuant to its own procedures and authorities.

2.2.2 Notification. Each Member shall notify the Agency when it appoints or changes its Board Member and/or Alternate Board Member.

ARTICLE 3. BOARD MEETINGS

3.1 MEETINGS. The Board shall hold at least one (1) regular meeting each calendar quarter, or as often as the Board deems necessary, as set forth in the resolution establishing the regular board meeting dates, at 6:00 PM, at Turlock Irrigation District, 333 E. Canal Drive, Turlock, CA

95380, or as set forth in the meeting agenda. Special meetings of the Board may be called by the Chair or any four directors by written request. Board meetings shall be conducted in compliance with all applicable laws, and as further specified herein. Meeting agendas shall be posted in compliance with the requirements of the Ralph M. Brown Act.

3.2 QUORUM. In determining a quorum as defined by Section 11.1 of the Agreement, Alternate Directors attending meetings shall not be counted as part of any meeting quorum unless such Alternate Director is formally representing an absent appointed Director.

3.3 ORDER OF BUSINESS. In general, at the regular meetings of the Board, the following will be the order of business:

3.3.1 Call to Order.

3.3.2 Roll Call.

3.3.3 Approval of Minutes of the Previous Meeting.

3.3.4 Public Comment Period.

3.3.5 Staff Updates.

3.3.6 Agenda Items, including any appropriate combination of consent items, regular business items, public hearing items or closed session items.

3.3.7 Comments from the Board.

3.3.8 Adjournment.

3.4 ACTION BY THE BOARD. Action by the Board on all resolutions or ordinances shall be taken using a roll- call vote and shall be recorded in writing, signed by the Chair, and attested to by the Secretary. All other actions of the Board shall be by motion recorded in written minutes. The Chair shall announce the results of the vote including the names of the Directors, if any, voting in the minority.

3.5 RULE OF ORDER. All rules of order not otherwise provided for in these Bylaws shall be

determined, to the extent practicable, in accordance with "Rosenberg's Rules of Order;" provided, however, that no action of the Board shall be invalidated or its legality otherwise affected by the failure or omission to observe or follow "Rosenberg's Rules of Order."

ARTICLE 4. OFFICERS

4.1 OFFICERS. The Officers of the Agency are the Chair, Vice-Chair, and Secretary, as provided for in Article 8 of the Agreement. All Directors are eligible to serve as an Officer. The Chair and the Vice Chair must be Directors.

4.2 ELECTION OF OFFICERS. At the first meeting of the Board, nominations for the Officers will be made and seconded by a Director. If more than two (2) Directors are nominated for any one office, voting occurs until a nominee receives a majority of the votes cast. The initial term of the elected Officers shall run from the date of their election to until the Board meeting two years after the election. Thereafter, each Officer shall serve a term of two (2) years. An Officer may succeed himself/herself and may serve any number of consecutive or non-consecutive terms.

4.3 REMOVAL OF OFFICERS. An Officer may be removed, with or without cause, by a majority vote of the Board at a regular or special meeting.

4.4 VACANCIES. Any vacancy in the offices because of death, resignation, removal, disqualification, or any other cause will be filled for the balance of the vacated term in the manner prescribed in these Bylaws for appointments to that office; provided, however, that such vacancies may be filled at any regular or special meeting of the Board.

4.5 RESIGNATION OF OFFICERS. Any Officer may resign at any time by giving written notice to the Board Chair or Secretary. Any resignation takes effect at the date of the receipt of that notice or at any later time specified in that notice. Unless otherwise specified in that notice, the acceptance of the resignation is not necessary to make it effective.

4.6 RESPONSIBILITIES OF OFFICERS.

4.6.1 Chair of the Board. The Chair of the Board shall preside at meetings of the Board and exercise and perform such other powers and duties as may be assigned to him/her by the Board or prescribed by these Bylaws. The Chair shall have the power to enforce

meeting decorum and rules of order consistent with Rosenberg's Rules of Order, unless overruled by a majority of the Board.

4.6.2 Vice-Chair of the Board. The Vice-Chair of the Board shall fulfill all the duties of the Chair in his/her absence and exercise and perform such other powers and duties as may be assigned to him/her by the Board.

4.6.3 Secretary. The Secretary shall perform duties assigned by the Board, such duties shall include, but not be limited to, the following:

i. Book of Minutes. Keep or cause to be kept, at the principal executive office of the Agency or such other place as the Board may direct, a book of minutes of all meetings and actions of Directors and Committees of the Agency, with the time and place of holding the meeting, whether regular or special, and, if special, how authorized, the notice given, the names of those present and absent at such meetings and the proceedings of such meetings. Minutes will be in the form of Action Minutes and a meeting summary.

ii. Notices and Other Duties. Prepare, give, or cause to be given, notice of, and agendas for, all meetings and/or hearings of the Board and committees of the Agency.

iii. Exercise and perform such other powers and perform such other duties as may be assigned to him/her by the Board.

ARTICLE 5. BOARD COMMITTEES, WORKING GROUPS, AND ADVISORY COMMITTEES

5.1 BOARD COMMITTEES. The Board may establish temporary or permanent Board Committees composed entirely of Directors to facilitate the conduct of its work. Temporary Board Committees will have a specific charge and operational duration not to exceed six months and are not subject to the Brown Act unless they include more than six Directors as Committee members. Permanent Committees will be given a specific role and regardless of the number of Directors appointed shall be subject to compliance with the Brown Act. All Board Committees will provide regular updates to the full Board about their activities and the progress of their work.

5.2 WORKING GROUPS. Informal working groups may be formed from time to time to provide opportunities for a small subset of Directors to work with staff on specific planning, analytical, or community engagement activities. Such working groups will have a defined area as the focus for its work and may function for a duration of up to six months, and may include such membership as needed to accomplish the objectives for which the working group was created.

5.3 ADVISORY COMMITTEES. Pursuant to Section 13 of the Agreement, the Board may establish one or more advisory committees to assist in carrying out the purposes and objectives of the Agency.

5.3.1 In establishing an Advisory Committee, the Board shall provide specific direction to the Committee as to its charge, expected duration for completion of its charge, and a summary of the resources, including staff or consultant support available to the Committee in performing its work.

5.3.2 Advisory Committee membership and appointments shall be at the Board's discretion based on creating the membership needed to meet the purpose for which the Advisory Committee was created.

5.3.3 Any advisory committee shall exercise such powers as may be delegated to it, except that no committee may:

i. Take any final action on matters which, under the Agreement, require approval by a majority vote of the Board;

ii. Amend or repeal the Bylaws or adopt new Bylaws;

iii. Amend or repeal any resolution of the Board; or

iv. Appoint any other committees of the Board or the members of these committees.

5.3.4 Advisory committees shall meet at the call of their respective committee chairs. All advisory committee meetings shall be conducted in accordance with the Ralph M. Brown Act (California Government Code sections 54950 et seq.). Minutes of committee

meetings shall be recorded and upon approval shall be distributed to the Board.

ARTICLE 6. AGENCY ADMINISTRATION, MANAGEMENT AND STAFFING

6.1 COLLABORATIVE MANAGEMENT. Except for the Agency's Treasurer function, Agency administration and management will be conducted using a collaborative staffing model in which the professional and technical staff of the member agencies work together to provide staff leadership, management and administration of the agency.

6.1.1 Staffing Support for Agency Officers and Board Members. Staff will work together to provide support for the Agency Officers and Board members. Board agenda and meeting materials will generally be prepared by or reviewed by one or more members of the staff prior to being finalized. Should member agency staff not be in agreement on any topic, the Agency Board Chair and Vice-Chair will be consulted to provide the necessary direction. Any issue not resolvable by staff and the Agency Board Chair and Vice-Chair will be referred to the full Board for decision.

6.1.2 Staffing for Development of GSA and GSP. Both staff from the Agreement member agencies and other professional and technical staff from the member agencies will be involved in providing staff support for the Agency. In addition, to the extent the Agency decides necessary, it may hire outside consultants and/or employ staff.

6.2 EXECUTIVE DIRECTOR. The Executive Director shall be the chief administration officer of the Agency and shall be responsible for the proper and efficient administration of the Agency. Subject to such supervisory powers as may be given by the Board, the Executive Director generally supervises, directs, and controls the business and the employees of the Agency.

6.2.1 Duties of the Executive Director. The Executive Director shall 1) bring pertinent issues to the attention of the Board; 2) prepare and present a proposed budget to the Board and control the approved budget; 3) appoint, direct and remove employees of the Agency; 4) implement and manage contracts and agreements approved by the Board; and 5) perform such other and additional duties as assigned by the Governing Board.

6.2.2 Executive Director Powers. He or she has such other powers and duties as may be prescribed by the Board or these Bylaws.

6.3 TREASURER. The Treasurer shall be the depository and have custody of all the money of the Agency from whatever source, and shall provide strict accountability of said funds in

accordance with Government Code Sections 6505 and 6505.5. The Treasurer shall possess the powers of, and shall perform those functions required by Government Code Sections 6505, 6505.5, and all other applicable laws and regulations, including any subsequent amendments thereto.

6.3.1 The Board has appointed a staff member of the Turlock Irrigation District as Agency Treasurer and will reimburse the District for the staff's services for the Agency. Reimbursement will include necessary staff time as well as the purchase and maintenance of any necessary materials and/or equipment required by the Treasurer in order to complete the work.

6.3.2 Treasurer's Duties. Particularly, the Treasurer shall perform, but not be limited to, the following duties:

i. Books of Account. Keep and maintain, or cause to be kept and maintained, adequate and correct books and records of accounts of the properties and business transactions of Agency, including accounts of its assets, liabilities, receipts, disbursements, gains, losses, capital, retained earnings, and other matters customarily included in financial statements. The books of account will be open to inspection by any Director at all reasonable times.

ii. Deposit and Disbursement of Money and Valuables. Consistent with the provisions of Article 9 of the Agreement, deposit all money and other valuables in the name and to the credit of the Agency within such depository funds and accounts as may be designated by the Board; disburse the funds of the Agency as may be ordered by the Board; and render to the Board, whenever requested, an account of all of his/her transactions as Treasurer and of the financial condition of the Agency.

iii. On a quarterly basis provide the Directors with a Treasurer's report that includes a bank reconciliation report on cash, summary of revenue and expenditure activity to date for the current fiscal year.

iv. Exercise and perform such other powers and perform such other duties as may be assigned to him/her by the Board.

6.4 STAFFING STRATEGY REVIEW UPON COMPLETION OF THE GROUNDWATER SUSTAINABILITY PLAN. The collaborative staffing model for the Agency will be reviewed and revised as needed. In particular, the performance of the collaborative staffing model in meeting the Agency's needs and the proposed role of the Agency in developing the GSA and GSP will be considered when determining the potential future staffing needs of the Agency.

ARTICLE 7. FINANCES

7.1 DEPOSIT AND DISBURSEMENT OF FUNDS. All funds of the Agency shall be deposited in one or more depository accounts as may be designated by the Board. Such accounts shall be independent of any account owned by or exclusively controlled by any of the Members. No disbursements of such funds shall be made unless the disbursements have been approved in the annual operating budget, or otherwise specifically approved by the Board. All disbursements shall be by check. Disbursements of not more than five thousand dollars ($5,000) may be issued pursuant to the Treasurer's sole signature. Disbursements in excess of five thousand dollars ($5,000) may only be issued upon the signature of the Treasurer and Chair, or in the Chair's absence, the Vice-Chair. The Treasurer may establish and implement a protocol allowing for electronic signatures by the Chair or Vice-Chair in order to facilitate efficient operation of the Agency.

7.2 BUDGET. The Agency shall operate pursuant to an operating budget to be adopted prior to the beginning of each new fiscal year. The Agency shall endeavor to operate each year pursuant to an annually balanced budget so that projected annual expenses do not exceed projected annual revenues. Budget adjustments to the annual budget shall be reviewed and acted upon by the Board at a regularly or specially scheduled Board meeting occurring after January 1 of each calendar year. The Board may take action to amend the budget at other times if circumstances require more immediate action.

ARTICLE 8. DEBTS AND LIABILITIES

The debts, liabilities and obligations of the Agency are not and will not be the debts, liabilities or obligations of any or all of the Members. However, nothing in this Article or in the Agreement prevents, or impairs the ability of, a Member or Members, from agreeing, in a separate agreement, to be jointly and/or severally liable, in whole or in part, for any debt, obligation or liability of the Agency, including but not limited to, any bond or other debt instrument issued by the Agency.

ARTICLE 9. RECORDS RETENTION

9.1 MAINTENANCE OF THE AGENCY RECORDS. The Agency will keep:

9.1.1 Adequate and correct books and records of account; and of the Board.

9.1.2 Minutes in written form of the proceedings of its Board, and committees, and advisory committees, if any.

9.1.3 All such records will be kept at the Agency's principal office.

9.2 RECORDS RETENTION POLICY AND SCHEDULE. The Board may review and adopt a Records Retention Policy and Schedule that specifies the retention period of different categories of materials. Implementation of this Policy will be the responsibility of Agency staff.

9.3 INSPECTION RIGHTS.

9.3.1 Any Member may inspect the accounting books and records and minutes of the proceedings of the Board and committees of the Board, at any reasonable time, for a purpose reasonably related to such person's interest.

9.3.2 Any inspection and copying under this Section may be made in person or by an agent or attorney or the entity entitled thereto and the right of inspection includes the right to copy.

9.4 MAINTENANCE AND INSPECTION OF AGREEMENT AND BYLAWS. The Agency will keep at its principal executive office the original or copy of the Agreement and these Bylaws as amended to date, which will be open to inspection by the Agency or any Member at all reasonable times during office hours.

9.5 INSPECTION BY DIRECTORS. Every Director has the absolute right at any reasonable time to inspect all non-confidential books, records, and documents of every kind and the physical properties of the Agency. This inspection by a Director may be made in person or by an agent or attorney, and the right of inspection includes the right to copy and make extracts of documents.

ARTICLE 10. ETHICS AND CONFLICTS OF INTEREST

The Agency shall be subject to the conflict of interest rules set forth in the Political Reform Act (commencing with Section 81000 of the Government Code of the State of California) and Sections 1090 et seq. of the Government Code of the State of California, and the Agency shall adopt an ethics policy as well as a conflict of interest code as required and as provided by the implementing regulations of the Political Reform Act.

ARTICLE 11. AMENDMENT

These Bylaws may be amended from time to time by resolution of the Board duly adopted upon majority vote of the Board at a regular or special meeting of the Board; provided, however, that no such amendment shall be adopted unless at least thirty (30) days written notice thereof has previously been given to all members of the Board. Such notice shall identify the Article to be amended, the proposed amendment, and the reason for the proposed amendment.

ARTICLE 12. DEFINITIONS AND CONSTRUCTION

Unless specifically defined in these Bylaws, all defined terms shall have the same meaning ascribed to them in the Agreement. If any term of these Bylaws conflicts with any term of the Agreement, the Agreement's terms shall prevail, and these Bylaws shall be amended to eliminate such conflict of terms. Unless the context or reference to the Agreement requires otherwise, the general provisions, rules of construction, and definitions in the California Civil Code will govern the construction of these Bylaws.

DRAFT BYLAWS FOR THE EAST TURLOCK SUBBASIN GROUNDATER SUSTAINABILITY AGENCY JPA:
ADOPTED March 31, 2017

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PREAMBLE

These Bylaws are adopted and effective as of March 31, 2017, pursuant to the Joint Powers Agreement of the EAST TURLOCK SUBBASIN GROUNDATER SUSTAINABILITY AGENCY JOINT POWERS AUTHORITY (Agreement).

ARTICLE 1. THE AGENCY

1.1 NAME OF AGENCY. The name of the Agency created by the Agreement shall be the East Turlock Subbasin Groundwater Sustainability Agency JPA (Agency).

1.2 OFFICE OF AGENCY. The principal office of the Agency shall be at the Eastside Water District, P.O. Box 280, Denair, CA 95316, or at such other location as the Board may designate by resolution.

1.3 POWERS. The powers of the Agency shall be as set forth in Article 4 of the Agreement.

ARTICLE 2. BOARD OF DIRECTORS

2.1 BOARD OF DIRECTORS. The Agency shall be governed by a Board of Directors (Board) as set forth in Article 6 of the Agreement.

2.2 PROCEDURE FOR APPOINTMENT OF BOARD MEMBERS

2.2.1 Appointment. Each Member Agency is responsible for appointing a Board Member and an alternate Board Member, pursuant to its own procedures and authorities. Alternate Board members are authorized to act in all of the roles of the appointed Board member in the appointed Board member's absence. This includes filling any officer duties of the appointed Board member.

2.2.2 Notification. Each Member shall notify the Agency when it appoints or changes its Board Member and/or alternate Board Member.

ARTICLE 3. BOARD MEETINGS

3.1 MEETINGS. The Board shall meet regularly, at least once per quarter on the fourth Thursday of the month for the quarter, at 10:00 AM, at Cortez Hall, 12937 N Cortez Avenue, Turlock, CA 95380 and more often as needed. Special meetings of the Board may be called by the Chair or any four directors by written request. Board meetings shall be conducted in compliance with all applicable laws, and as further specified herein. Meeting agendas shall be posted 72 hours before each meeting in compliance with the requirements of the Ralph M. Brown Act.

3.2 QUORUM. In determining a quorum as defined by Section 11.1 of the Agreement, Alternate Directors attending meetings shall not be counted as part of any meeting quorum unless such Alternate Director is formally representing an absent appointed Director.

3.3 ORDER OF BUSINESS. In general, at the regular meetings of the Board, the following will be the order of business:

3.3.1 Call to Order.

3.3.2 Roll Call.

3.3.3 Approval of Minutes of the Previous Meeting.

3.3.4 Staff Updates.

3.3.5 Public Comment Period

3.3.6 Agenda Items, including any appropriate combination of consent items, regular business items, public hearing items or closed session items.

3.3.7 Comments from the Board.

3.3.8 Adjournment.

3.4 ACTION BY THE BOARD. Action by the Board on all resolutions or ordinances shall be taken using a rollcall vote and shall be recorded in writing, signed by the Chair, and attested to by the Secretary. All other actions of the Board shall be by motion recorded in written minutes. The Chair shall announce the results of the vote including the names of the Directors, if any, voting in the minority.

3.5 RULE OF ORDER. All rules of order not otherwise provided for in these Bylaws shall be determined, to the extent practicable, in accordance with "Rosenberg's Rules of Order;" provided,

however, that no action of the Board shall be invalidated or its legality otherwise affected by the failure or omission to observe or follow "Rosenberg's Rules of Order."

ARTICLE 4. OFFICERS

4.1 OFFICERS. The Officers of the Agency are the Chair, Vice-Chair, and Secretary, as provided for in Article 8 of the Agreement. All Directors are eligible to serve as an Officer. The Chair and the Vice Chair must be Directors.

4.2 ELECTION OF OFFICERS. At the first meeting of the Board, nominations for the Officers will be made and seconded by a Director. If more than two (2) Directors are nominated for any one office, voting occurs until a nominee receives a majority of the votes cast. The initial term of the elected Officers shall run from the date of their election to until the Board meeting two years after the election. Thereafter, each Officer shall serve a term of two (2) years. An Officer may succeed himself/herself and may serve any number of consecutive or non-consecutive terms.

4.3 REMOVAL OF OFFICERS. An Officer may be removed, with or without cause, by a majority vote of the Board at a regular or special meeting.

4.4 VACANCIES. Any vacancy in the offices because of death, resignation, removal, disqualification, or any other cause will be filled for the balance of the vacated term in the manner prescribed in these Bylaws for regular appointments to that office; provided, however, that such vacancies may be filled at any regular or special meeting of the Board.

4.5 RESIGNATION OF OFFICERS. Any Officer may resign at any time by giving written notice to the Board Chair or Secretary. Any resignation takes effect at the date of the receipt of that notice or at any later time specified in that notice. Unless otherwise specified in that notice, the acceptance of the resignation is not necessary to make it effective.

4.6 RESPONSIBILITIES OF OFFICERS.

4.6.1 Chair of the Board. The Chair of the Board shall preside at meetings of the Board and exercise and perform such other powers and duties as may be assigned to him/her by the Board or prescribed by these Bylaws. The Chair shall have the power to enforce meeting decorum and rules of order consistent with Rosenberg's Rules, unless overruled
by the Board.

4.6.2 Vice-Chair of the Board. The Vice-Chair of the Board shall fulfill all the duties of the Chair in his/her absence and exercise and perform such other powers and duties as may be assigned to him/her by the Board.

4.6.3 Secretary. The Secretary shall perform duties assigned by the Board, such duties shall include, but not be limited to, the following:

i. Book of Minutes. Keep or cause to be kept, at the principal executive office of the Agency or such other place as the Board may direct, a book of minutes of all meetings and actions of Directors and Committees of the Agency, with the time and place of holding the meeting, whether regular or special, and, if special, how authorized, the notice given, the names of those present and absent at such meetings and the proceedings of such meetings. Minutes will be in the form of Action Minutes and a meeting summary.

ii. Notices and Other Duties. Prepare, give, or cause to be given, notice of, and agendas for, all meetings and/or hearings of the Board and committees of the Agency.

iii. Exercise and perform such other powers and perform such other duties as may be assigned to him/her by the Board.

ARTICLE 5. BOARD COMMITTEES, WORKING GROUPS, AND ADVISORY COMMITTEES

5.1 BOARD COMMITTEES. The Board may establish temporary or permanent Board Committees composed entirely of Board Members to facilitate conduct of its work. Temporary Board Committees will have a specific charge and operational duration not to exceed six months and are not subject to the Brown Act unless they include more than six Directors as Committee members. Permanent Committees will be given a specific role and regardless of the number of Directors appointed shall be

subject to compliance with the Brown Act. All Board Committees will provide regular updates to the full Board about their activities and the progress of their work.

5.2 WORKING GROUPS. Informal working groups may be formed from time to time to provide opportunities for a small subset of Directors to work with staff on specific planning, analytical, or community engagement activities. Such working groups will have a defined area as the focus for its work and may function for a duration of up to six months, and may include such membership as needed to accomplish the objectives for which the working group was created.

5.3 ADVISORY COMMITTEES. Pursuant to Section 13 of the Agreement, the Board may establish one or more advisory committees to assist in carrying out the purposes and objectives of the Agency.

5.3.1 In establishing an Advisory Committee, the Board shall provide specific direction to the Committee as to its charge, expected duration for completion of its charge, and a summary of the resources, including staff or consultant support available to the Committee in performing its work.

5.3.2 Advisory Committee membership and appointments shall be at the Board's discretion based on the creating the membership needed to meet the purpose for which the Advisory Committee was created.

5.3.3 Any advisory committee shall exercise such powers as may be delegated to it, except that no committee may:

i. Take any final action on matters which, under the Agreement, require approval by a majority vote of the Board;

ii. Amend or repeal the Bylaws or adopt new Bylaws;

iii. Amend or repeal any resolution of the Board; or

iv. Appoint any other committees of the Board or the members of these committees.

5.3.4 Advisory committees shall meet at the call of their respective committee chairs. All advisory committee meetings shall be conducted in accordance with the Ralph M. Brown Act (California Government Code sections 54950 et seq.). Minutes of committee meetings shall be recorded and upon approval shall be distributed to the Board.

ARTICLE 6. AGENCY ADMINISTRATION, MANAGEMENT AND STAFFING

6.1 COLLABORATIVE MANAGEMENT. Except for the Agency's Treasurer function, Agency administration and management will be conducted using a collaborative staffing model in which the professional and technical staff of the member agencies work together to provide staff leadership, management and administration of the agency.

6.1.1 Staffing Support for Agency Officers and Board Members. Staff will work together to provide support for the Agency Officers and Board members. Board agenda and meeting materials will generally be prepared by or reviewed by one or more members of the staff prior to being finalized. Should member agency staff not be in agreement on any topic, the Agency Board Chair and Vice-Chair will be consulted to provide the necessary direction. Any issue not resolvable by staff and the Agency Board Chair and Vice-Chair will be referred to the full Board for decision.

6.1.2 Staffing for Development of GSA and GSP. Both staff from the Agreement member agencies and other professional and technical staff from the member agencies will be involved in providing staff support for the Agency. In addition, to the extent the Agency decides necessary, it may hire outside consultants and/or employ staff.

6.2 TREASURER. The Treasurer shall be the depository and have custody of all the money of the Agency from whatever source, and shall provide strict accountability of said funds in accordance with Government Code Sections 6505 and 6505.5. The Treasurer shall possess the powers of, and shall perform those functions required by Government Code Sections 6505, 6505.5, and all other applicable laws and regulations, including any subsequent amendments thereto.

6.2.1 The Board has appointed a staff member of the Eastside Water District as Agency Treasurer and will reimburse the District for the staff’s services for the Agency. Reimbursement will include

necessary staff time as well as the purchase and maintenance of any necessary materials and/or equipment required by the Treasurer in order to complete the work.

6.2.2 Treasurer's Duties. Particularly, the Treasurer shall perform, but not be limited to, the following duties:

i. Books of Account. Keep and maintain, or cause to be kept and maintained, adequate and correct books and records of accounts of the properties and business transactions of Agency, including accounts of its assets, liabilities, receipts, disbursements, gains, losses, capital, retained earnings, and other matters customarily included in financial statements. The books of account will be open to inspection by any Director at all reasonable times.

ii. Deposit and Disbursement of Money and Valuables. Consistent with the provisions of Article 9 of the Agreement, deposit all money and other valuables in the name and to the credit of the Agency within such depository funds and accounts as may be designated by the Board; disburse the funds of the Agency as may be ordered by the Board; and render to the Board, whenever requested, an account of all of his/her transactions as Treasurer and of the financial condition of the Agency.

iii. On a quarterly basis provide the Directors with a Treasurer's report that includes a bank reconciliation report on cash, summary of revenue and expenditure activity to date for the current fiscal year.

iv. Exercise and perform such other powers and perform such other duties as may be assigned to him/her by the Board.

6.3 STAFFING STRATEGY REVIEW UPON COMPLETION OF THE GROUNDWATER SUSTAINABILITY PLAN. The collaborative staffing model for the Agency will be reviewed and revised as needed. In particular, the performance of the collaborative staffing model in meeting the Agency's needs and the proposed role of the Agency in developing the GSA and GSP will be considered when determining the potential future staffing needs of the Agency.

ARTICLE 7. FINANCES

7.1 DEPOSIT AND DISBURSEMENT OF FUNDS. All funds of the Agency shall be deposited in one or more depository accounts as may be designated by the Board. Such accounts shall be independent of any account owned by or exclusively controlled by any of the Members. No disbursements of such funds shall be made unless the disbursements have been approved in the annual operating budget, or otherwise specifically approved by the Board. All disbursements shall be by check. Disbursements of not more than five thousand dollars ($5,000) may be issued pursuant to the Treasurer's sole signature. Disbursements in excess of five thousand dollars ($5,000) may only be issued upon the signature of the Treasurer and Chair, or in the Chair's absence, the Vice-Chair. The Treasurer may establish and implement a protocol allowing for electronic signatures by the Chair or Vice-Chair in order to facilitate efficient operation of the Agency.

7.2 BUDGET. The Agency shall operate pursuant to an operating budget to be adopted prior to the beginning of each new fiscal year. The Agency shall endeavor to operate each year pursuant to an annually balanced budget so that projected annual expenses do not exceed projected annual revenues. Budget adjustments to the annual budget shall be reviewed and acted upon by the Board at a regularly or specially scheduled Board meeting occurring after January 1 of each calendar year. The Board may take action to amend the budget at other times if circumstances require more immediate action.

ARTICLE 8. DEBTS AND LIABILITIES

The debts, liabilities and obligations of the Agency are not and will not be the debts, liabilities or obligations of any or all of the Members. However, nothing in this Article or in the Agreement prevents, or impairs the ability of, a Member or Members, from agreeing, in a separate agreement, to be jointly and/or severally liable, in whole or in part, for any debt, obligation or liability of the Agency, including but not limited to, any bond or other debt instrument issued by the Agency.

ARTICLE 9. RECORDS RETENTION

9.1 MAINTENANCE OF THE AGENCY RECORDS. The Agency will keep:

9.1.1 Adequate and correct books and records of account; and of the Board.

9.1.2 Minutes in written form of the proceedings of its Board, and committees, and advisory committees, if any.

9.1.3 All such records will be kept at the Agency's principal office.

9.2 RECORDS RETENTION POLICY AND SCHEDULE. The Board may review and adopt a Records Retention Policy and Schedule that specifies the retention period of different categories of materials. Implementation of this Policy will be the responsibility of Agency staff.

9.3 INSPECTION RIGHTS.

9.3.1 Any Member may inspect the accounting books and records and minutes of the proceedings of the Board and committees of the Board, at any reasonable time, for a purpose reasonably related to such person's interest.

9.3.2 Any inspection and copying under this Section may be made in person or by an agent or attorney or the entity entitled thereto and the right of inspection includes the right to copy.

9.4 MAINTENANCE AND INSPECTION OF AGREEMENT AND BYLAWS. The Agency will keep at its principal executive office the original or copy of the Agreement and these Bylaws as amended to date, which will be open to inspection by the Agency or any Member at all reasonable times during office hours.

9.5 INSPECTION BY DIRECTORS. Every Director has the absolute right at any reasonable time to inspect all non-confidential books, records, and documents of every kind and the physical properties of the Agency. This inspection by a Director may be made in person or by an agent or attorney, and the right of inspection includes the right to copy and make extracts of documents.

9.6 PUBLIC RECORDS ACT REQUESTS.

ARTICLE 10. ETHICS AND CONFLICTS OF INTEREST

The Agency shall be subject to the conflict of interest rules set forth in the Political Reform Act (commencing with Section 81000 of the Government Code of the State of California) and Sections 1090 et seq. of the Government Code of the State of California, and the Agency shall adopt an ethics policy as well as a conflict of interest code as required and as provided by the implementing regulations of the Political Reform Act.

ARTICLE 11. AMENDMENT

These Bylaws may be amended from time to time by resolution of the Board duly adopted upon majority of the Board at a regular or special meeting of the Board; provided, however, that no such amendment shall be adopted unless at least thirty (30) days written notice thereof has
previously been given to all members of the Board. Such notice shall identify the Article to be amended, the proposed amendment, and the reason for the proposed amendment.

ARTICLE 12. DEFINITIONS AND CONSTRUCTION

Unless specifically defined in these Bylaws, all defined terms shall have the same meaning ascribed to them in the Agreement. If any term of these Bylaws conflicts with any term of the Agreement, the Agreement's terms shall prevail, and these Bylaws shall be amended to eliminate such conflict of terms. Unless the context or reference to the Agreement requires otherwise, the general provisions, rules of construction, and definitions in the California Civil Code will govern the construction of these Bylaws.

END OF ETS GSA JPA BYLAWS Adopted March 31, 2017

Appendix C

GSP Preparation -

Notices of Intent and Memorandum of Agreement

Notice of Intent to Develop a Groundwater Sustainability Plan in the Turlock Subbasin; West Turlock Subbasin Groundwater Sustainability Agency

Notice of Intent to Develop a Groundwater Sustainability Plan in the Turlock Subbasin; East Turlock Subbasin Groundwater Sustainability Agency

Memorandum of Agreement (MOA) between the West Turlock Subbasin Groundwater Sustainability Agency and the East Turlock Subbasin Groundwater Sustainability Agency

WTS GSA

WEST TURLOCK SUBBASIN
GROUNDWATER SUSTAINABILITY AGENCY
P. O. BOX 949, TURLOCK CA 95381
(209) 668-5590 TEL
(209) 668-5695 FAX

January 10, 2018

Mr. Trevor Joseph, Section Chief
California Department of Water Resources
PO Box 942836
Sacramento, CA 94236

RE: Notice of Intent to Develop a Groundwater Sustainability Plan in the Turlock Subbasin

Dear Mr. Joseph:

The West Turlock Groundwater Sustainability Agency (WTSGSA), pursuant to California Water Code Section 10727.8 and California Code of Regulations Title 23 Section 353.6, hereby gives notice to the California Department of Water Resources (DWR) that it will initiate development of a Groundwater Sustainability Plan (GSP) for the Turlock Groundwater Subbasin, DWR Bulletin 118 Basin Number 5-22.03. The WTSGSA filed notice of intent to serve as a Groundwater Sustainability Agency for portions of the Turlock Subbasin on March 27, 2017 and has since been designated as an exclusive GSA.

The WTSGSA was formed as a joint powers agency and holds quarterly public meetings each calendar quarter on the first Thursday of the month, at 6 PM, at the Turlock Irrigation District Board Room, 333 East Canal Drive, Turlock, California. Interested parties may participate in the planning and development of the GSP by attending the WTSGSA board meetings or the Technical Advisory Committee meetings, which are open to the public. The WTSGSA is collaborating with the East Turlock Subbasin GSA on a single GSP for the Turlock Subbasin and on coordinated stakeholder outreach and education efforts.

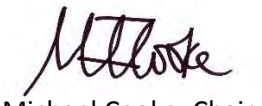
Since the passage of SGMA, Turlock Subbasin local agencies have taken a proactive approach to stakeholder engagement, and that will continue throughout the sustainable groundwater management planning horizon in the coming decades. A website for Turlock Subbasin groundwater management and GSA business activity is currently under development and will be available this winter at www.turlockgroundwater.org.

Specific to the GSP process, the public will continue to be encouraged to participate in GSP development in a number of ways; principally by attending meetings and other public events to be scheduled, and by submitting comments prior to ultimate GSP adoption. Stakeholders will be provided multiple opportunities to be included on the GSA's Interested Parties List, maintained pursuant to Water Code

Section 10723.4, to be informed of upcoming meetings and GSP development by emailing the GSA at info@turlockgroundwater.org.

The WTSGSA looks forward to working collaboratively with DWR on developing and implementing a GSP. Should you have any questions, please contact me at (209) 668-5590.

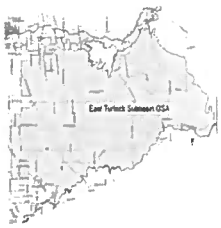
Sincerely,



Michael Cooke, Chair
WTSGSA Technical Advisory Committee

CC: Stanislaus County Board of Supervisors
Merced County Board of Supervisors
City of Turlock City Council
City of Ceres City Council
City of Modesto City Council
City of Hughson City Council
City of Waterford City Council

EAST TURLOCK SUBBASIN GROUNDWATER SUSTAINABILITY AGENCY
JOINT POWERS AUTHORITY



January 11, 2018

Mr. Trevor Joseph, Section Chief
California Department of Water Resources
PO Box 942836
Sacramento, CA 94236

RE: Notice of Intent to Develop a Groundwater Sustainability Plan in the Turlock Subbasin

Dear Mr. Joseph:

The East Turlock Groundwater Sustainability Agency (ETSGSA), pursuant to California Water Code Section 10727.8 and California Code of Regulations Title 23 Section 353.6, hereby gives notice to the California Department of Water Resources (DWR) that it will initiate development of a Groundwater Sustainability Plan (GSP) for the Turlock Groundwater Subbasin, DWR Bulletin 118 Basin Number 5-22.03. The ETSGSA filed notice of intent to serve as a Groundwater Sustainability Agency for portions of the Turlock Subbasin on April 3, 2017 and has since been designated as an exclusive GSA.

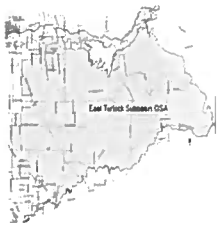
The ETSGSA was formed as a joint powers agency and holds quarterly public meetings each calendar quarter on the fourth Thursday of the month, at 10 AM, at Cortez Hall, 12937 North Cortez Avenue, Turlock, California. Interested parties may participate in the planning and development of the GSP by attending the ETSGSA board meetings or the Technical Advisory Committee meetings, which are open to the public. The ETSGSA is collaborating with the West Turlock Subbasin GSA on a single GSP for the Turlock Subbasin and on coordinated stakeholder outreach and education efforts.

Since the passage of SGMA, Turlock Subbasin local agencies have taken a proactive approach to stakeholder engagement, and that will continue throughout the sustainable groundwater management planning horizon in the coming decades. A website for Turlock Subbasin groundwater management and GSA business activity is currently under development and will be available this winter at www.turlockgroundwater.org.

Specific to the GSP process, the public will continue to be encouraged to participate in GSP development in a number of ways; principally by attending meetings and other public events to be scheduled, and by submitting comments prior to ultimate GSP adoption. Stakeholders will be provided multiple opportunities to be included on the GSA's Interested Parties List, maintained pursuant to Water Code Section 10723.4, to be informed of upcoming meetings and GSP development by emailing the GSA at info@turlockgroundwater.org.

731 East Yosemite Avenue, Suite B #318 Merced, CA 95340

Phone 209.589.0689 paddedcell@sbcglobal.net



The ETSGSA looks forward to working collaboratively with DWR on developing and implementing a GSP. Should you have any questions, please contact me at (209) 969-1175.

Sincerely,

Kevin Kauffman, Coordinator
East Turlock Subbasin Groundwater Sustainability Agency

CC: Stanislaus County Board of Supervisors
Merced County Board of Supervisors

731 East Yosemite Avenue, Suite B #318 Merced, CA 95340

Phone 209.589.0689 paddedcell@sbcglobal.net

MEMORANDUM OF AGREEMENT

BETWEEN THE WEST TURLOCK SUBBASIN GROUNDWATER SUSTAINABILITY AGENCY AND THE EAST TURLOCK SUBBASIN GROUNDWATER SUSTAINABILITY AGENCY

THIS AGREEMENT is entered into and effective this 14th day of December, 2017 (**"Effective Date"**), by and among the West Turlock Subbasin Groundwater Sustainability Agency ("WTS GSA") and the East Turlock Subbasin Groundwater Sustainability Agency ("ETS GSA") (collectively **"Parties"** or individually a "**Party**").

RECITALS

A. On August 29, 2014, the California Legislature passed comprehensive groundwater legislation contained in SB 1168, SB 1319 and AB 1739. Collectively, those bills, as subsequently amended, enacted the "Sustainable Groundwater Management Act" ("SGMA"). Governor Brown signed the legislation on September 16, 2014 and it became effective on January 1, 2015.

B. Each of the Parties overlie the San Joaquin Valley Groundwater Basin, Turlock Subbasin, California Department of Water Resources ("DWR") Basin No. 5-22.03 as its boundaries may be modified from time to time in accordance with Water Code Section 10722.2 (the "Basin").

C. The WTS GSA elected to manage the groundwater over the boundaries of its members and act as the Groundwater Sustainability Agency ("GSA") pursuant to SGMA with the DWR on or about March 27, 2017.

D. The ETS GSA elected to manage the groundwater over the boundaries of its members and act as the GSA pursuant to SGMA with the DWR on or about April 3, 2017.

E. The members of the WTS GSA and ETS GSA have previously collaborated on groundwater management through membership in the Turlock Groundwater Basin Association.

F. The Parties desire, through this Agreement, to coordinate the work of the GSAs and the management of the Basin, in accordance with SGMA.

G. The Parties plan to review this Agreement and the provisions therein after a joint GSP has been developed or in 2022, whichever occurs earlier.

THEREFORE, in consideration of the mutual promises, covenants and conditions herein set forth, the Parties agree as follows:

ARTICLE 1: DEFINITIONS

1.1 **Definitions.** As used in this Agreement, unless the context requires otherwise, the meaning of the terms hereinafter set forth shall be as follows:

a. **"Agreement"** shall mean this Agreement between the WTS GSA and the ETS GSA.

b. **"Basin"** shall mean Turlock Groundwater Subbasin, California Department of Water Resources Basin No. 5-22.03 as its boundaries may be modified from time to time in accordance with Water Code Section 10722.2.

c. "**Basin-Wide Activities**" shall mean those activities or actions that affect the Basin as a whole, or are otherwise required by SGMA to be determined as the Basin level.

d. **"Coordination Agreement"** shall mean a legal agreement adopted between two or more GSAs that provides the basis for intra-basin coordination for more than one groundwater sustainability plan ("GSP") within a single basin.

e. **"DWR"** shall mean the California Department of Water Resources.

f. **"Effective Date"** shall be as set forth in the Preamble.

g. **"Groundwater Sustainability Agency"** or **"GSA"** shall mean an agency enabled by SGMA to regulate a portion of the Basin cooperatively with all other Groundwater Sustainability Agencies in the Basin, in compliance with the terms and provisions of SGMA.

h. **"Groundwater Sustainability Plan"** or **"GSP"** shall mean a plan of a Groundwater Sustainability Agency adopted pursuant to SGMA.

i. "**Joint TAC**" shall mean a meeting of the technical advisory committees of both of the Parties.

j. **"Management Area"** shall mean the area within the boundaries of a GSP that are managed separately or differently than the remainder of the GSP for the Basin.

k. **"Members"** shall mean the member agencies of each of the Parties' Joint Powers Agreements.

l. **"Parties"** shall mean any of the signatories to this Agreement.

m. "**Project Agreement**" shall mean a separate Agreement amongst and between the Parties for a specific project, whose purpose, terms, or financial contributions are different than those set forth in this Agreement.

n. **"SGMA"** shall mean the Sustainable Groundwater Management Act of 2014 and all regulations adopted under the legislation (SB 1168, SB 1319 and AB 1739) that

collectively comprise the Act, as that legislation and those regulations may be amended from time to time.

ARTICLE 2: KEY PRINCIPLES

2.1 The Parties intend to work together in mutual cooperation to develop a GSP in compliance with SGMA, for the sustainable management of groundwater for the portion of the Basin underlying the boundaries of each of the Parties.

2.2 The Parties intend to mutually cooperate to the extent possible to jointly implement the GSP within the Basin.

2.3 To the extent the Parties are not able to collaborate on a single GSP, each Party reserves the right to develop a GSP for the portion of the Basin the GSA is authorized to manage. To the extent it is not possible to jointly implement the GSP within the Basin, the Parties reserve the right to implement the GSP within its boundaries, and work with all Parties to coordinate such implementation in accordance with the requirements of SGMA.

2.4 The Parties expressly intend that this Agreement shall not limit or interfere with the respective Parties' rights and authorities over their own internal matters, including, but not limited to, a Party's legal rights to surface water supplies and assets, groundwater supplies and assets, facilities, operations, water management and water supply matters. The Parties make no commitments by entering into this Agreement to share or otherwise contribute their water supply assets as part of the development or implementation of a GSP.

2.5 Nothing in this Agreement is intended to modify or limit a Party's police powers, land use authorities, or any other authority.

2.6 The Parties further intend through this Agreement to collaborate in obtaining consulting, administrative and management services needed to efficiently and effectively develop a GSP, to conduct outreach to other Basin agencies and private parties, and to identify mechanisms for the management and funding commitments reasonably anticipated to be necessary for the purposes of this Agreement.

2.7 The Parties acknowledge and agree that SGMA is a new, complex and evolving legislation, with implementing regulations continuing to be developed by DWR. While this Agreement reflects the Parties' initial approach to SGMA compliance, a great deal of data needed for implementation is unknown, and necessary models are still in development. The Parties may experience changes in political boundaries, gain experience in the application of SGMA, or discover other considerations that may affect the decision of Parties on how to best comply with SGMA within each of their own boundaries and/or Management Area boundaries. DWR has acknowledged the need for entities to be able to change their decisions about participating in or becoming a GSA, and it is the intent of the Parties to support flexibility in admitting additional Parties, accommodating voluntary withdrawals, coordinating with other multi-agency or individual GSAs, changing the form of their organizational documents, for example, or creating an independent agency through a Joint Powers Agreement, and making other types of adjustments required by the Parties to achieve efficient compliance with SGMA,

consistent with the schedule and requirements of SGMA for coordination throughout the Basin and the provisions of this Agreement.

2.8 Each of the Parties acknowledges that SGMA requires that multiple GSAs within a Bulletin 118 groundwater basin designated as high- or medium-priority must coordinate, use the same data and consistent methodologies for certain required technical assumptions when developing a GSP, and the entire basin must be managed under one or more GSPs.

ARTICLE 3: FORMATION, PURPOSE AND POWERS

3.1 **Recitals:** The foregoing recitals are incorporated by reference.

3.2 **Certification.** Each of the Parties certifies and declares that it is a public agency (as defined in Government Code Section 6500 *et seq.*) that is authorized to be a GSA and manage groundwater for the portion of the Basin for which its members overlie.

3.3 **Purpose of the Agreement.** The purposes of this Agreement are to:

a. Cooperatively carry out the purposes, goals and objectives of SGMA;

b. Provide for coordination amongst and between the Parties to develop and implement a GSP and/or facilitate a Coordination Agreement, to the extent necessary for SGMA compliance;

c. Develop, adopt and implement a legally sufficient GSP in compliance with SGMA covering those portions of the Basin that are within the jurisdictional boundaries of the Parties, subject to the limitations set forth in this Agreement; and

d. Satisfy the requirements of SGMA for coordination among the WTS GSA and the ETS GSA.

3.4 **Authority Under the Agreement.** To the extent authorized by the Parties, subject to the limitations set forth in this Agreement and the limitations of all applicable laws, the Parties acting collectively shall have the following authority including, but not limited to the power to:

a. Coordinate the implementation of SGMA among the Parties in accordance with this Agreement;

b. Recommend the adoption of actions, rules, regulations, policies, and procedures related to the coordination of the Parties for purposes of implementation of SGMA;

c. Perform all acts necessary or proper to carry out fully the purposes of this Agreement and to exercise all other powers necessary and incidental to the implementation of the powers set forth herein.

3.5 **Powers Reserved to Parties.** Each of the Parties will have the sole and absolute right, in its sole discretion, to:

a. Act as a GSA within its boundaries or the Management Area managed in whole or in part by such Parties;

b. Approve any portion, section or chapter of the GSP developed pursuant to this Agreement;

c. Exercise authorities granted to each of the Parties as a GSA under SGMA;

d. Exercise authority to implement SGMA and any GSP adopted pursuant to this Agreement;

e. Defend any challenge to the adoption or implementation of a GSP developed pursuant to this Agreement; and

f. Notwithstanding anything to the contrary in this Agreement, this Agreement does not provide any Parties the authority to undertake any activities within the geographic or service area boundaries of any other Parties pursuant to the GSP developed or adopted hereunder, unless the Parties have formally and expressly consented and agreed in writing to the activity proposed.

3.6 **Term.** This Agreement shall be effective as of the Effective Date and shall remain in effect until terminated in accordance with Article 7.4 of this Agreement.

3.7 **Role of Party Members.** Each of the Parties agrees to undertake such additional proceedings or actions as may be necessary in order to carry out the terms and intent of this Agreement, including the support of its Members, to participate in this Agreement. This support will involve the following types of actions:

a. The Parties will provide support to the Joint TAC and any third party facilitating the development of the GSP by making available staff time, information and facilities within available resources.

b. Policy support shall be provided by the Parties to either approve, or respond quickly to, any recommendations made as to funding shares, operational decisions, fare structures, and other policy areas.

c. Each of the Parties may contribute public resources including but not limited to personnel, services, equipment or property to facilitate this Agreement. Such in-kind resource support is made in order to facilitate this Agreement and comply with SGMA; without a separate Project Agreement, the contributions shall not be made with the expectation of reimbursement from other Parties.

3.8 **Other Officers and Employees.** To the extent the Parties need support from employees, officers, consultants or otherwise need to hire employees, the Parties may do the following:

a. Provide that any employee of the Parties, or the Parties' respective Members, with the express approval of the Parties, may work on behalf of the Parties under this

Agreement, and shall perform the same various duties under the direction of the Joint TAC as for his or her other employer in order to carry out this Agreement. This work may be completed and funded under the existing employment with the Parties or each of their Members. In the alternative, the Joint TAC may recommend that work performed by employees of the Parties or Members of the Parties be reimbursed by the Parties. Such recommendation shall include the scope of activities and the recommended reimbursement structure.

b. With the consent of the Parties, per Article 3.7, the Parties may independently contract or hire consultants and/or employees to perform work under this Agreement. Under this arrangement, the hiring or contracting Parties must present the contract to the Joint TAC for review and approval. Further, the contract must include appropriate indemnity, insurance, and non-disclosures to protect all Parties.

ARTICLE 4: GOVERNANCE

4.1 **Joint Technical Advisory Committee.** Activities under this Agreement will be guided by the appointed technical advisory committees of each Party ("Joint TAC"). The Joint TAC shall work collaboratively under this Agreement to develop recommendations for the technical and substantive Basin-wide issues. Recommendations from the Joint TAC that require approval or action of the Parties shall be provided to each Parties' respective governing boards for adoption, approval, or other recommended action. The Joint TAC shall be responsible, but not be limited to, the following actions:

a. Develop budget(s) for any project or program that requires funding from the Parties;

b. Draft reports or options with regard to decisions related to the levying of taxes, assessments or property-related fees and charges;

c. Propose guidance and options for obtaining grant funding;

d. Recommend the adoption of rules, regulations, policies, and procedures related to the Agreement;

e. Recommend the approval of contracts with consultants or subcontractors that would undertake work on behalf of the Parties pursuant to this Agreement;

f. Update each Party's respective governing boards on specific issues, including the development of the GSP, when appropriate or requested;

g. Advise the Parties when the convening of an Ad Hoc committee is needed to resolve an impasse or inability to make a consensus recommendation;

h. Conduct outreach with stakeholder groups;

i. Participate and guide the development of GSP and materials in support thereof;

j. Recommend action and/or approval of a GSP.

4.2 **Meetings.** The Joint TAC shall provide for regular and special meetings in accordance with Chapter 9, Division 2, Title 5 of Government Code of the State of California (the "Ralph M. Brown Act" commencing at Section 54950), and any subsequent amendments of those provisions.

4.3 **Advisory Committees.** The Joint TAC may establish other advisory committees, technical committees or other committees for any purpose, including but not limited to the GSP purposes in Water Code Section 10727.8.

4.4 **Impasse Resolution.** To the extent the Joint TAC is unable to make a consensus-based recommendation on an issue for which their respective governing boards need to make a decision, the Joint TAC may convene an Ad Hoc committee comprised of the Parties' governing board members in an attempt to resolve the impasse.

ARTICLE 5: INFORMATION AND DATA SHARING

5.1 **Exchange of Information**. The Parties acknowledge and recognize pursuant to this Agreement and SGMA, the Parties will need to exchange information amongst and between the Parties.

5.2 **Procedure for Exchange of Information.** The Parties may exchange information through collaboration and/or informal requests made at the Joint TAC level or through working/stakeholder committees. However, to the extent it is necessary to make a written request for information to other Parties, the following protocols shall be followed:

5.2.1 Each of the Parties shall designate a representative to respond to information requests and provide the name and contact information of the designee to the Joint TAC. Requests may be communicated in writing and transmitted in person or by mail, facsimile machine or other electronic means to the appropriate representative as named in this agreement.

5.3 **Non-Disclosure of Confidential Information.** It is understood and agreed to that the Parties to this Agreement may provide the Parties with certain information that may be considered confidential. To ensure the protection of such information and in consideration of the agreement to exchange said information, the Parties agree as follows:

5.3.1 The confidential information to be disclosed under this Agreement ("Confidential Information") includes data, information, modeling, projections, estimates, plans, that are not public and in which the Parties have a reasonable expectation of confidentiality, regardless of whether such information is designated as "Confidential Information" at the time of its disclosure.

5.3.2 In addition to the above, Confidential Information shall also include, and the Parties shall have a duty to protect, other confidential and/or sensitive information which is (a) disclosed as such in writing and marked as confidential (or with other similar designation) at

the time of disclosure; and/or (b) disclosed in any other manner and identified as confidential at the time of disclosure and is also summarized and designated as confidential in a written memorandum delivered within thirty (30) days of the disclosure.

5.3.3 The Parties shall use the Confidential Information only for the purposes set forth in this Agreement.

5.3.4 The Parties shall limit disclosure of Confidential Information within its own organization to its directors, officers, partners, consultants, members and/or employees having a need to know and shall not disclose Confidential Information to any third party (whether an individual, corporation, or other entity) without prior written consent. The Parties shall satisfy its obligations under this paragraph if it takes affirmative measures to ensure compliance with these confidentiality obligations by its employees, agents, consultants and others who are permitted access to or use of the Confidential Information.

5.3.5 This Agreement imposes no obligation upon the Parties with respect to any Confidential Information (a) that was possessed before receipt; (b) is or becomes a matter of public knowledge through no fault of receiving Parties; (c) is rightfully received from a third party not owing a duty of confidentiality; (d) is disclosed without a duty of confidentiality to a third party by, or with the authorization of the disclosing Parties; or (e) is independently developed.

5.3.6 If there is a breach or threatened breach of any provision of this section, it is agreed and understood that the non-breaching Parties shall have no adequate remedy in money or other damages and accordingly shall be entitled to injunctive relief; provided however, no specification in this Agreement of any particular remedy shall be construed as a waiver or prohibition of any other remedies in the event of a breach or threatened breach of this Agreement.

ARTICLE 6: FINANCIAL PROVISIONS

6.1 **Contributions and Expenses:** Each of the Parties shall be responsible to fund its participation in this Agreement. The Parties agree to fund Basin-wide activities, including development of the GSP, in a manner consistent with how each of the Parties' Members funded participation in the Turlock Groundwater Basin Association ("TGBA"). Specifically, this funding obligation would be allocated as 49.36 percent to the ETS GSA and 50.64 percent to the WTS GSA. Funding for non-basin-wide activities or other activities that the Parties separately agree shall not be split proportionately, shall be through a separate Project Agreement. For the activities under Project Agreements, the Joint TAC shall develop a scope of work, proposed cost allocation, and separate Project Agreement that would need to be approved by each Party's respective governing board before it is binding on such Parties. This provision shall be revisited by the Parties upon completion of the GSP or 2022, whichever is earlier.

6.2 **Funding Responsibility**. Each of the Parties will be solely responsible for raising funds for payment of the Parties' share of operating and administrative costs. The obligation of each of the Parties to make payments under the terms and provisions of this Agreement is an individual and severable obligation and not a joint obligation with those of the other Parties.

Each of the Parties shall be individually responsible for its own covenants, obligations, and liabilities under this Agreement. No Parties shall be precluded from independently pursuing any of the activities contemplated in this Agreement. No Parties shall be the agent or have the right or power to bind any other Parties without such Parties' express written consent, except as expressly provided in this Agreement.

6.3 **Alternate Funding Sources.** The Parties may secure contributions of grant funding, state, federal, or county funding as funding or a portion of funding for projects between the Parties.

ARTICLE 7: CHANGES IN PURPOSE, PARTICIPATION, WITHDRAWAL AND TERMINATION

7.1 **Changes in Purpose.** This Agreement shall remain in place and all applicable provisions shall remain in effect, in the event the Parties determine it is not possible to develop a single GSP pursuant to this Agreement. In that instance, the Parties may develop separate, multiple GSPs and continue to collaborate and work together as necessary to comply with SGMA and develop a Coordination Agreement as required by SGMA.

7.2 **Noncompliance.** In the event any of the Parties (1) fails to comply with the terms of this Agreement, or (2) undertakes actions that conflict with or undermine the compliance with SGMA and/or achieving sustainable groundwater management, the Parties alleging non-compliance shall provide written notice summarizing the nature of lacking compliance to the Party against whom the allegations are lodged. The alleged non-compliant Party agrees to make best efforts to resolve or remedy any such non-compliance. Such actions may include, for example, failure to pay its agreed upon contributions when due; refusal to participate in GSA activities or to provide required monitoring of sustainability indicators; refusal to enforce controls as required by the GSP; refusal to implement any necessary actions as outlined by the approved GSP; and exceedance of minimum thresholds that are likely to lead to "undesirable results" under SGMA.

7.3 **Mediation**. To the extent notice and informal discussion of non-compliance pursuant to section 7.2 does not resolve the issue of non-compliance, the Parties agree to participate in good faith to settle the alleged non-compliance by mediation administered under its standard mediation procedures before resorting to arbitration, litigation, or some other dispute resolution procedure.

7.4 **Withdrawal and Termination.** Either Party may, in its sole discretion, unilaterally withdraw and terminate its participation from this Agreement, effective upon thirty (30) days' prior written notice to the governing board of the other Party, provided that (a) the withdrawing Party will remain responsible for its proportionate share of any obligation or liability duly incurred while a Party to this Agreement. In the event the withdrawing Party has any rights in any property or has incurred obligations, the Party may not sell, lease or transfer such rights or be relieved of its obligations, except in accordance with a written agreement executed by it and the other Party.

7.5 **Disposition of Property Upon Termination.** Upon termination of this Agreement, the Joint TAC shall recommend the Parties distribute the assets between the successor entity and the Parties in proportion to how the assets were provided.

7.6 **Use of Data.** Upon withdrawal, a Party shall be entitled to use any data or other information developed during its time as a Party to the Agreement. Further, should a Party withdraw after completion of the GSP, it shall be entitled to utilize the GSP for future implementation of SGMA within its boundaries.

ARTICLE 8: MISCELLANEOUS PROVISIONS

8.1 **Indemnification**. Each of the Parties shall hold harmless, defend and indemnify the other Party, and its agents, officers and employees from and against any liability, claims, actions, costs, damages or losses of any kind, including death or injury to any person and/or damage to property arising out of the activities of this Agreement. These indemnification obligations shall continue beyond the Term of this Agreement as to any acts or omissions occurring before or under this Agreement or any extension of this Agreement.

8.2 **CASGEM Reporting Entity.** The Department of Water Resources runs the California Statewide Groundwater Elevation Monitoring ("CASGEM") Program, which requires the identification of a local monitoring entity to report elevation data. Prior to the enactment of SGMA, the TGBA acted as the CASGEM monitoring entity. The Parties hereby agree that the WTS GSA shall act as the CASGEM monitoring entity from the Effective Date of this Agreement. The WTS GSA shall work through this Agreement to obtain the necessary approvals from DWR to transfer the local monitoring entity's duties to the WTS GSA, coordinate with the ETS GSA to obtain required information, and collaborate with the ETS GSA on data provided as the CASGEM monitoring entity.

8.3 **Liability of Joint TAC.** Each Party must defend, indemnify and hold harmless the other Party from the actions of its employees or agents taken within the scope of the authority of this Agreement.

8.4 **Amendments.** This Agreement may only be amended by a written instrument executed by all Parties.

8.5 **Binding on Successors.** Except as otherwise provided in this Agreement, the rights and duties of the Parties may not be assigned or delegated without a unanimous vote by the Parties. Any approved assignment or delegation shall be consistent with the terms of any contracts, resolutions, indemnities and other obligations then in effect. This Agreement shall inure to the benefit of, and be binding upon, the successors and assigns of the Parties hereto.

8.6 **Notice.** Any notice or instrument required to be given or delivered under this Agreement may be made by: (a) depositing the same in any United States Post Office, postage prepaid, and shall be deemed to have been received at the expiration of 72 hours after its deposit in the United States Post Office; (b) transmission by facsimile copy to the addressee; (c) transmission by electronic mail; or (d) personal delivery, as follows:

WTS GSA

Michael Cooke
WTS GSA Technical Advisory Committee Chair
City of Turlock Municipal Services
156 S. Broadway, Suite 270
Turlock, CA 95380
Email: mcooke@turlock.ca.us
Phone: 209-668-4142

With copy to: Valerie Kincaid
O'Laughlin & Paris LLP
2617 K Street, Suite 100
Sacramento, CA 95816
Email: vkincaid@olaughlinparis.com
Phone: 916.599.5498

ETS GSA

Kevin Kauffman, ETS GSA Coordinator
P.O. Box 692632
Stockton, CA 95269
E-mail: Kauffmankevin@comcast.net and paddedcell@sbcglobal.net
Phone: (209) 478-4940

With copy to: Baker Manock & Jensen
c/o Lauren D. Layne
5260 N. Palm Ave., Suite 421
Fresno, CA 93704
E-mail: llayne@bakermanock.com
Phone: (559) 432-5400

8.7 **Counterparts.** This Agreement may be executed by the Parties in separate counterparts, each of which when so executed and delivered shall be an original. All such counterparts shall together constitute but one and the same instrument.

8.8 **Choice of Law.** This Agreement shall be governed by the laws of the State of California.

8.9 **Severability.** If one or more clauses, sentences, paragraphs or provisions of this Agreement are held to be unlawful, invalid or unenforceable, it is hereby agreed by the Parties that the remainder of the Agreement shall not be affected thereby. Such clauses, sentences, paragraphs or provisions shall be deemed reformed so as to be lawful, valid and enforced to the maximum extent possible.

8.10 **Headings.** The paragraph headings used in this Agreement are intended for convenience only and shall not be used in interpreting this Agreement or in determining any of the rights or obligations of the Parties to this Agreement.

8.11 **Construction and Interpretation.** This Agreement has been arrived at through negotiation and each of the Parties has had a full and fair opportunity to revise the terms of this Agreement. As a result, the normal rule of construction that any ambiguities are to be resolved against the drafting Parties shall not apply in the construction or interpretation of this Agreement.

8.12 **Entire Agreement.** This Agreement constitutes the entire agreement among the Parties and supersedes all prior agreements and understandings, written or oral.

IN WITNESS WHEREOF, the Parties have executed this Agreement on the day and year first above-written.

"ETS GSA"

East Turlock Subbasin Groundwater Sustainability Agency

Date: 1/18/18

Al Rossini, Chairman
East Turlock Subbasin GSA

"WTS GSA"

West Turlock Subbasin Groundwater Sustainability Agency

Date: 1/16/18

Joe Alamo, Chairman
West Turlock Subbasin GSA

Appendix D

C2VSimTM The Turlock-Modesto Integrated Water Resources Model Turlock Subbasin Documentation

C2VSimTM

The Turlock-Modesto Integrated Water Resources Model

Turlock Subbasin Documentation

WOODARD & CURRAN

TURLOCK GROUNDWATER

DECEMBER 2021

TURLOCK SUBBASIN GROUNDWATER SUSTAINABILITY PLAN (GSP)

TURLOCK MODEL REPORT

DECEMBER 27, 2021

WEST TURLOCK SUBBASIN GROUNDWATER SUSTAINABILITY AGENCY

EAST TURLOCK SUBBASIN GROUNDWATER SUSTAINABILITY AGENCY

Prepared by: Woodard & Curran, Inc. and Davids Engineering, Inc.

In Association with: Todd Groundwater, Inc and Wood Rogers, Inc.

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1. INTRODUCTION

Water is a precious resource in the San Joaquin Valley, providing the underlying needs for cities and residents, agriculture, and ecosystems. However, water supply can fluctuate dramatically between drought and floods in the San Joaquin Valley due to variable hydrology. In years of little precipitation and snowmelt resulting in reduced surface water supply, agricultural water users often turn to groundwater to meet their crop demands.

Due to an overreliance on groundwater in California, the Sustainable Groundwater Management Act (SGMA) was passed in 2014. SGMA requires that local agencies develop and implement plans to achieve sustainable groundwater management over the course of twenty years. As part of SGMA, Groundwater Sustainability Agencies (GSAs) need to quantify conditions in the subbasin under historical, current, and projected conditions. To support that endeavor, the West and East Turlock Subbasin GSAs (WTSGSA and ETSGSA respectively) have jointly developed the Turlock Model.

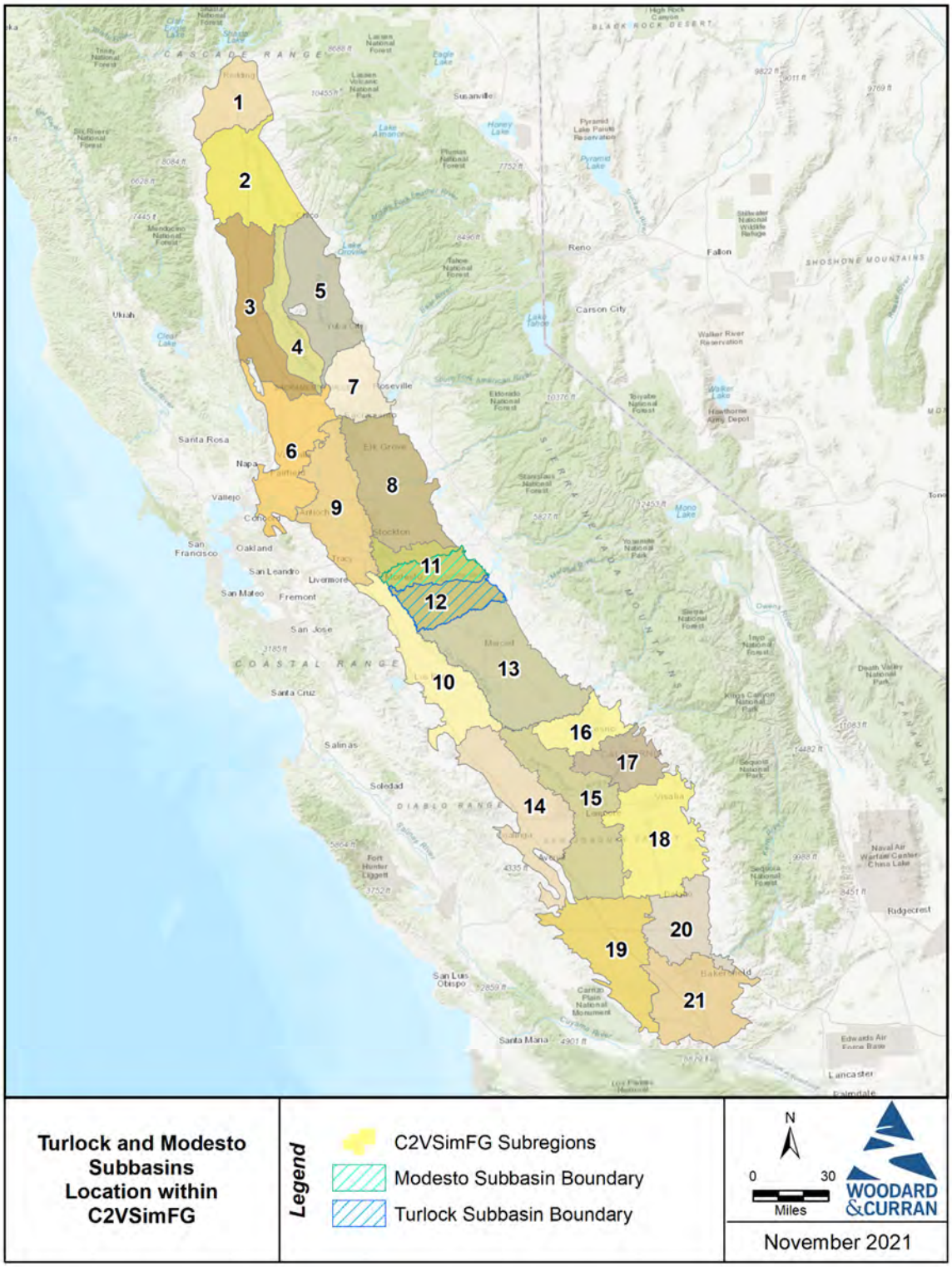
The Turlock-Modesto Integrated Water Resources Model (C2VSimTM) is a fully integrated surface and groundwater flow model, based on the California Central Valley Groundwater-Surface Water Simulation – Fine Grid Model (C2VSimFG). The Turlock-Modesto Model is a more refined version of the model that reflects the local data including hydrology, hydrogeology, land use and cropping patterns, and water resources operations, for the Turlock and Modesto Subbasins (**Figure 1**). These refinements are made to enable the model to support the development of groundwater sustainability plans for the respective subbasins. While the C2VSimTM retains its Central Valley wide major hydrologic and hydrogeologic features and simulation capabilities, the refinements are made specific to each subbasin. The refinements to the model for Turlock and Modesto Subbasins are documented in two separate reports, one for each Subbasin.

This report describes the details of the refinements for the Turlock Subbasin, and describes the objectives, data refinements, calibration refinements, and results of the C2VSimTM model for the Turlock Subbasin. As this model was developed as a local refinement of C2VSimFG, the purpose of this report is to present the additional details that have gone into the refinement of the Turlock Subbasin. All details relating to the construction of the base C2VSimFG model are documented in the DWR Report (DWR, 2020) and the reader is encouraged to consider this report as an addendum to the C2VSimFG documentation and refer to the C2VSimFG report as published by the Department of Water Resources for appropriate level of background, features, and details on the C2VSimFG in general.

The report is outlined as follows:

- Section 1: Introduction
- Section 2: C2VSimFG Refinements in the Turlock Subbasin
- Section 3: Land Surface Processes
- Section 4: Groundwater System Processes
- Section 5: Model Calibration
- Section 6: Results and Discussion
- Section 7: Summary & Recommendations
- Section 8: References

Figure 1: Locations of Turlock and Modesto Subbasins within C2VSimFG



1.1 GOALS OF MODEL DEVELOPMENT

The objective of the Turlock Model's development and calibration is to have an adequately robust, technically sound, agency accepted analytical computer tool that simulates the integrated land surface system; stream and river system; and groundwater hydrologic and hydrogeologic system in the model area for use in regional water management and sustainability analysis.

Specifically, SGMA requires that GSAs discuss historical, current, and projected water demands and supplies (Water Code §10727.2(a)(3)). These can be evaluated in the context of water budgets, which are a useful tool for understanding water availability. Water budgets allow water resource managers to quantify inflows, outflows, and changes in storage at both the local and regional scale. The preparation of a water budget allows water resource managers to check their understanding of regional water supplies and demands based on available data and use that understanding to make management decisions such as investing in new water supplies, water conveyance infrastructure or reducing water demands. Water budget development can reveal data gaps and uncertainties in how much water is available. The Turlock Model refines C2VSimFG to capture and represent local considerations and conditions.

It is challenging to represent a complex hydraulic system without an integrated model; surface water and groundwater are an integrated physical system that is used to meet water demands in the San Joaquin Valley. Monitoring of groundwater pumping and recharge, direct measurement of subsurface flows is not widely possible, and the traditional method of accounting for water supplies and demands empirically through a water budget is multi-faceted. As a result, there is a need to represent the physical properties of the hydrologic system in an integrated way to enable estimation of the unknown water budget components. An integrated hydrologic model is designed for this purpose. This type of model simulates both surface water and groundwater flow and the interactions between surface water and groundwater while representing the known physical constraints between the various water budget components. This coupling dynamically accounts for both conservation of mass and momentum, and allows for simulation of regional and local changes in land use, water use and water supply conditions on the groundwater movement, levels, storage, budgets, as well as interaction between the surface water courses and streams with the groundwater system, all of which are important to sustainable groundwater management. Comprehensive water budgets, including those reflecting land surface processes, groundwater system, and the stream system are considered for the historical period, existing conditions baseline, projected conditions baseline, and projected conditions baseline under climate change, as well as for the sustainable groundwater management scenarios.

1.2 TURLOCK SUBBASIN

The Turlock Subbasin is in the heart of the San Joaquin Valley and straddles Stanislaus County and Merced County. It is bounded by the Modesto Subbasin to the north (Tuolumne River), Merced Subbasin to the south (Merced River), and Delta Mendota Subbasin to the west (San Joaquin River). The Turlock Subbasin is Bulletin 118 basin number 5-022.03.

Two GSAs comprise the Turlock Subbasin: West Turlock Subbasin GSA (WTSGSA) and East Turlock Subbasin (ETSGSA). WTSGSA includes Turlock Irrigation District (TID), which operates Don Pedro Dam and Turlock Lake, and is a large surface water provider in the basin. It also includes some non-district areas which primarily rely on riparian surface water. WTSGSA member agencies also include the Cities of Turlock, Ceres, Modesto, Hughson, Waterford (for Hickman), and the communities of Delhi, Denair, and Keyes. Groundwater is used as a supplemental water supply throughout WTSGSA, and as a primary or supplemental water supply by the municipal water systems. ETSGSA spans the eastern half of the Subbasin, excluding Turlock Lake and other TID water diversion and conveyance infrastructure near the Tuolumne River. Water demand in ETSGSA is met primarily by groundwater, and it is made up of primarily

agricultural and native areas, including Eastside Water District (EWD), Ballico-Cortez Water District (BCWD), and Merced Irrigation District (MID).

1.3 ACKNOWLEDGEMENTS

The C2VSimTM is developed in a collaborative environment with open and transparent process in compilation of data and information for the Subbasin, detailed assumptions including those on the land use, cropping patterns, water use, water supply, reservoir operations and surface water deliveries, irrigation practices, drainage conditions, hydrogeologic conditions, groundwater use, and other detailed features.

The following individuals had significant contributions in development of the model for the Turlock Subbasin:

Debbie Montalbano, Turlock Irrigation District
Michael Cooke, Turlock Irrigation District
Wes Monier, Turlock Irrigation District
Kevin Kaufman, Eastside Water District
Sarah Woolfe, Eastside Water District
Miguel Alvarez**,** City of Modesto
Karen Morgan, City of Ceres
Michael Cooke, City of Turlock (prior to joining TID)

The model development task was funded by the Department of Water Resources as part of the grant for groundwater sustainability plan development. Following DWR individuals played key role in the model development activities:

Tyler Hatch, DWR: Sustainable Groundwater Management Office
Can Dogrul, DWR: Bay Delta Office

The following consultants were engaged in development and calibration of the model, and/or development of the baseline conditions and application of the model for sustainable groundwater management in the Turlock Subbasin:

Woodard & Curran, Inc.
Ali Taghavi, Principal in Charge and Senior Oversight
Dominick Amador, Lead Modeler

Davids Engineering
Bryan Thoreson, IDC Refinement Oversight
Lindsay Hall, IDC Refinement

Todd Groundwater (Prime Consultant)

Phyllis Stanin, GSP Project Manager
Liz Elliott, Hydrogeologic Conceptual Model

Other individuals who provided support on review of the data, assumptions, calibration, and model application:
Derrick Williams, Montgomery and Associates
John Lambi, e-Purwater
Mike Tietza, Formations Environmental

2. C2VSIMFG REFINEMENTS IN THE TURLOCK SUBBASIN

2.1 MODEL FRAMEWORK

The Turlock Model simulates the entire C2VSimFG model domain, including all C2VSimFG model features, with appropriate refinements in the Turlock Subbasin. This version of C2VSimFG uses the IWFM-2015 code, includes hydrologic data from period of water years 1922-2015, and was calibrated from October 1990 through September 2015.

Although the C2VSimTM was originally based on the BETA2 release, and the C2VSimFG has since been released as version 1.1, the foundational model datasets, such as the grid, hydrologic and hydrogeologic data sets, and soil conditions have maintained consistency through the various model versions. Version 1.1 has refinements to the land and water use, as well as hydrologic and hydrogeologic parameters that were refined during C2VSimFG model calibration (DWR, 2021). As part of the Turlock Model's refinements, these datasets and parameters were refined and over-written for the Turlock Subbasin. The details of data refinements and sources of data are presented in remaining sections of this report. The Turlock Model, thus, maintains consistency with C2VSimFG datasets and uses the most recent relevant information. Therefore, the Turlock Model is the latest and most defensible model available to address the integrated groundwater and surface water resources in the Turlock Subbasin.

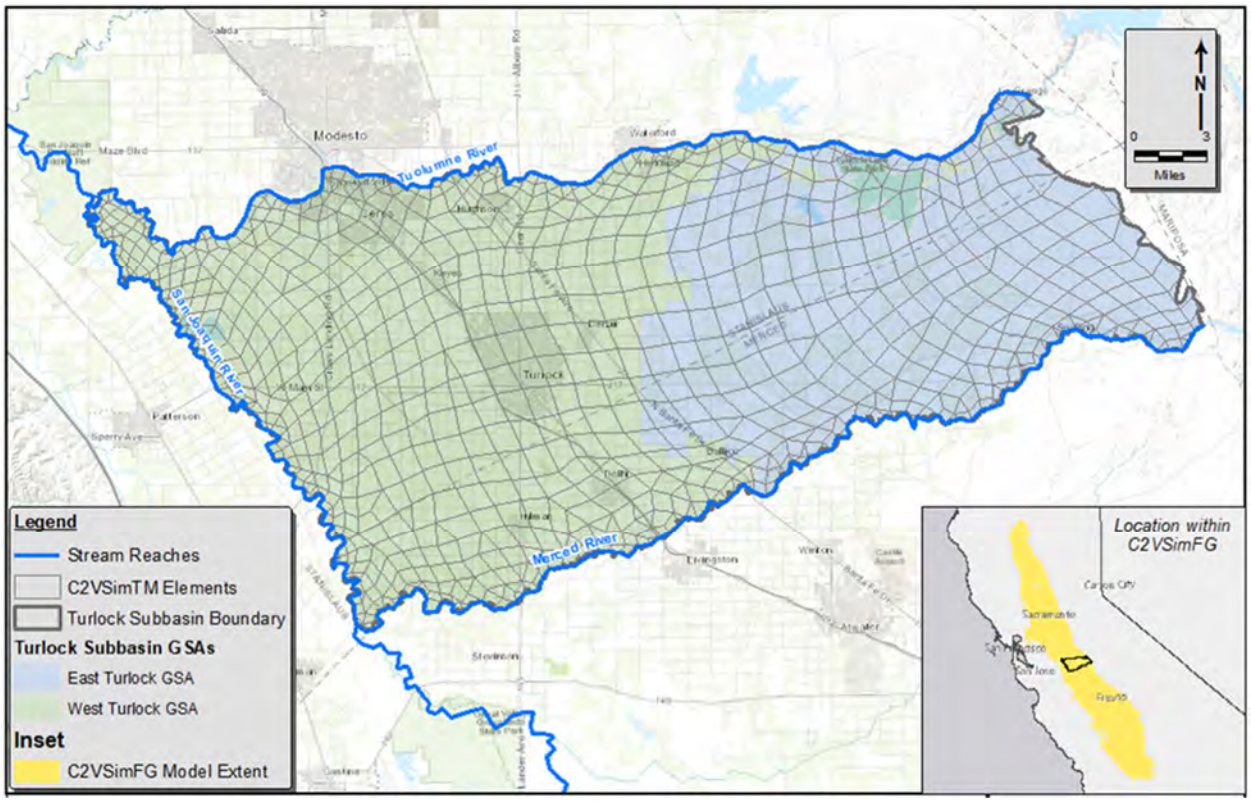
In total, there are 32,537 elements in the entire model, covering an area of more than 20,000 square miles. Starting from the C2VSimFG model features and standard inputs, subsequent modifications and refinements were made to land surface parameters corresponding to model features within the Turlock Subbasin, identified as Subregion 12 in the C2VSimFG domain. The Turlock Subbasin portion of the model contains 962 elements that cover approximately 348,500 acres, with average element size of approximately 362 acres, ranging from 18 to 1100 acres. Although the Turlock Model encompasses data refinements and calibration enhancements for the Turlock and Modesto Subbasins, this report documents the data and calibration refinements in the Turlock Subbasin portion of the model only, which is used to support the development of the Turlock Subbasin GSP. As such, this report refers to the model as the "Turlock Model". The refinements for the Modesto Subbasin are documented in a separate report for the Modesto Subbasin.

A map of the elements and model subareas within the Turlock Subbasin is shown in **Figure 2**. As with any IWFM-2015 model, the Turlock Model simulates all hydrologic processes and conditions at the node and element level.

There has been past modeling practices and model development projects that covered the Turlock Subbasin. The C2VSimTM development and data compilation relied on some of these models, on an as needed basis:

Model Name	Author	Year Published
California Central Valley Ground-Surface Water Model (CVGSM)	California Department of Water Resources	1990
Turlock Groundwater Basin Model	Tim Durbin	2008, 2014
Hydrologic Model of the Modesto Region (MERSTAN)	United States Geological Survey	2015
Stanislaus County Hydrologic Model	Mike Tietze	2017
Merced Water Resources Model (MercedWRM)	Woodard & Curran	2019
California Central Valley Groundwater-Surface Water Simulation – Fine Grid Model (C2VSimFG)	California Department of Water Resources	2020

Figure 2: Turlock Model Elements



2.1.1 Land Surface Processes

The IWFM modeling platform is configured to simulate water demand and exchanges between the land surface and groundwater system at each element level based on various land use types and crop categories (Dogrul et al., 2016). Land use information, soil characteristics, and various other root zone parameters were developed and specified as inputs to the Turlock Model as the basis for characterizing and simulating all land surface processes in the Turlock Subbasin. The data sources and approach used to specify these inputs are described in Section 3. Where possible, inputs were derived directly from measured or reported data, locally available information sources, and local water budgets. Key resources in the Turlock Subbasin include:

- Turlock Irrigation District (TID) operations and water supply data (generally available in electronic form beginning in 1991)
- TID semi-automated water budget application, and water budget results (beginning in 1991)
- TID daily IWFM Demand Calculator (IDC) root zone water budget application, developed and used as part of the TID semi-automated water budget application

As described in Sections 3, in cases where direct data or local information were unavailable, inputs to the Turlock Model were developed and configured to provide for model results that match:

- TID semi-automated water budget application, and water budget results (for elements in TID)
- Typical, expected local irrigation practices (for elements outside TID in the Turlock Subbasin)
- Irrigation practices and information obtained from personal communications with representatives of other entities, including Eastside Water District

2.1.2 Surface Water System

As described above, the Turlock Model encompasses the entire C2VSimFG model domain, including all C2VSimFG surface water network features. A total of 110 stream reaches are simulated across the entire model domain, represented by 4,634 total stream nodes. More than 400 diversions are specified to distribute water from these streams or from outside the model domain on elements across the entire model domain.

Surrounding the Turlock Subbasin, the Turlock Model dynamically simulates flow in the Tuolumne, Merced, and San Joaquin Rivers. In addition to the three major rivers, the Turlock Model also accounts for recharge and runoff from local creeks and tributaries. Contributions to the Subbasin's groundwater system from the upper watersheds outside of the Subbasin boundary (such as Dry Creek) are captured as surface and subsurface flows from the small watershed package within IWFM (**Section 2.1.4**). On the other hand, recharge and runoff from watersheds that originate within the model area (such as Mustang and Sand Creek) are simulated at the element level using the Natural Resource Conservation Service (NRCS) Curve Number Method.

Streams along the boundary of the Turlock Subbasin and diversions to land within the Turlock Subbasin were reviewed and updated, as needed, in the Turlock Model. Diversions were adapted to accommodate the actual reported distribution and delivery of surface water by Turlock and Merced Irrigation Districts. New stream inflows were also added to the Turlock Subbasin area to account for spillage into the Merced, Tuolumne, and San Joaquin Rivers from TID canals and laterals. The data sources and methodologies used to specify these changes to the surface water network are described in **Section 3.7.1**.

2.1.3 Groundwater System

The Following section highlights the hydrogeologic analysis and structures within Turlock Subbasin. Additional detailed information relating to stratigraphy and the development of model layers are available in the C2VSimFG Model Report (DWR, 2020)

2.1.3.1 Hydrogeologic Structure

The Turlock Subbasin lies predominately within the San Joaquin Valley, which forms the southern half of California's Central Valley, a large, northwest-southeast-trending sediment-filled basin underlain by the igneous and metamorphic bedrock of the Sierra Nevada batholiths and the east-dipping of marine sedimentary rocks of the Coast Ranges (Norris & Webb, 1990). Major water bearing formations in the San Joaquin Valley include the Valley Springs, Mehrten, Laguna, Turlock Lake, Etchegoin, San Joaquin, Tulare, Riverbank, Modesto, and Kern River Formations, seven of which are present in Turlock Subbasin:

Valley Springs Formation
The Valley Springs Formation crops out discontinuously along the eastern flank of the Central Valley from just south of the Bear River to just north of the Chowchilla River. The Valley Springs is a mostly fluvial sequence consisting chiefly of sandy clay, quartz sand, rhyolitic ash, and siliceous gravel (Davis & Hall, 1959). The Valley Springs Formation ranges in thickness from 0 to about 450 feet in the San Joaquin Valley (DWR, 1978). The Valley Springs Formation is considered largely non-water-bearing due to its fine ash and clay matrix (ESJGA, 2019).

Mehrten Formation
The Mehrten Formation is considered the oldest significant fresh water-bearing formation within the Eastern San Joaquin Valley. The Mehrten Formation in the east-central portion of the Central Valley is comprised of sandstone composed of amphiboles, pyroxenes, and pebbles with lenticular bedding (Bartow & Doukas, 1979). The Mehrten Formation outcrops discontinuously along the eastern flank of the Valley and was laid down by streams carrying andesitic debris from the Sierra Nevada (Ferriz, 2001).

It is typically between 700 and 1,200 feet thick. The black sands of the Mehrten Formation have moderate to high permeability and yield large quantities of fresh water to wells (Davis & Hall, 1959) (DWR, 1967).

Laguna Formation
The Laguna Formation is exposed in the eastern foothills in the northern portion of the San Joaquin Valley. The Laguna Formation is a sequence of predominantly non-volcanic, fine-grained, poorly bedded, somewhat-compacted continental sedimentary deposits that are typically tan to brown in color (Olmsted & Davis, 1961).

The Laguna Formation outcrops in the northeastern part of San Joaquin County and reaches a maximum thickness of 1,000 feet. The Laguna Formation is moderately permeable with some reportedly highly permeable coarse-grained fresh water-bearing zones.

Turlock Lake Formation
The Turlock Lake Formation consists of mostly fine sand, silt, and, in places, clay. The Turlock Lake Formation coarsens upward, with silt and clay at the bottom of the formation and more sand and gravel near the top of the formation (Marchand & Allwardt, 1981). The thickness of the Turlock Lake Formation is variable and appears to increase toward the east, ranging from 160 to 1,000 feet thick. Near the valley axis, it is intercalated with the Tulare Formation, described below.

Tulare Formation
The Tulare Formation is made up of lenticular and generally poorly sorted clay, silt, sand, and gravel. It consists of interfingered sediments ranging in texture from clay to gravel (Hotchkiss & Balding, 1971). The Tulare Formation conformably overlies the San Joaquin Formation. In the southwestern part of the San Joaquin Valley, the exposed Tulare ranges in thickness from a few tens of feet to more than 4,000 feet (Wood & Dale, 1964).

The Tulare Formation includes alluvial fan deposits, deltaic deposits, flood plain deposits, and lake deposits. The lake deposits compose the Corcoran Clay (E-Clay) member of the Tulare Formation, a prominent aquitard present in the western portion of Turlock Subbasin. The Corcoran Clay separates the semi-confined Upper Tulare from the confined Lower Tulare Formation (Hotchkiss & Balding, 1971). The Corcoran Clay extends eastward into the Turlock Lake Formation, and separates the semi-confined Upper Turlock Lake from the confined Lower Turlock Lake Formation.

Riverbank Formation
The Riverbank Formation consists primarily of arkosic sand with gravel lenses derived mainly from the interior Sierra Nevada, which forms at least three sets of terraces and coalescing alluvial fans along the eastern San Joaquin Valley (Marchand & Allwardt, 1981). The Riverbank Formation unconformably overlies the Laguna Formation and is typically between 65 and 260 feet thick (ESJGA, 2019).

Modesto Formation
The Modesto Formation is composed of arkosic gravels and sands with silt, which were deposited over top of late Riverbank alluvium as a series of coalescing alluvial fans extending continuously from the Kern River drainage on the south to the Sacramento River tributaries in the north. The total thickness of the Modesto deposits is reported to be 50 to 100 feet in eastern Stanislaus County, 130 feet along the Merced River, and about 65 feet along the Chowchilla River fan.

Outcrops of the above formations are locally overlain by younger alluvium – typically sediments deposited less than 9,000 years ago.

2.1.3.2 Model Layering and Initial Parameters

The Turlock Model layering is the same as the C2VSimFG stratigraphy, a detailed description of which is available within the C2VSimFG Model Report (DWR 2020). A summary of the basis for model layering is described below. The C2VSimFG stratigraphy and initial parameters are based upon a Central Valley-wide texture model produced by DWR. It included a total of 10,444 well and boring logs and provided information about the three-dimensional distribution of coarse-grained and fine-grained materials within the groundwater system. These texture distributions were adopted as the initial aquifer parameters and stratigraphy by node and layer in the Turlock Model and were refined during calibration.

Based on the geologic information in the lithologic dataset, C2VSimFG is divided into four aquifer layers that were adopted in the Turlock Model. The top three layers represent freshwater aquifers while the bottom layer, Layer 4, corresponds to the saline layer where little to no pumping occurs. Layers 2 through 4 have a minimum thickness of 50 feet. Information, as well as supporting source data, on each layer is provided below. The C2VSimTM uses the same model layering and thicknesses as the C2VSimFG.

Ground Surface Elevation

Ground surface elevation is established for each Turlock Model groundwater node relative to mean sea level. The ground surface elevation for the Turlock Model was derived from the USGS National Elevation Dataset.

Layer 1

Layer 1 represents the portion of the unconfined aquifer in which shallow groundwater pumping occurs. Layer 1 thickness ranges from 65 feet to 425 feet in the Turlock Subbasin. Layer 1 represents the western-upper principal aquifer where the Corcoran Clay exists and is the unconfined section of the eastern-principal aquifer. Layer 1 represents the top-most, unconfined principal aquifer. Because of the relatively large thickness of this layer, locally perched aquifers are not simulated.

Layer 2 Aquitard

The Layer 2 aquitard, which falls between aquifer Layer 1 and Layer 2, represents the Corcoran Clay that separates the upper western principal aquifer from the lower western principal aquifer. The Corcoran Clay depth and thickness were sourced from the updated USGS contours (2019) used in the CVHM model. It is the only layer explicitly modeled as an aquitard in the Turlock Model and pinches out in the eastern principal aquifer portion of the model. The Turlock Model simulates vertical movement of groundwater through an aquitard layer as an aquitard between the two aquifer model layers 1 and 2, as opposed to a separate explicit intervening low conductivity aquifer layer. Both formulations have shown to be valid and relatively comparable.

Layer 2

Layer 2 generally represents the portion of the sub-Corcoran confined aquifer system in which regional groundwater pumping occurs. In western areas of the Turlock Subbasin where the Corcoran Clay exists, Layer 2 represents the upper fraction of the western-lower principal aquifer where most of the groundwater production occurs. In the eastern-principal aquifer, Layer 2 is considered the lower-pumping zone where most of the production occurs. Layer 2 thickness ranges from roughly 50 feet to 610 feet in the Turlock Subbasin.

Layer 3

Layer 3 generally corresponds to the deep, confined aquifer where little pumping occurs. Where the Corcoran Clay is present, it defines the deeper, confined aquifer layer. The bottom of Layer 3 is the reported base of fresh groundwater adopted from C2VSimFG. Layer 3 thickness ranges from 50 to 665 feet in the Turlock Subbasin. The base of freshwater, or the bottom of Layer 3, was prepared by the DWR South Central Regional Office by reviewing the DOGGR electric logs and induction-electric logs to estimate the quality of water at a specific depth. (DWR, 2015; Olivera, 2016).

Layer 4

Layer 4 is bounded by the base of fresh groundwater at the top and by the reported basement complex (relatively impermeable igneous and metamorphic rocks and the Cretaceous Great Valley sequence) at the bottom. The bottom of Layer 4 represents the interface between the post-Eocene continental deposits and underlying, lower-permeability Cretaceous or Eocene deposits of marine origin. This layer contains primarily saline groundwater with concentrations defined as Total Dissolved Solids (TDS) of more than 3,000 parts per million. This layer is up to 2,640 feet thick in the Turlock Subbasin. Although, there is little to no active pumping in layer 4 at this depth, inclusion of this layer in the model is important for several reasons: (i) a hydraulically defensible no-flow boundary condition is established at the bedrock; (ii) including the complete saturated thickness of the aquifer can facilitate simulation of interconnection between fresh water (Layers 1-3) and salt water (Layer 4) layers, and (iii) potential impacts of upward movement of groundwater due to pumping from deep wells in layer 3 can be simulated. The thickness of the aquifer was developed by Williamson et al. 1989 and included in USGS's Central Valley Regional Aquifer System Analysis (CV-RASA).

2.1.4 Small-Stream Watersheds

A significant portion of the water that flows through Turlock Subbasin originates in the rim watersheds up-gradient from the alluvial portion of the valley. Within the Turlock Model, these rim watersheds can be divided into two broad classes: gauged watersheds with specified inflows into the C2VSimFG stream network, which are described in **Section 2.1.2**, and ungauged watersheds whose outflow is dynamically calculated using the IWFM Small Watershed component, which are discussed below.

The land cover in these small watersheds is generally native vegetation. The watersheds receive precipitation and discharge surface water into small and intermittent streams that flow across the valley floor into larger streams and rivers, with a portion of this flow entering the aquifer as recharge. They also discharge a small amount of groundwater laterally into Turlock Subbasin aquifers. These monthly surface water discharge, recharge, and subsurface groundwater flow values from small watersheds are dynamically calculated in the Turlock Model.

The Turlock Model includes the same small watersheds as C2VSimFG, and adopts simulation of 11 small watersheds bounding the Turlock Subbasin to the east. The small watersheds were delineated using the USGS Watershed Boundary Dataset. The outer boundary of the small watersheds conforms to the HUC-12 boundaries, which were clipped to the C2VSimFG boundary. Surface flows from small watersheds are routed along specified groundwater nodes, with a user-defined maximum percolation rate to groundwater at each node, selected using the USGS NHD Flow Lines. Precipitation for each small watershed was developed using the same method as precipitation for the model elements, as described in section 3.1 of this document. All subsurface inflows from the small watersheds are routed to model Layer 1. The above assumptions were not changed between C2VSimFG and the Turlock Model.

The range of selected small watershed parameters are shown in Table 1: Average Small Watershed Parameters near the Turlock Subbasin. Root zone hydraulic conductivity, root zone depth, evapotranspiration rate, wilting point, field capacity, total porosity, and pore size distribution index for each watershed were defined based on the average root zone soil parameters of elements bordering the small

watersheds. An average curve number of 60 was selected for all watersheds to represent the native vegetation coverage of the foothills based on NRCS runoff curve number descriptions in Technical Release 55 (TR-55).

Table 1: Average Small Watershed Parameters near the Turlock Subbasin

ET Rate (in/month)	Wilting Point	Field Capacity	Total Porosity	Pore Size Dist. Index	Root Zone Depth (ft)	Root Zone Hyd. Cond. (ft/month)	Curve Number
680.36	0.11	0.21	0.33	0.49	6.20	0.15	60

3. LAND SURFACE PROCESSES

Land surface processes include flows through the root zone of irrigated and non-irrigated lands, groundwater pumping to meet agricultural and urban water demand, and surface water diversions and flows over the land surface. The land surface processors are simulated using the IWFM Demand Calculator (IDC). The IDC is one of the major modules of the IWFM modeling package that can be developed and used as a stand-alone model for calculation of agricultural water demand, or can be used as an integrated part of the overall IWFM modeling package. In the case of the Turlock Model, the IDC was initially developed and calibrated as a stand-alone model and was subsequently integrated with the groundwater flow and stream package to be part of the overall C2VSimTM. The final integrated package was re-calibrated for the land surface processes and calibrated for the groundwater flow and streamflow as a comprehensive and integrated model. Section 3 presents the refinement, updates, and calibration of the IDC module. In this section, the IDC may also be referred to as model. Section 5 presents the calibration process for the complete integrated C2VSimTM model.

To account for all flows through the root zone, a root zone water budget was computed for each crop and land use class in all elements of the Turlock Model domain. The root zone water budget is a critical part of the overall Turlock Model, as it quantifies many of the interactions between land surface processes and the underlying groundwater system. The root zone water budget uses data and inputs describing precipitation, land use, soil characteristics, runoff, and other parameters described in the following sections to track moisture through the root zone.

Water supplies in the Turlock Subbasin include both surface and groundwater. Surface water deliveries are provided to users by Turlock Irrigation District, Merced Irrigation District, and riparian diverters. Groundwater is also conveyed to users by Turlock Irrigation District, Merced Irrigation District, and urban water suppliers. In addition to agency-based water supplies, there are private agricultural and urban groundwater users across the Subbasin, both on the west and east side. Private groundwater production is calculated in the Turlock Model to meet a portion of the total or all of the agricultural and urban water demand in a given element.

Data and model inputs that define land surface processes were evaluated and refined within the Turlock Subbasin using available local information for agencies and areas within the WTSGSA and ETSGSA. Where local information is unavailable, model inputs have been evaluated and refined using the best available information and professional standards of practice. Generally, more local information is available for member agencies in the WTSGSA: urban water use and population data are available for several cities in the WTSGSA, and TID has developed and maintained a detailed water budget for its irrigation service area since the 1990s. Although less local information is available for member agencies in the ETSGSA, the land surface processes for these areas have been simulated using all pertinent, available information, professional judgment, and standards of practice.

This section describes the data sources and methodologies used to specify model parameters and monthly time series data provided as inputs to the Turlock Model to simulate these land surface processes. Unless otherwise noted, other inputs to the C2VSimFG model were generally used directly in the Turlock Model.

3.1 PRECIPITATION

The precipitation data set for the Turlock Model is based on the C2VSimFG with no changes, other than updates to WY 2018. Monthly precipitation data included with the C2VSimFG release files were used directly in the Turlock Model. These precipitation data originate from spatially discretized precipitation datasets available from the Parameter-elevation Regressions on Independent Slopes Model (PRISM) climate analysis system. PRISM combines weather and climate data from various monitoring station networks, applies a range of modeling techniques, and develops gridded spatial climate parameter datasets for grid cells across the United States at spatial resolutions of four kilometers and 800 meters (NACSE,

2021). A PRISM dataset that is spatially discretized at an 800-meter resolution was mapped to corresponding model elements and small watershed in the C2VSimFG model domain.

3.2 LAND USE

Annual, spatial land use in the Turlock Subbasin was developed using the data sources identified in **Table 2**. Elemental land areas in the Turlock Subbasin were assigned to one of 24 land use classes. These land use classes are summarized by water use sector in **Table 3**.

Within the TID service area, the following approach was used. Annual land use inputs to the Turlock Model were summarized from TID parcel crop data for all applicable land use classes. Other land use inputs were summarized from spatially distributed land use data during years when those data were available (**Table 3**). In other years, land use areas were interpolated by county using annual County Agriculture Commission land use data.

Within the Turlock Subbasin, but outside the TID service area, the following approach was used. Annual land use was estimated from spatially distributed land use data during years when those data were available (**Table 3**). To address missing data within Merced County between 2012-2015, available spatial data during this period was combined into one spatial dataset and applied to all four years. In other years and regions, land use areas were generally interpolated by county using annual County Agriculture Commission land use data, with small adjustments to match the total acreage of the Subbasin within each county.

Table 2: Land Use Data Sources Available during the Historical Period (1991-2015).

Data Type	Data Source	Years Available during the Historical Period (1991-2015)
Spatially distributed land use data	TID parcel crop data	1991-2015
	DWR County Land Use surveys (Stanislaus County)	1996, 2004, 2010
	DWR County Land Use surveys (Merced County)	1995, 2002
	Land IQ remote sensing-based land use identification	2014
	County land use, provided by Todd Groundwater	2014
Tabular land use data	County Agriculture Commission land use data (Stanislaus County, Merced County)	1991-2015

Table 3: Summary of Land Use in the Turlock Subbasin.

Water Use Sector	Land Use Class	Land Use Code	Average Area, 1991-2015 (acres[1])
Agricultural	Alfalfa	AL	17,780
	Almonds & Pistachios	AP	93,940
	Citrus & Subtropical	CS	120
	Corn	CN	53,840
	Cotton	CO	0
	Cucurbits	CU	30
	Dry Beans	DB	1,830

	Grain	GR	0
	Idle	ID	8,360
	Onions & Garlic	OG	10
	Other Deciduous	OR	17,320
	Other Field	FL	12,760
	Other Truck	TR	1,590
	Pasture	PA	18,330
	Potatoes	PO	2,040
	Safflower	SA	0
	Sugar Beets	SB	0
	Tomato-Fresh	TF	0
	Tomato-Processing	TP	270
	Vineyards	VI	10,470
Native Vegetation	Native Vegetation	NV	60,100
	Open Water	OW	6,550
	Riparian Vegetation	RV	4,880
Urban	Urban	UR	38,080
Total			348,300

[1] Average land use areas rounded to nearest 10 acres.

3.3 SOIL PARAMETERS

3.3.1 Soil Textural Classes and Model Parameters

Soil textural classes and associated soil hydraulic parameters used in the Turlock Model were adopted from C2VSimFG and developed from soils data available through the Soil Survey Geographic (SSURGO) database. The SSURGO database used in development of this model was prepared by Soil Survey Staff in 2014, and contains information collected by the National Cooperative Soil Survey (NCSS) about soils across the United States. The United States Department of Agriculture-Natural Resources Conservation Service (USDA-NRCS), formerly known as the Soil Conservation Service (SCS), organizes the NCSS and publishes soil surveys.

Six soil texture classes were simulated in the Turlock Subbasin portion of the Turlock Model domain (**Table 4**). Most soils found in the Subbasin have predominantly sandy or loamy characteristics, representing more than 90 percent of the total Subbasin area.

Six soil parameters were specified for each soil texture and provided as inputs to the Turlock Model:

1. Permanent Wilting Point (PWP), dimensionless
2. Field Capacity (FC), dimensionless
3. Total Porosity (φ), dimensionless
4. Pore Size Distribution Index (λ), dimensionless
5. Saturated Hydraulic Conductivity (K_{sat}), in feet per day (ft/day)
6. Ponded Hydraulic Conductivity (Ponded K), in ft/day

For each soil texture class derived from SSURGO, initial soil hydraulic parameters were estimated based on pedotransfer functions (predictive functions of certain soil properties using data from soil surveys) reported by Saxton and Rawls (2006), refined to provide drainage from saturation to field capacity within a reasonable amount of time, and used to predict minimal gravitational drainage once field capacity was reached.

Table 4 summarizes the soil parameter values specified in the Turlock Model for elements within the Turlock Subbasin.

Table 4: Soil Textures and Corresponding Soil Parameters in the Turlock Subbasin

Soil Texture	Area in Turlock Subbasin (acres)	Percent of Total Area in Turlock Subbasin (%)	Soil Parameters (units)					
			PWP (-)	FC (-)	φ (-)	λ (-)	Ksat (ft/d)	Ponded K, area-weighted average (ft/d)
Sandy loam	207,868	60%	0.077	0.158	0.384	0.370	19.20	0.00952
Loamy sand	47,295	14%	0.022	0.081	0.400	1.020	29.70	0.00906
Loam	38,053	11%	0.121	0.241	0.392	0.180	9.90	0.00966
Sand	29,060	8%	0.005	0.038	0.424	2.650	36.70	0.00867
Clay loam	15,675	4%	0.211	0.350	0.439	0.145	0.33	0.00971
Sandy clay loam	10,568	3%	0.153	0.261	0.397	0.160	7.80	0.00934
Total	348,520	100%						

3.3.2 Initial Soil Moisture

For non-ponded, ponded, urban, and native lands, the initial soil moisture (i.e., volumetric water content as a fraction of field capacity at the beginning of the historical water budget period, 1991-2015) was determined from the soil moisture conditions based on C2VSimFG. It was assumed that none of the initial soil moisture was contributed by precipitation, based on typical precipitation patterns in the summer months. While the precise soil moisture at the start of each water year varies and is generally unknown, initializing the Turlock Model historical simulation based on the final conditions of a previous simulation period with similar hydrologic conditions helps to minimize any potential effect from uncertainties related to initial soil moisture. These effects are not considered significantly to impact analyses of the historical water budget period (1991-2015).

3.4 RUNOFF CURVE NUMBER

The Turlock Model initially adopted a modified version of the SCS curve number (SCS-CN) method used in C2VSimFG to compute runoff of precipitation. A curve number for each land use class and soil type is required as part of the model inputs for each model element. Curve numbers are used as described in the National Engineering Handbook Part 630[1] (USDA, 2004, 2009) based on land use or cover type, treatments (straight rows, bare soil, etc.), hydrologic condition, and hydrologic soil group.

Curve numbers were evaluated and refined for areas within the Turlock Subbasin using available local information. For elements representing the TID service area, curve numbers were evaluated and refined through comparisons of runoff from the standard curve number inputs to the C2VSimFG Root Zone Component v.4.11 model and the daily IWFM Demand Calculator (IDC) root zone water budget application used to support TID's semi-automated water budget. A 25 percent reduction factor was applied to the curve numbers included with C2VSimFG Root Zone Component v.4.11, resulting in runoff that was consistent with TID's daily IDC application.

For other elements in the Turlock Subbasin, curve numbers were evaluated by reviewing monthly runoff volumes resulting from the standard curve number inputs to the C2VSimFG Root Zone Component v.4.11

[1] Table 9-1. Runoff curve numbers for agricultural lands.

model. Results were reviewed with consideration for crops and local soil conditions found in the ETSGSA, as determined from field visits, soil analyses, and land use analyses (described above). These evaluations concluded that runoff simulated by the C2VSimFG Root Zone Component v.4.11 standard inputs were reasonable for local conditions. Thus, without additional local water budget information to refine the curve numbers, standard curve number inputs to the C2VSimFG Root Zone Component v.4.11 model were used directly.

3.5 AGRICULTURAL WATER DEMAND

3.5.1 Evapotranspiration

Crop evapotranspiration (ET_c), or crop consumptive use, represents the volume of water that is lost to the atmosphere through both evaporation from the soil and transpiration from crop surfaces. A portion of the total water that crops and vegetation consume originates from precipitation (referred to as evapotranspiration of precipitation, or ET_{pr}) while other portions of ET_c may originate from applied water (referred to as evapotranspiration of applied water, or ET_{aw}).

The Turlock Model updated ETc values included in C2VSimFG by computing a monthly root zone water budget, utilizing inputs of monthly ET_c together with other parameters described in Section 3.2 and Section 3.3 that specify land use and soil characteristics, respectively. Together, these parameters allow the Turlock Model to simulate all inflows and outflows through the root zone, including the portions of ET_c resulting from precipitation (ET_{pr}) and applied water (ET_{aw}). A root zone water budget is a generally accepted and widely used method to properly and consistently track the portions of ET_c attributed to precipitation and applied water, as well as other water that is transmitted through the soil and plant surfaces (ASCE, 2016 and ASABE, 2007).

Monthly ET_c inputs for each crop in the Turlock Subbasin were summed from daily ET_c values originally calculated for select land use classes in the TID semi-automated water budget. **Table 5** summarizes the mapping of specific crops simulated in the Turlock Subbasin to the crop ET groups simulated in the TID semi-automated water budget.

Daily ET_c for each crop ET group in the Turlock Subbasin was calculated using the "crop coefficient – reference crop ET" methodology, using daily evapotranspiration from a hypothetical, well-irrigated, clipped, cool-season grass reference crop surface (ET_o) and local crop coefficient (K_c) curves.

Daily ET_o values calculated from California Irrigation Management Information System (CIMIS) station weather data were used to represent average reference crop consumptive use across TID (**Table 6**). Measured weather parameters supporting daily ET_o calculations were quality-controlled following standard procedures (ASCE-EWRI, 2005) to produce a high quality daily ET_o time series. These quality controlled ET_o values were multiplied by local crop coefficients to develop ET_c time series for each land use class. Crop coefficients were derived using the daily ET_o values described in the previous paragraph, spatial land use data, and actual ET (ET_a) estimates for each of the crop ET groups in **Table 5**.

Actual ET_a estimates were calculated across nine recent years and used to further refine the ET values in the Turlock Model. ET_a estimates were based on the results of two remotely sensed surface energy balance approaches: Mapping Evapotranspiration at High Resolution with Internalized Calibration (METRIC) and Surface Energy Balance Algorithm for Land (SEBAL). METRIC and SEBAL results account for effects of salinity, deficit irrigation, disease, fertilization, immature permanent crops, crop canopy structure, and any other factors resulting in differences between potential and actual crop ET. Studies by Bastiaanssen et al. (2005), Allen et al. (2007, 2011), Thoreson et al. (2009), and others have found that when performed by an expert analyst, seasonal ET_a estimates by these models can be within five percent of actual ET determined using other, reliable methods.

For years before the Denair CIMIS station began reporting daily weather data in September 2002, monthly reference evapotranspiration was multiplied by each of the crop coefficients, resulting in a monthly time

series of ET_c for each crop modeled in the daily water budget within TID for these years. These monthly ET_c values were then converted to average daily ET_c and for use within the daily TID root zone water budget model. Between September 2002 and the end of the historical water budget period, daily reference evapotranspiration values obtained from the CIMIS stations were directly multiplied by each crop coefficient to provide daily ET_c for use within the IDC model.

In elements representing the WTSGSA (including those outside TID), daily ET_c values calculated for the TID water budget were first summed to monthly ET_c values, and then provided directly as inputs for land use classes (**Table 5**). The annual ET_c for these crop ET groups over the historical water budget period are shown in **Figure 3** and **Table 7**.

For elements representing the ETSGSA, further analyses were completed to identify additional refinements needed to accurately represent local ET_c. Actual ET_a estimates for crops in the ETSGSA area were calculated from remotely sensed surface energy balance results and were compared with the corresponding ET_a estimates (i.e., same year, same crop, same remote sensing approach) calculated from remotely sensed surface energy balance results to support the TID semi-automated water budget. These comparisons found no significant difference, so the same ET_c inputs used in the WTSGSA for each crop ET group and land use class were also used in the ETSGSA.

Table 5: Crop Evapotranspiration Groups for Land Use Classes in the Turlock Subbasin

Crop ET Group (METRIC and SEBAL Remote Sensing Analyses)	Land Use Class (Simulated in Monthly Turlock Model, for Turlock Subbasin)	Average ET_c, 1991-2015 (inches/year)
Alfalfa	Alfalfa	43.6
Almonds & Pistachios	Almonds & Pistachios	38.5
Corn	Corn	38.2
	Dry Beans	
Other Field Crops	Cotton	37.3
	Cucurbits	
	Grain	
	Onions & Garlic	
	Other Field Crops	
	Other Truck Crops	
	Potatoes	
	Safflower	
	Sugar Beets	
	Tomatoes – Fresh	
	Tomatoes – Processing	
Other Deciduous Crops	Citrus & Subtropical	36.1
	Other Deciduous Crops	
Pasture	Pasture	39.7
Vineyards	Vineyards	25.3

Table 6: Daily ET_o Data Sources During Historical Period (Water Years 1991-2015)

Weather Station	Start Date	End Date	Comment
CIMIS Station #71 (Modesto)	Oct. 1, 1990	Aug. 31, 2002	CIMIS. Provided ET_o estimates until Denair station came online.
CIMIS Station #168 (Denair, east of Turlock)	Sept. 1, 2002	Apr. 8, 2009	CIMIS. Moved to Denair II in April 2009.

CIMIS Station #206 (Denair II, east of Turlock)	Apr. 9 2009	Sept. 30, 2015	CIMIS.

Figure 3: Annual ETc for Crop ET Groups in the Turlock Subbasin, 1991-2015

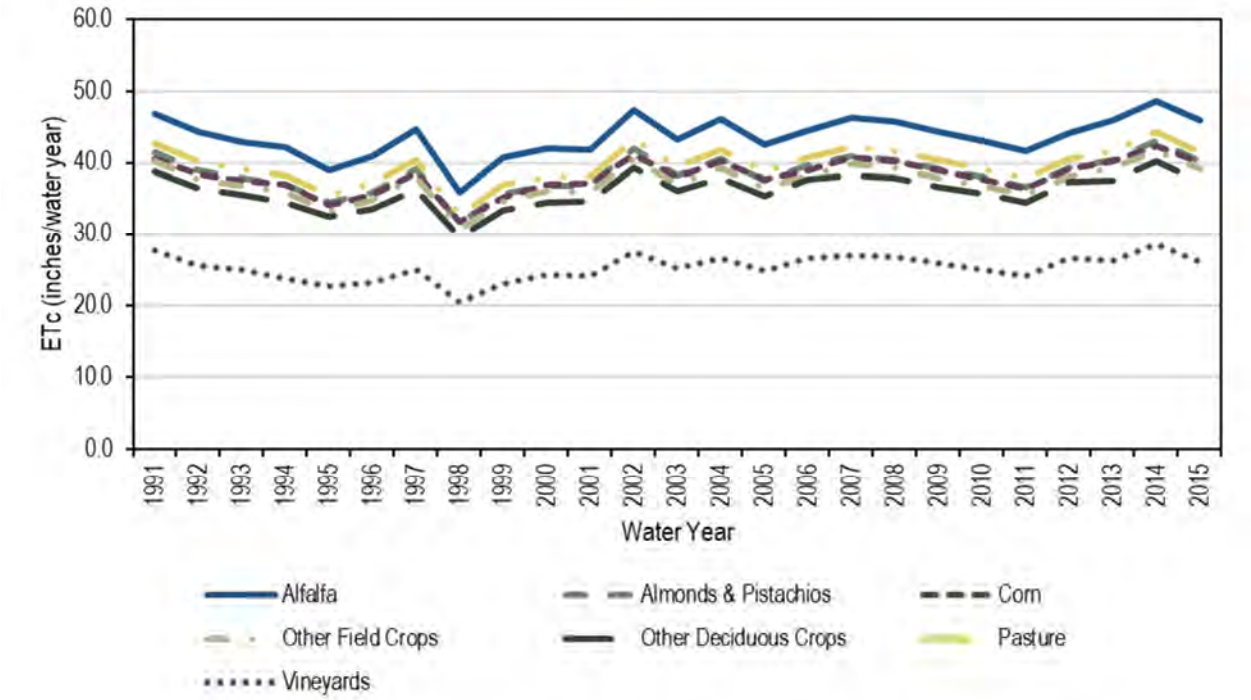


Table 7: Annual ETc for Crop ET Groups in the Turlock Subbasin, 1991-2015 (inches/year)

Water Year	Alfalfa	Almonds & Pistachios	Corn	Other Field Crops	Other Deciduous Crops	Pasture	Vineyards
1991	46.9	41.4	40.5	40.2	38.7	42.7	27.7
1992	44.3	39.0	38.4	37.8	36.5	40.3	25.5
1993	43.0	37.9	37.6	36.7	35.6	39.1	24.9
1994	42.1	37.0	37.0	35.9	34.5	38.2	23.8
1995	39.0	34.5	34.2	33.3	32.5	35.5	22.7
1996	41.0	36.0	35.6	34.8	33.6	37.2	23.2
1997	44.7	39.1	38.5	38.0	36.2	40.4	24.9
1998	35.9	31.6	31.7	30.7	29.7	32.6	20.6
1999	40.7	35.7	35.3	34.6	33.3	36.9	23.0
2000	42.0	36.9	36.9	36.0	34.4	38.1	24.3
2001	41.9	36.9	37.1	35.8	34.6	38.1	24.1
2002	47.5	41.9	41.2	40.5	39.3	43.2	27.5
2003	43.3	38.3	38.1	37.0	36.1	39.5	25.2
2004	46.1	40.5	40.1	39.3	37.9	41.8	26.6
2005	42.5	37.6	37.6	36.4	35.4	38.8	24.7
2006	44.5	39.7	39.0	38.2	37.6	40.8	26.6
2007	46.3	40.9	40.8	39.8	38.3	42.2	26.9
2008	45.7	40.4	40.2	39.2	37.8	41.6	26.8
2009	44.3	39.1	38.9	37.9	36.7	40.3	25.8
2010	43.0	38.0	37.7	36.8	35.7	39.2	25.0
2011	41.6	36.7	36.5	35.5	34.4	37.9	24.1
2012	44.2	39.4	39.2	38.0	37.3	40.5	26.6
2013	46.0	40.3	40.2	39.4	37.4	41.7	26.3
2014	48.6	43.0	42.3	41.7	40.3	44.3	28.6
2015	45.9	40.2	40.1	39.2	37.4	41.5	26.1
Average (1991-2015)	43.6	38.5	38.2	37.3	36.1	39.7	25.3

3.5.2 Rooting Depth

The rooting depth is the depth, in feet, that the roots of vegetation and crops extend beneath the land surface, and generally the depth from which they can extract soil moisture. Rooting depths included with C2VSimFG Root Zone Component v.4.11 were used for all simulated land use classes within the Turlock Subbasin except for "Almonds & Pistachio" and "Other Deciduous Crops." For both these land use groups, the rooting depth was set at 4 ft (reduced from 6 ft in C2VSimFG Root Zone Component v.4.11). These rooting depths were estimated based on ASCE-EWRI (2016), assuming crop growth specific to local soil conditions in the Turlock Subbasin where runoff occurs. Rooting depths for other simulated land use classes were found to be consistent with typical characteristics reported in ASCE-EWRI (2016) and were unchanged. The same rooting depth values were used in the ETSGSA and WTSGSA portions of the Turlock Subbasin.

For all land use classes, rooting depths were assumed to remain constant, on average, over the duration of the monthly Turlock Model simulation.

3.5.3 Irrigation Periods

The irrigation period indicator determines the irrigation season and non-irrigation season periods for each crop simulated in the Turlock Model. A value of one represents the irrigation season, during which the model calculates applied water demand (ET_{aw}) for the crop and applies irrigation water, as needed, in accordance with irrigation and soil parameters in the model. A value of zero represents the non-irrigation season, during which the model does not compute applied water demand for the crop and does not apply irrigation water. Different irrigation periods can be defined for different land use types, as needed.

In the Turlock Subbasin portion of the Turlock Model, the irrigation period indicator was set to one between March and October for all non-ponded agricultural land use classes except idle. For all other months and for idle land use, the irrigation period indicator was set to zero. The same irrigation period indicator was used to simulate typical irrigation practices in both the ETSGSA and WTSGSA portions of the Turlock Subbasin.

Outside of the Turlock Subbasin, and for all other land use classes, the irrigation period indicator was unchanged from the C2VSimFG standard inputs.

3.5.4 Reuse and Return Flow Fractions

The return flow fraction determines the proportion of applied water that can leave irrigated land as runoff, while the reuse fraction determines the proportion of applied water that is captured and reused for irrigation. A return flow fraction value of one indicates that all applied water can leave as runoff (also referred to as tailwater), while a reuse fraction of one indicates that all runoff of applied water is captured and reused for irrigation. A return flow fraction value of zero indicates that no applied water leaves the land use element, and a reuse fraction of zero indicates that no water is reused for irrigation.

Reuse and return flow fractions from C2VSimFG were evaluated and refined for areas within the Turlock Subbasin using available local information.

For elements in the ETSGSA and elements outside TID in the WTSGSA, the irrigation water reuse and return flow fractions included with C2VSimFG Root Zone Component v.4.11 were evaluated by comparing those values to information gathered from field visits and discussions about typical local irrigation practices. Through these evaluations, it was determined that typically no appreciable reuse of applied irrigation water occurs in the ETSGSA, so reuse fractions of 0 were used for all crops (i.e., fractions unchanged from C2VSimFG Root Zone Component v.4.11 standard inputs). It was also determined that irrigation outside TID generally uses pressurized systems with lower flow rates that do not typically result in significant runoff (return flow). Thus, return flow fractions of 0.01 were considered appropriate to account for only a small fraction of tailwater (i.e., fractions unchanged from C2VSimFG Root Zone Component v.4.11 standard inputs).

For elements within TID, the reuse and return flow fractions were evaluated and revised through comparison of results between the Turlock Model and TID's semi-automated water budget application. Reuse fractions were adjusted to 0.10 and return flow fractions were adjusted to 0.11 in all irrigation season months for elements within TID to simulate reuse and return flow volumes that were consistent with reuse and tailwater results reported in the TID water budget.

3.5.5 Configuration of Root Zone Parameters

Root zone parameters were refined, as needed, from values included in C2VSimFG through an iterative process to calibrate the Turlock Model water budget results using available local data. In the ETSGSA and elements in the WTSGSA outside of TID, root zone parameters were configured to provide for typical irrigation efficiencies associated with local irrigation practices observed in those areas, based on field visits and discussion with locals as well as districts and GSA representatives. For elements in the TID service area, root zone parameters were configured for agreement with results from TID's semi-automated water budget application.

Two key parameters considered during the calibration process were the target soil moisture fraction (TSMF) and the crop consumptive use fraction (CCUF).

The TSMF is a model input that specifies the irrigation target soil moisture as a fraction of field capacity and is used by the Turlock Model to compute irrigation depths for each land use in the model domain. When simulating an irrigation event, the Turlock Model will apply water until the soil reaches the specified percent of field capacity. The TSMF was the primary model input adjusted so that the annual CCUF in TID approximately matched the TID water budget results.

The CCUF is a ratio of the consumptive use of applied water (also referred to as evapotranspiration of applied water, or ET_{aw}) to the total volume of applied water. Values generally vary from approximately 0.55 to 0.90 with higher CCUF values indicating higher irrigation efficiency, and lower CCUF values indicating lower irrigation efficiency. Discussion with local water users and review of irrigation methods over time in the ETSGSA and WTSGSA suggest that irrigation efficiency has generally increased over time, leading to increasing CCUF values over the historical water budget period. The CCUF was the primary metric used to review model results in the ETSGSA and WTSGSA following each iteration of root zone parameter refinement.

3.5.5.1 IDC Model Input Refinements

For model elements in the ETSGSA and the WTSGSA outside of the TID service area, the IDC calibration refinement was performed by adjusting soil parameters and the TSMF for each crop simulated in the Turlock Model. Soil parameters and TSMF values were refined through several iterations of adjustment and evaluation of local CCUF values, until those CCUF values were determined to be appropriate and reasonable for the high-efficiency irrigation practices used in those areas.

For model elements in the TID service area, IDC model calibration was performed through a multi-step process in which model parameters were configured to match the results of the daily root zone water budget computed in the TID semi-automated water budget application. In this process:

- soil parameters were configured to match the root zone deep percolation, among other key root zone inflows simulated in the TID root zone water budget (see **Section 3.3**)
- target soil moisture was reviewed and refined, as needed, to approximately match typical irrigation efficiencies in TID (as observed through the CCUF)
- curve numbers were configured to match the volume of monthly runoff resulting from the TID daily root zone water budget (see **Section 3.4**)

The adjustments and refinements are reflected in the soil parameters, curve numbers and the TSMF reported in the sections above.

For model elements outside the Turlock Subbasin, calibrations were made primarily by adjusting soil parameters, especially the pore size distribution index (λ), the saturated hydraulic conductivity (K_{sat}), and the ponded hydraulic conductivity (ponded K). Soil parameters were likewise refined through several iterations of adjustment and evaluation of CCUF values.

3.5.5.2 Results of IDC Model Refinements

In the calibrated IDC model, average CCUF values range between approximately 60 and 80 percent across all land uses and areas (**Figure 4**). CCUF values are highest in the Eastside Water District (EWD), reflecting the predominant use of groundwater-supported pressurized irrigation systems for orchard crops in that area. In TID, CCUF values have risen in recent years as irrigators have increasingly shifted away from lower-efficiency flood irrigation and adopted higher-efficiency pressurized irrigation systems.

Figure 5 and **Table 8** provide a comparison of root zone water budget components between TID elements in the calibrated model and the TID semi-automated water budget. These results indicate general agreement, on average, between the water budget calculated in the Turlock Model and the TID semi-automated water budget used for water management planning and reporting. Differences in major flow paths are less than one inch per year, on average, and the average CCUF is between 65-67 percent.

The calibrated TSMF values in EWD, BCWD, MID, and in other areas outside the TID service area range from 0.81 to 0.87 (i.e., 81 to 87 percent of field capacity) for all non-ponded crops. These values approximate the average soil moisture conditions during each month that result from common irrigation practices for the orchard crops predominantly grown in these areas.

Figure 4: Average CCUF Values in the Calibrated IDC Model

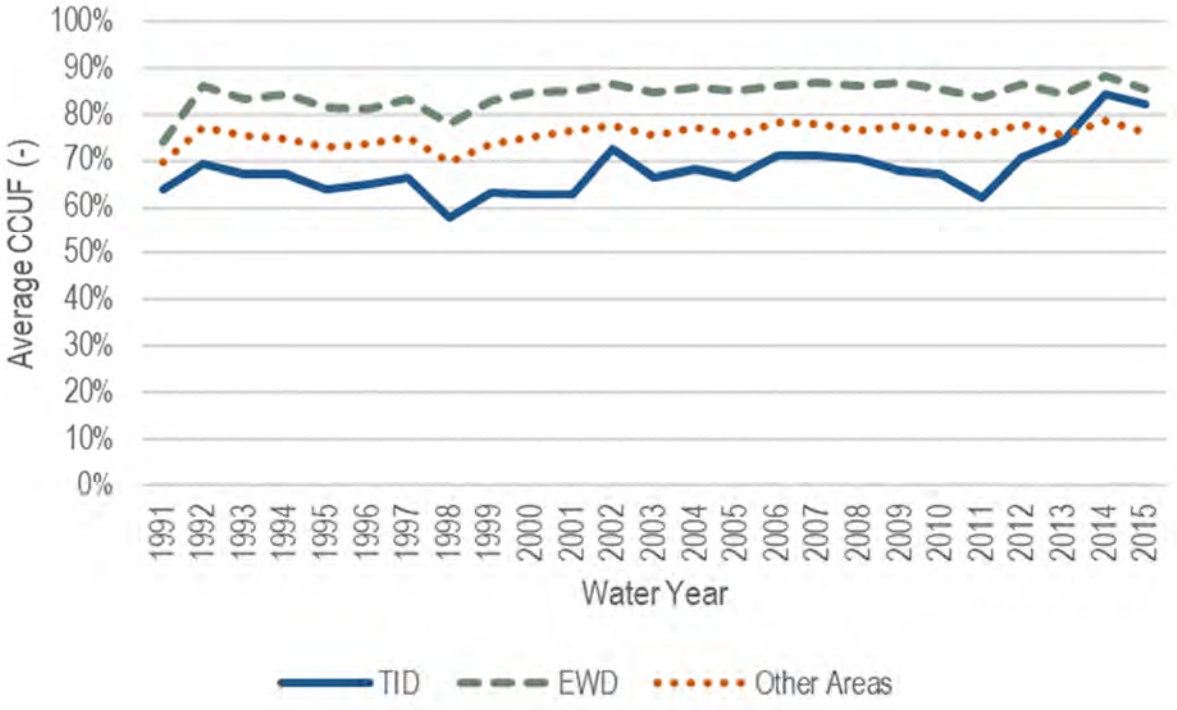


Figure 5: Comparison of Turlock IDC Model Calibrated Root Zone Water Budget Components

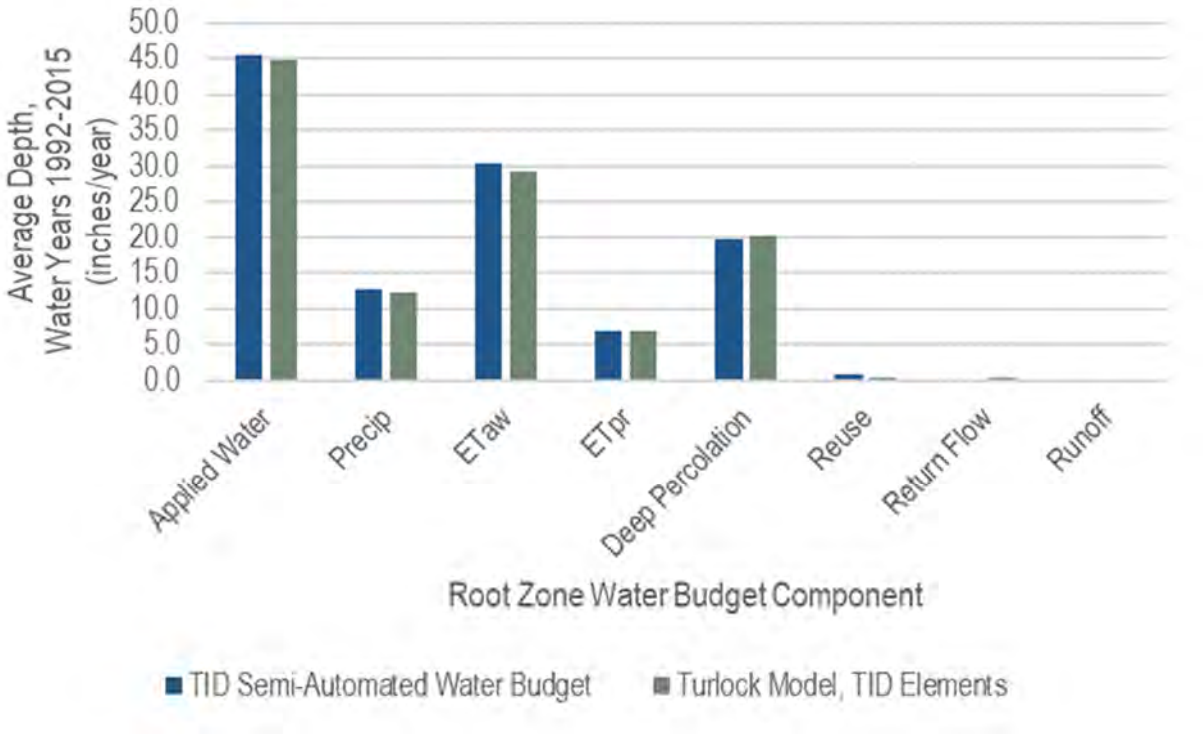


Table 8: Comparison of Turlock IDC Model Calibrated Root Zone Water Budget Components

Component	Average Depth, Water Years 1992-2015 (inches/year)		Difference (inches/year)	Percent Difference (%)
	TID Semi-Automated Water Budget	Turlock Model, TID Elements		
Applied Water	45.6	44.9	0.7	1%
Precipitation	12.7	12.3	0.4	3%
ET_{aw}	30.4	29.4	1	3%
ET_{pr}	6.8	6.9	-0.1	-1%
Deep Percolation	19.8	20.3	-0.5	-2%
Reuse	0.8	0.4	0.4	48%
Return Flow	0.2	0.4	-0.2	-131%
Runoff	0.3	0.3	0	0%
Total ET	37.2	36.3	0.9	2%
CCUF (ET_{aw} / Applied Water)	67%	65%		

3.6 URBAN WATER DEMAND

Key land use inputs for urban areas in the Turlock Model were updated from the inputs in C2VSimFG to accommodate new, locally defined urban demand areas. These urban demand areas in the Turlock Subbasin were specified as subdivisions of larger urban demand areas in C2VSimFG, corresponding to specific urban subareas for which water supply and/or water use data were available from municipal water suppliers. The new urban demand areas correspond to the following municipal and community water systems and communities:

- Ceres
- Delhi
- Denair
- Hickman
- Hilmar
- Hughson
- Keyes
- Modesto
- Turlock
- Unincorporated areas (domestic wells)

Data sources used to describe these urban demand areas include population data and estimates from the California Department of Finance and the United States Census Bureau, as well as various city, community, and general plans prepared and published by the various entities in the Turlock Subbasin.

Key urban land use inputs that were identified or refined for these urban demand areas are population, per capita water use, urban indoor water use fractions, and urban pervious area fractions. The development of these inputs is described below. Urban groundwater pumping characteristics were also refined, as discussed in the **Section 3.8.1**.

3.6.1 Population

The population in each urban demand area was quantified based on available population data and population estimates from the California Department of Finance and from the United States Census Bureau. Annual population estimates were available from the Department of Finance for Ceres, Hughson, Modesto, and Turlock in calendar years 1990-2015. The population in Delhi, Denair, Hickman, Hilmar, and Keyes was summarized from available Census Bureau data in 1990, 2000, and 2010, and through linear interpolation in other years.

The population of unincorporated areas in the Turlock Subbasin was estimated by county using census data from 1990, 2000, and 2010. The unincorporated population of Stanislaus and Merced County was first adjusted to exclude any urban demand areas already specified in the Turlock Model domain and was then prorated to account for only the unincorporated area within the Turlock Subbasin, assuming a uniform unincorporated population density in each county. In other years, the population of unincorporated areas was estimated through linear interpolation.

3.6.2 Per Capita Water Use

Per capita water use for each urban demand area was estimated based on the monthly groundwater production volumes for each urban demand area and the annual urban population for that area. Average per capita water use for each urban demand area was extracted from the respective Urban Water Management Plans (UWMP) and is summarized in **Table 9**, ranging from approximately 178 gallons per capita per day in Delhi to nearly 393 gallons per capita per day in Hickman.

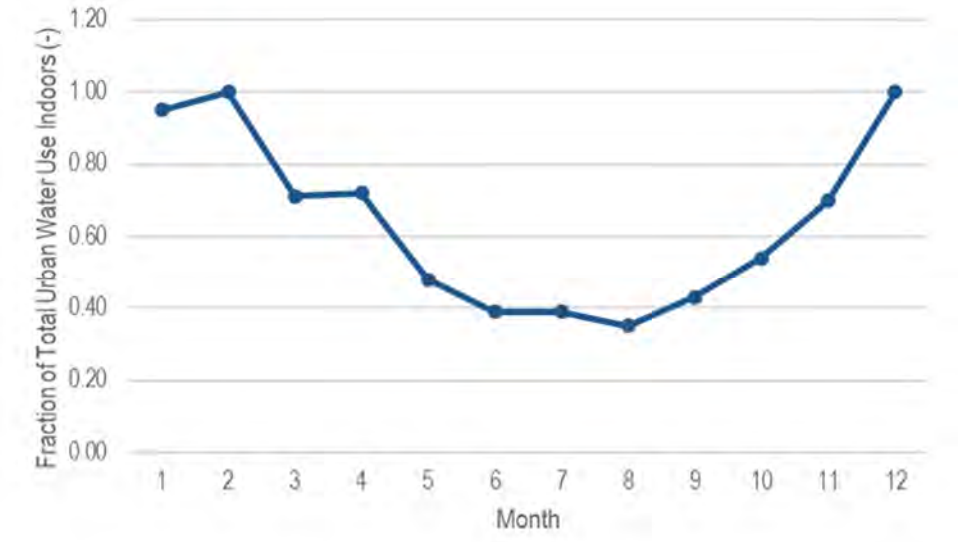
Table 9: Average Per Capita Water Use for Urban Demand Areas in the Turlock Subbasin

Urban Demand Area	Average Per Capita Water Use (gallons per person per day) 1991-2015
Ceres	204
Delhi	178
Denair	301
Hickman	393
Hilmar	231
Hughson	227
Keyes	242
Modesto	269
Turlock	317
Unincorporated	342

3.6.3 Indoor Water Use Fraction

The Turlock Model parses the total volume of applied water in each urban demand area into the amount of water that is used indoors versus outdoors based on user-defined indoor use fractions. A monthly pattern of indoor use fractions was calculated based on available groundwater pumping and wastewater treatment data in the City of Turlock. These average monthly indoor use fractions were used for all urban demand areas in all years (**Figure 6**).

Figure 6: Urban Indoor Water Use Fractions for Urban Demand Areas in Turlock Subbasin.



3.6.4 Urban Pervious Area Fraction

The urban pervious area fraction input is used by the Turlock Model to quantify evapotranspiration (ET) and runoff from urban areas. It is assumed that only pervious areas are available for ET, and that no ET occurs in impervious areas. It is also assumed that all precipitation that falls on impervious areas becomes runoff.

The pervious fractions in all Turlock Subbasin urban demand areas were updated to a value of 0.45 in all months, indicating slightly less pervious area (45 percent) and slightly more developed area (55 percent), on average. These values were estimated to reflect the proportion of 'built-up' and undeveloped areas within the urban demand areas in the Turlock Subbasin and are like the pervious fractions specified for other urban areas in C2VSimFG.

3.7 WATER SUPPLY

Water supplies in the Turlock Subbasin include surface water diversions and deliveries by TID and Merced Irrigation District (Merced ID) and groundwater pumping by TID, urban water suppliers, and numerous private groundwater users in both the WTSGSA and ETSGSA. These water supplies are described in the following sections.

3.7.1 Surface Water Supply

The majority of surface water supply that is used in the Turlock Subbasin is diverted by TID from La Grange Dam releases. Surface water that is diverted into the TID system is generally delivered to land within the TID service area, though small quantities of water are also delivered to adjacent land in a few years when surplus water is available. Along the Subbasin boundary, spillage from the TID system enters

the Merced, Tuolumne, and San Joaquin Rivers. A small amount of surface water supply is also diverted by riparian water rights users from these boundary waterways. In addition, water diverted by Merced ID from the Merced River is delivered to approximately 10,000 acres in the ETSGSA.

The data sources and methodology used to quantify these surface water flows are described below.

3.7.2 Diversions

In the C2VSimTM, diversions are simulated from specified points along streams to provide water for deliveries to irrigated lands. Inputs related to diversion locations, timeseries flows, and loss fractions are required to simulate these processes.

Diversions and/or other surface water supplies (including recycled water) specified in the Turlock Model are summarized in **Table 10**. The following sections describe changes made to the C2VSimFG input files to simulate diversions to TID and irrigators in the Turlock Subbasin. Diversions by Merced ID and riparian diversions were not updated as C2VSimFG had reasonably updated presentation of these diversions. .

Table 10: Summary of Diversions in the Turlock Model

Diverter/ Supplier	Diversion Description	Source	Supporting Information
TID	TID Surface Water Supplies	Measured	TID data
	Seepage from the TID Upper Main Canal	Calculated	TID data (TID Turlock Lake and Upper Main Canal water balance)
	Evaporation from the TID Upper Main Canal	Calculated	TID data (canal wetted surface area), CIMIS data (ET_o), free surface evaporation coefficient of 1.05 (ASCE, 2016).
	Seepage from Turlock Lake	Calculated	TID data (Turlock Lake level, relationship between lake surface area and lake level), CIMIS data (ET_o), free surface evaporation coefficient of 1.05 (ASCE, 2016).
	Evaporation from Turlock Lake	Calculated	TID data (Turlock Lake level, relationship between lake surface area and lake level), CIMIS data (ET_o), free surface evaporation coefficient of 1.05 (ASCE, 2016).
	Seepage from TID Distribution System (below Turlock Lake)	Calculated	NRCS soils data, published seepage rates by soil type, estimated wetted area, estimated wetted duration, representative ponding tests
	Evaporation from TID Distribution System (below Turlock Lake)	Calculated	TID data (canal wetted surface area), CIMIS data (ET_o), free surface evaporation coefficient of 1.05 (ASCE, 2016).
	Deliveries of Replenishment Water from TID to Customers Outside the TID Service Area	Measured	TID data
City of Modesto	City of Modesto recycled water to ranchland	Measured, Estimated	City of Modesto data (2006-2008), estimated other years. This water is used for irrigation water supply

City of Turlock	City of Turlock recycled water to irrigators in TID	Measured	City of Turlock data, TID water balance
Hilmar Cheese	Hilmar Cheese process water to irrigators in TID	Measured	TID data

3.7.2.1 TID Diversions

Most of the surface water used in the Turlock Subbasin originates from Don Pedro Reservoir and the Tuolumne River. TID diverts water from the Tuolumne River into the District's Upper Main Canal at La Grange Diversion Dam, according to pre- and post-1914 flow and storage water rights. Diversions flow via gravity through the Upper Main Canal to Turlock Lake for temporary storage and re-regulation for irrigation deliveries. Most of the water is supplied to irrigators in TID. However, some leaves the TID system or canals and reservoirs due to evaporation or seepage. Other water passes through the distribution system as storm releases and canal spillage. In certain years when above-normal precipitation occurs, the TID Board of Directors may also allow the sale of "replenishment water" to lands outside of, but adjacent to TID.

To correctly account for the monthly volume of water that enters the TID distribution system, the monthly La Grange Dam releases provided within the C2VSimFG surface water diversions data input file were adjusted and re-regulated during the period 1991 through 2015. Re-regulation of flows allowed the diversions to accurately reflect the actual monthly pattern of inflows to the TID distribution system from Turlock Lake.

First, the monthly La Grange Dam releases were reduced by monthly measured TID canal spillage, TID-provided planned spillage, TID-provided storm releases, and surplus deliveries made by TID to parcels outside of TID (described below). Then, the adjusted monthly La Grange Dam releases were summed to an adjusted annual timeseries. Finally, the adjusted annual timeseries was redistributed back to a monthly diversion timeseries according to the monthly pattern of TID-recorded Turlock Lake releases (monthly releases as a percent of the total annual releases).

Seepage (recoverable loss) and evaporation (nonrecoverable loss) from the Upper Main Canal, Turlock Lake, and TID's distribution system below Turlock Lake were specified as monthly volumes in the model (**Table 10**). Monthly seepage and evaporation were calculated based on TID data and information from the semi-automated water budget application.

Surface water supplies in the TID distribution system and replenishment water deliveries were also specified as a separate monthly diversion path, allowing water to be applied to specific areas within TID (across 17 separate distribution areas), or to specific parcels outside of TID. Monthly volumes for these diversions were developed from delivery records, assuming no recoverable and non-recoverable loss. As described above, recoverable and non-recoverable losses for diversions to TID were accounted for in the monthly seepage and evaporation volumes.

It should be noted that the total La Grange Dam releases are still accounted within the simulation, albeit across the separate flow paths described above.

3.7.2.2 Reclaimed Surface Water Supply

In addition to surface water supplies delivered by TID, recycled water is also delivered to some irrigators and rangeland in the Turlock Subbasin.

Recycled treated wastewater from the City of Modesto is delivered to rangeland surrounding the city, and the recycled treated wastewater from the City of Turlock is delivered to specific irrigators in the TID service

area. Dairy nutrient water and industrial process water from Hilmar Cheese are also used to irrigate lands within TID. Diversions were created to specify these deliveries in the Turlock Subbasin using data reported by the Cities and data collected by TID.

3.7.3 Irrigation Water Spills

Within TID, some spillage from the TID distribution system enters into the stream system as inflows. To account for these the spills are simulated as stream inflows within the Turlock Model and monthly spillage timeseries were prepared from TID data and included as nine new stream inflow sites at stream nodes adjacent to the spill sites. Spillage sites near each other were assumed to enter as stream inflows together at the same stream node. There was not sufficient data on any possible spillage from the Merced ID northside canal. As such that is not included in the model. The stream inflows from TID spillage sites are summarized in **Table 11**.

Table 11: Summary of Stream Inflows from the TID Distribution System by Spillage Site

Spillage Site	Waterway Inflow	Inflow Location (Stream Node)	Average Volume (1991-2015, TAF/year)
Highline Spill	Merced River	1789	5.6
Lower Stevinson Spill	Merced River	1808	4.6
Laterals 6 and 7 Spill	San Joaquin River	1831	9.8
Lateral 5 ½ Lower Spill	San Joaquin River	1865	1.9
Laterals 4 ½, 4, 5 ½, 5 (Hodges) Spill	San Joaquin River	1876	15.7
Laterals 2 ½ and 3 Spill	San Joaquin River	1901	6.4
Lateral 2 Spill	San Joaquin River	1909	4.5
Hickman Spill	Tuolumne River	1967	1.1
Ceres Main (Faith Home) Spill	Tuolumne River	1997	15.4
		Total	**65.1**

3.8 GROUNDWATER SUPPLY

Additional supplies to meet irrigation water demand is considered as groundwater pumping within the Turlock Model and is separated into pumping by specific wells and pumping by elements where the locations of specific wells are not known but are generally distributed throughout the model element based on land use. The former largely includes agency-operated wells that deliver groundwater to a public water supply system from known wells. The latter includes estimated private agricultural and domestic groundwater pumping for which specific well locations are not known.

3.8.1 Agency Pumping

Where available, pumping data are specified on a monthly time-step throughout the historical simulation period. Data provided typically includes well locations, total depth, screen perforation depth, use (agricultural or urban) and historical monthly pumping records.

Municipal Pumping - Municipal groundwater production in the Turlock Subbasin was based on available urban supplier pumping records, and information available from Urban Water Management Plans (UWMP) and General Plans for the cities located within the Turlock Subbasin. To capture the dynamic flows resulting from these production wells, each water agency provided the location, depth, and monthly pumping time-series of their well facilities. **Table 12** summarizes the availability of UWMP and General Plan documents for each city, as well as the data provided for the development of the Turlock Model.

Table 12: Historical Groundwater Pumping Data for Communities in the Turlock Subbasin

Community	General Plan	Urban Water Management Plan	Well Characteristics	Historical Pumping Data
Ceres	Yes (1997)	Yes (2015)	Yes	WY 1991-2015
Delhi	Yes (2006)	No	Yes	WY 1991-2012
Denair	No	No	Yes	WY 1991-2015
Hickman	No	No	Yes	WY 1991-2015
Hilmar	Yes (2008)	No	Yes	WY 1991-2015
Hughson	Yes (2005)	Yes (2005)	Yes	WY 1991-2015
Keyes	No	No	Yes	WY 1991-2015
Turlock	Yes (2012)	Yes (2010 & 2015)	Yes	WY 1991-2015

TID District Pumping

TID uses drainage pumping and rented pumping to supplement its surface water supplies and support deliveries to customers. Drainage wells are owned and operated by TID primarily to lower groundwater levels in localized, high groundwater areas and to supplement other irrigation water supplies. Rented wells are owned by private parties or IDs, and are rented by TID to supplement irrigation supplies, particularly in drier years when surface water supplies are limited. Both drainage and rented pumping volumes are calculated based on power meter records for individual wells multiplied by a power factor derived from pump tests. These pumping volumes are calculated and maintained by TID as part of the district's semi-automated water budget application. The location and physical characteristics of 152 TID drainage wells and 251 rented wells were specified as inputs to the Turlock Model, and monthly pumping volumes were specified for each well.

Table 13 lists the number of wells by water purveyor included in the Turlock Model.

Table 13: Summary of Well Pumping in the Turlock Subbasin

Purveyor	Number of Production Wells	Average Annual Pumping (AF/Year)
Ceres	20	8,600
Delhi	6	1,400
Denair	6	1,300
Hilmar	4	1,200
Hughson	8	1,300
Keyes	5	1,200
Modesto	21	3,000
Turlock	40	21,000
TID (Drainage Well)	152	49,900
TID (Rented Well)	251	29,200
Total Average Annual Pumping		118,100
Note: All values are in acre-feet and averaged over the 1991-2015 historical period		

3.8.2 Private Groundwater Pumping

Private agricultural and domestic pumping volumes are not typically known and thus are estimated in IWFM to meet demands not satisfied through other sources (e.g., municipal service systems, reclaimed water and and surface water deliveries). In such cases, groundwater demand is estimated at the element-

level and each element simulates private agricultural pumping to meet agricultural demands unmet by other sources.

The perforation interval, which dictates the layers a simulated well extracts water from, were assigned separately to the domestic (i.e., rural residential) and agricultural wells. For rural residential wells, a statistical analysis of perforation interval developed for C2VSimFG was utilized. Perforation interval data were compiled by DWR using data from the CASGEM and Online System for Well Completion Reports databases. Simulated perforation intervals were assigned as the 5th and 95th percentiles of the well perforation interval data for each township/range block.

Private Agricultural Pumping

Private pumping was estimated in the Turlock Model on an element basis as part of the root zone simulation. The volume of pumping in each element was calculated within the model as the additional volume of water necessary to meet agricultural demand within that element, after distributing any other specified District groundwater pumping and surface water deliveries.

The volume of private pumping resulting from these calculations was compared to available private pumping data and was monitored during the root zone calibration process (described in **Section 3.5.5**). In the TID service area, model-calculated private pumping volumes were validated through comparison with TID's estimates of the total private pumping volume. Outside the TID service area, root zone characteristics were calibrated to ensure that groundwater pumping, and crop consumptive use characteristics resulted in irrigation efficiencies appropriate to the irrigation systems and crop types known to occur throughout the Turlock Subbasin (see Section 3.5.5).

Private Urban and Domestic Pumping

Private groundwater pumping quantities on an individual well basis are largely unknown; therefore, private domestic pumping in the Turlock Model is estimated by IWFM on an element basis. Water demands at each element are used to calculate pumping necessary to meet the urban demand estimated by the IDC. Demand for rural residential areas, was based on estimated population **(Section 3.6.1)** and per capita water use **(Section 3.6.2)** of the unincorporated areas, or those not otherwise supplied by a public water system. Private urban or rural-domestic water demand is defined at the subbasin level and distributed to each element based on relative proportion of urban land use at each timestep.

4. GROUNDWATER SYSTEM PROCESSES

This section presents the source and analysis of some of the input data used in the development of groundwater system part of the Turlock Model. The overall groundwater system data needs include spatial and temporal information for hydrologic, hydrogeologic, water use, water supply, and operations data sets used in the model, as well as physical settings, parameters, and assumptions. However, as part of the IDC model development the hydrology, water demand, and water supplies (including surface water and groundwater supplies) were presented in Section 3. This Section presents additional data for the groundwater model, including initial conditions and boundary conditions, as well as observed groundwater level data that are used for calibration of the groundwater model. Section 5 will present the approach to calibration of the groundwater portion of the model and will present calibrated groundwater parameters.

4.1 INITIAL CONDITIONS

Groundwater heads for each model node and each layer at the beginning of the calibration simulation (October 1, 1990) were developed using local observation data, combined with DWR's WDL database. The available 531 wells with data were analyzed for use in building the initial groundwater heads for the Turlock Model. Due to the availability of data in different wells, a hierarchy of data was used to compile sufficient coverage over the model domain for development of initial conditions:

- October 1990 where available
- Fall 1990 (September-November) where available
- Surrounding years data, averaged (Fall 1989 or Fall 1991)
- Surrounding years data, averaged (Fall 1988 or Fall 1992)
- Where all the above sources were unavailable, depth to water was interpolated and extrapolated to ensure a reasonably complete coverage

Observation data was interpolated to develop a raster representing initial groundwater levels over the model domain. For monitoring locations that lacked construction information, the groundwater heads described above are used for all layers. The initial conditions for the Turlock Model representing October 1, 1990, are shown in **Figure 7** though **Figure 10**.

Figure 7: Initial Groundwater Heads for Layer 1 (feet above mean sea level)

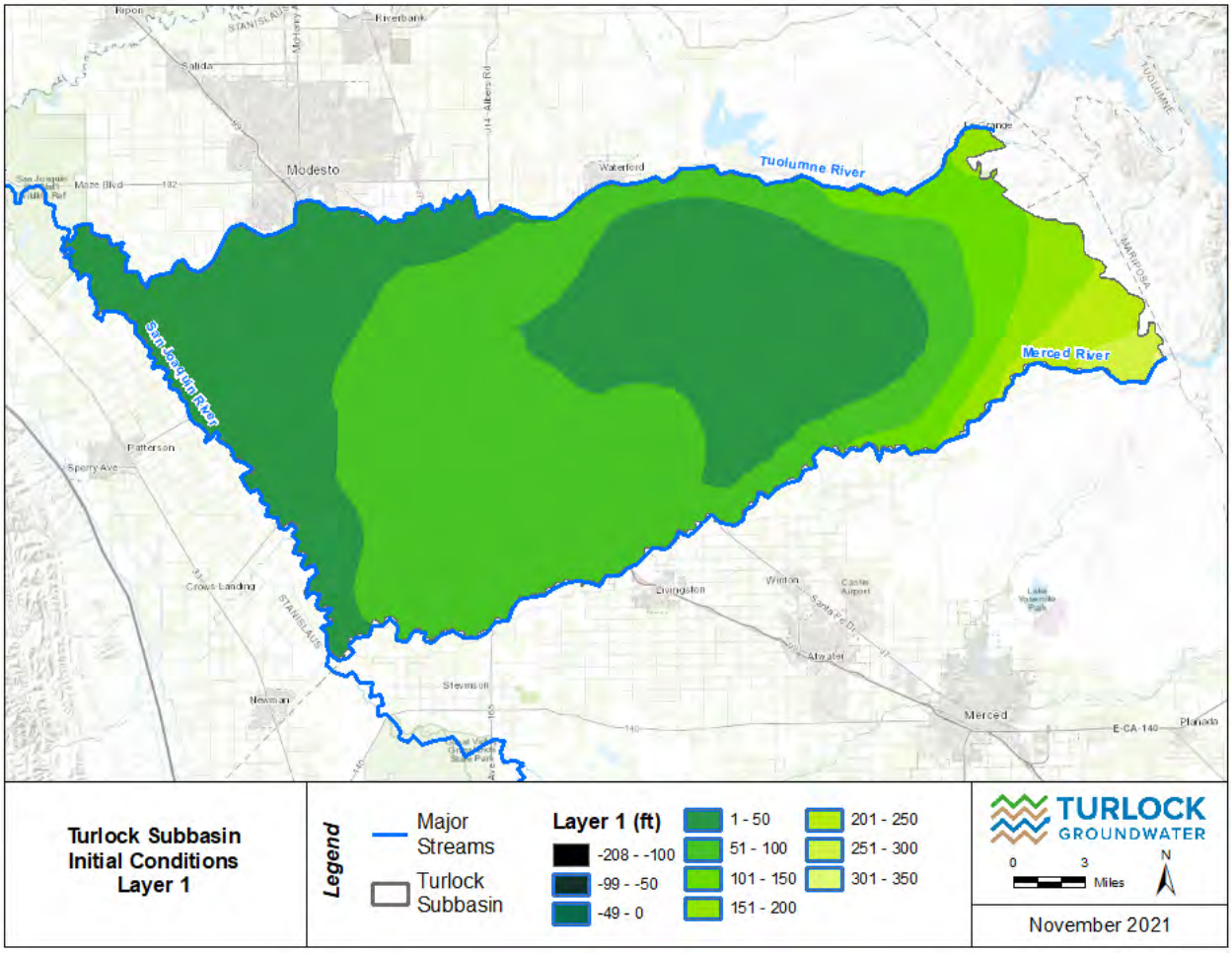


Figure 8: Initial Groundwater Heads for Layer 2 (feet above mean sea level)

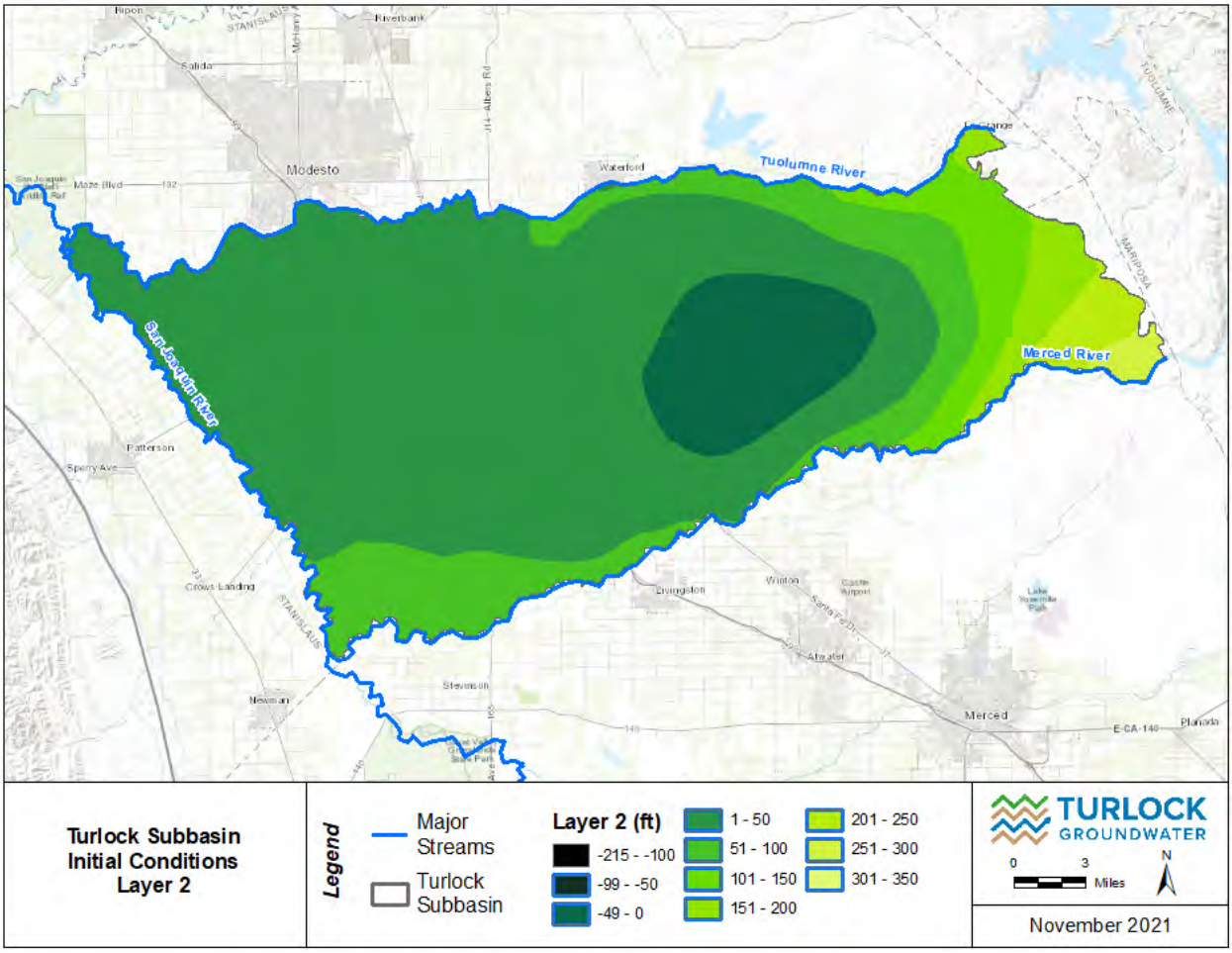


Figure 9: Initial Groundwater Heads for Layer 3 (feet above mean sea level)

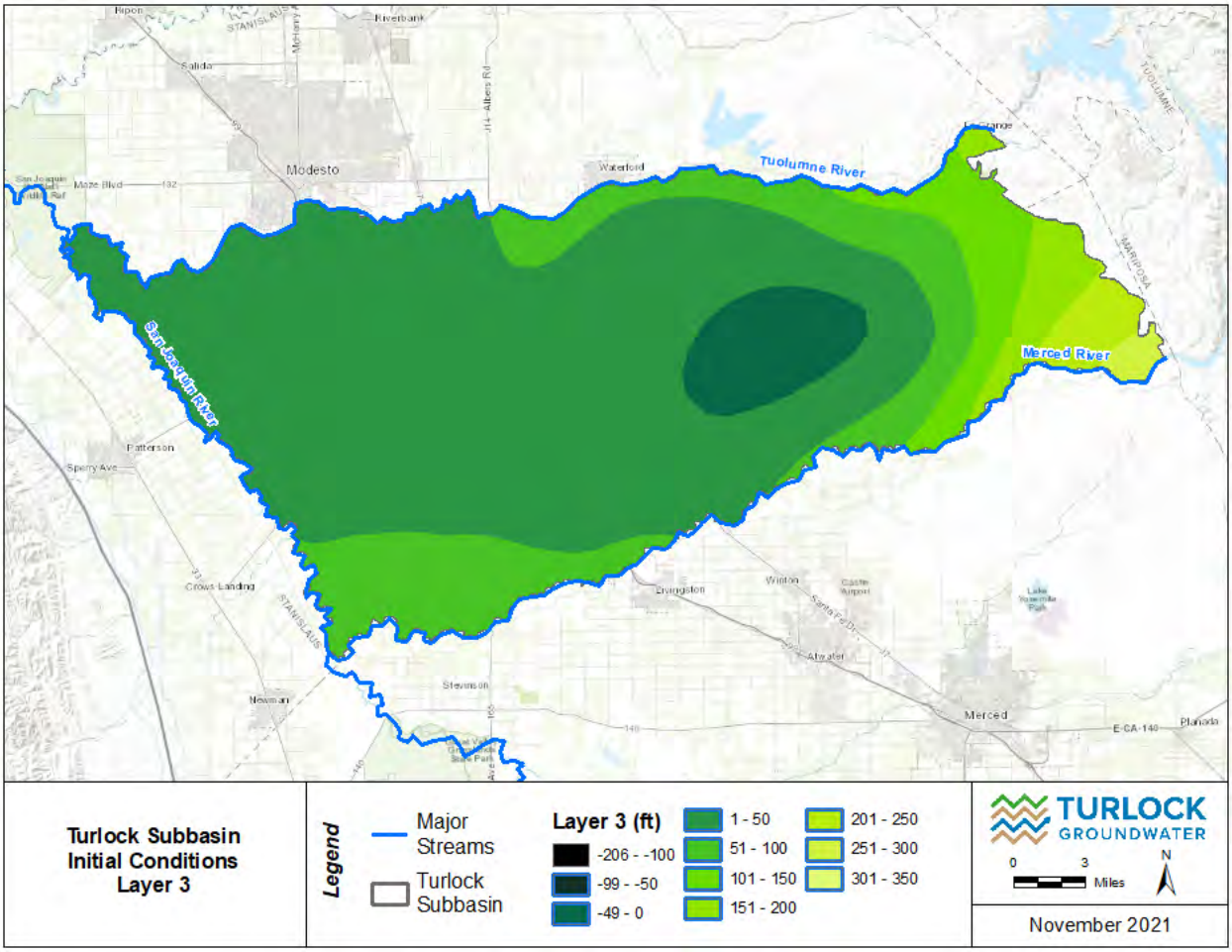
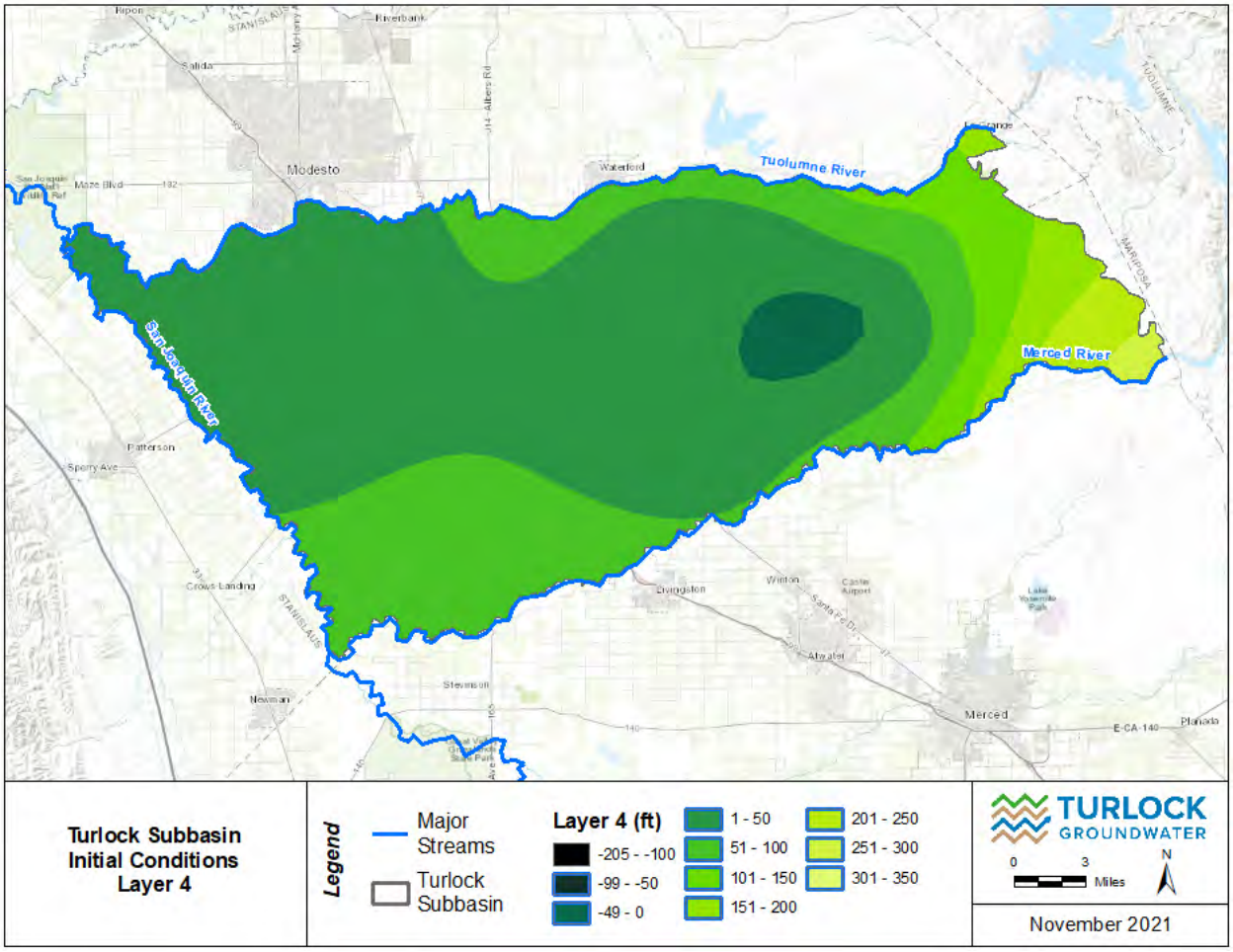


Figure 10: Initial Groundwater Heads for Layer 4 (feet above mean sea level)



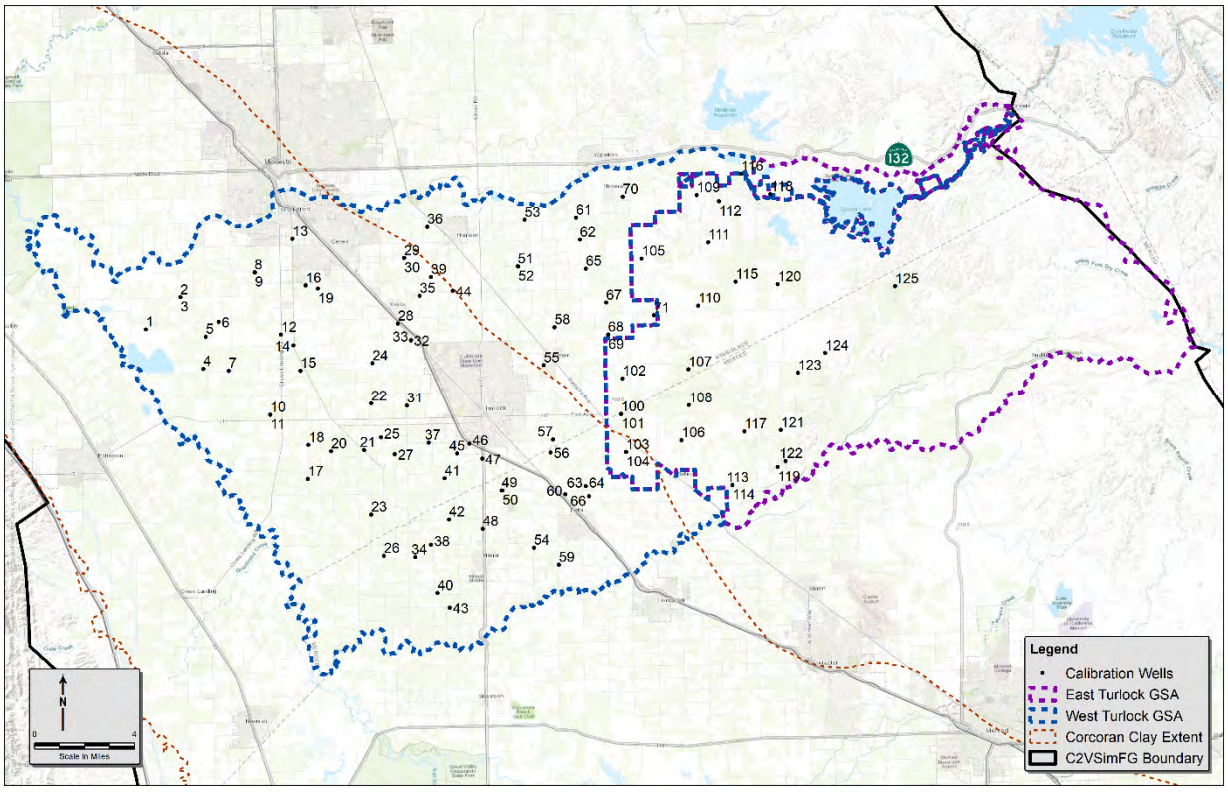
4.2 BOUNDARY CONDITIONS

Specified head boundary conditions define the subsurface inflow for the western and southern boundaries of the Turlock Subbasin. The Turlock Model utilizes specified head boundary conditions that varies over time on a monthly time step, for all active layers at groundwater nodes between one to two miles away from the subbasin boundaries. Conditions in the Merced and Delta-Mendota subbasins were defined based on a combination of historical data available from observed groundwater elevations from DWR's Water Data Library (WDL) and groundwater contours from DWR's SGMA Data Viewer web application. Where all the above sources were unavailable, depth to water was interpolated.

4.3 GROUNDWATER LEVEL HYDROGRAPHS

Groundwater levels were calibrated to achieve acceptable agreement between the simulated and observed values (in this case, groundwater levels at the calibration wells), as discussed in Section 5. Within the Turlock Subbasin, over 500 wells were evaluated to be used as potential representative hydrograph locations (calibration wells). Data for these wells were obtained from DWR's CASGEM program, DWR's Water Data Library, and local monitoring data. The calibration wells were selected based on their period of record, number of observation points, temporal and spatial distribution across the model, representative location of the well, and trends of nearby wells. After a review of the available observation data, a working set of 97 wells (**Figure 11**) was selected to be used for the calibration process.

Figure 11: Turlock Model Calibration Wells



5. MODEL CALIBRATION

The Turlock Model is an integrated water resources model developed to simulate the interconnected nature of the various components of the hydrologic system. The Turlock Model was calibrated to align simulated with observed records, including water budget components, surface water flow, and groundwater levels. The sources used during the calibration process include local knowledge, AWMPs, UWMPs, other local planning efforts, observed groundwater levels and associated contours, and observed streamflow data.

Model calibration is an important part of model development, performed to assure the model is adequate to inform GSP development and implementation through the development of water budgets, analysis of sustainable yield and assessment of project and management action effectiveness under historical, current and future conditions. To do this, the calibrated model must meet the following principal objectives:

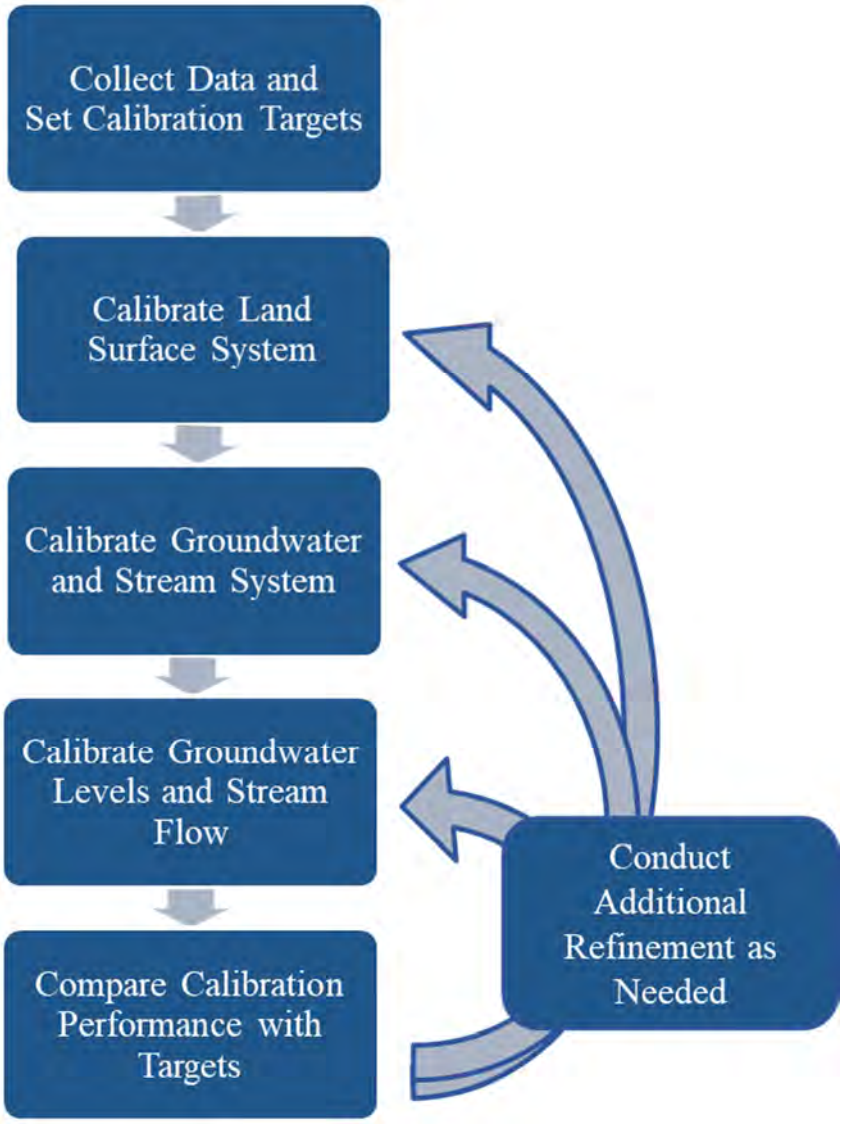
- Develop water budgets that adequately represent each of the hydrologic systems modeled (i.e., land surface, stream, and groundwater system) across various geographic scales (i.e., Subbasin, GSA, and districts), and temporal timesteps (i.e., monthly, and annually).
- Represent the regional distribution of groundwater conditions, while maintaining or achieving adequate agreement between simulated results and observed values for short-term seasonal and long-term trends in groundwater levels at selected calibration wells.
- Represent appropriate level of stream-aquifer interaction to achieve adequate agreement between simulated results and observed streamflow hydrographs at selected gaging stations.
- Adequately represent the interbasin flows between the Turlock Subbasin and its adjacent areas, the Modesto, Merced, and Delta-Mendota Subbasins.

These objectives are achieved through comparison of simulated and observed conditions, refinement of model inputs to achieve an improved history match, and review of the model input and adjusted model parameters. Calibration is often evaluated in terms of the ability of a model to reproduce known groundwater flow directions, groundwater levels, land surface and groundwater budget information and trends; lack of spatial bias, and a reasonably close match between observed and simulated data. The latter metric is often reviewed in terms of calibration statistics based on statistical analysis of the difference between observed and simulated groundwater levels (residuals). In general, a model is typically considered acceptable when (1) the acceptable residual should be a small fraction of the head difference between the highest and lowest heads across the site (ASTM D5981) and (2) the Root Mean Square Error (RSME) of the residuals is less than 10 percent of the range (Rumbaugh and Rumbaugh, 2017).

5.1 CALIBRATION PROCESS AND METHODOLOGY

Model calibration began after the data analysis and input data file development were complete. The calibration effort can be broken down into subsets that align with multiple packages within the IWFM platform. As an integrated hydrologic model, the results of each part of the simulation are interdependent on one another. The model calibration is a systematic process that is illustrated in **Figure 12** and includes the following steps.

Figure 12: Model Calibration Process



1) **Set Calibration Targets:** The first step in model calibration was the collection and refinement of data related to model calibration targets for the calibration period. Data related to model calibration was collected and refined for the calibration period. This process includes the systematic review of both published and observed information, as well the preparation of the statistical data for the evaluation of both local and regional calibration.

2) **Calibrate the Land Surface System:** In the second step, preliminary rootzone and land and water use budgets were established and verified. The calibration effort focused on soil hydraulic parameters, curve numbers, cropping and irrigation coefficients, urban water use specifications, deep percolation, runoff and return flow. Urban and agricultural demand, groundwater pumping, and surface water supply from water budgets were verified against available data from a combination of state and local resources as discussed in Section 3, and culminating in the iterative calibration of the root zone water budget as discussed in Section 3.5.5.

3) **Calibrate the Groundwater and Stream System Water Budgets:** The third step was calibration of the groundwater and stream system budgets. The water budgets for the stream and aquifer

systems are calibrated in tandem through the evaluation of both flow components and simulated hydrographs. Due to the interconnected nature of these systems, this process is often preformed iteratively, with step five as refinements to the system parameters or operational budgets affect both groundwater levels and stream flow.

4) **Calibrate Groundwater Levels and Stream Flow:** The fourth step calibrates groundwater levels by changing aquifer parameters with the use of a parameter grid and stream flow through a combination of land surface and stream-bed parameters. This step aims to obtain a reasonable match between the simulated groundwater levels and stream flows with recorded measurements. The iterative calibration process continues until the calibration goals are met.

5) **Compare Calibration Performance with Targets:** The final step in model calibration is to evaluate model uncertainty in context with the available data and knowledge of the Subbasin. This step includes review of the simulated water budgets and hydrographs in conjunction with the local technical advisory committee and stakeholders to evaluate model performance.

5.2 WATER BUDGET CALIBRATION

Water budgets were calibrated to improve the accuracy of the representation of the hydrologic characteristics of the groundwater basin. A water budget balances supplies, demands, and any subsequent change in storage occurring within that specific portion of the hydrologic cycle. IWFM automatically outputs budgets at the subregion scale, which for this model represented the Turlock Subbasin. Additionally, IWFM can output data down to a single element or group of elements, representing processes involving water use, the rootzone, unsaturated zone, and groundwater systems with the stream system budgets being available at all stream-nodes.

During this step of the calibration process, model results were reviewed and summarized into monthly and annual (by water year) budgets. The primary budgets reviewed for calibration are the groundwater budget, land and water use budget, and stream budget. After water budget analysis, key model datasets and parameters are adjusted, particularly groundwater aquifer parameters, to better match local budgets from local agricultural water purveyors and local planning efforts. The Turlock Model water budget results are summarized in the following sections.

5.2.1 Land and Water Use Calibration

As part of the Land Surface Processes, the land and water use budget represents the balance of the IWFM-calculated water demands with the water supplied for the urban and agricultural sectors and the resulting deep percolation and recharge. As described in Section 3, the IDC was used to simulate the land surface processes, calculation of water demands, and balance with the water supplies. Both the agricultural and urban versions include the same components that make up the water balance:

- Water demand (either agricultural or urban)
- Surface water supply (including recycled water deliveries and pumping delivered as surface water)
- Groundwater supply (does not include pumping delivered as surface water)

Development of the land and water use budgets, including calibration targets, refined parameters, and a detailed breakdown of components are described throughout **Section 3**. In its entirety, the Turlock Subbasin has an agricultural supply requirement of approximately 786,700 AFY, which is comprised mostly of field crops and deciduous fruit and nut crops, as shown in **Table 3**. The Turlock Subbasin's agricultural demand is met predominantly with surface water supplies, averaging 517,000 AFY across 1991-2015 historical period. To meet the Turlock Subbasin's water demand, this surface water supply is supplemented with an average annual groundwater production of 269,700 AFY.

Throughout the historical simulation, all municipalities, and private domestic users rely on groundwater to meet their urban demand. The City of Modesto does utilize surface water from Modesto Irrigation District, but its surface water supply meets demand only in the Modesto Subbasin. From 1991 to 2015, the urban water demand and subsequent pumping in the Turlock Subbasin has averaged 55,500 AFY. **Figure 13** through **Figure 18** illustrates the annual, historical agricultural and urban supplies and demands in the Turlock Subbasin and its GSAs. The land and water use budgets are presented below in **Table 14**.

Table 14: Summary of Turlock Model Land and Water Use Budget
(Average Annual for the Period WY 1991-2015; Units are in Acre-Feet per Year)

	Turlock Subbasin	WTSGSA	ETSGSA
Agricultural Demand	786,700	563,300	223,400
Agricultural Surface Water Supply	517,000	505,500	11,500
Agricultural Groundwater Supply	269,700	57,800	211,900
Urban Demand	55,500	53,800	1,700
Urban Surface Water Supply	0	0	0
Urban Groundwater Supply	55,500	53,800	1,700
Note: Values represent volumes available to meet the water demand, as such surface water supplies represent the surface water delivered to the growers.			

Figure 13: Turlock Subbasin Annual Agricultural Land and Water Use Budget

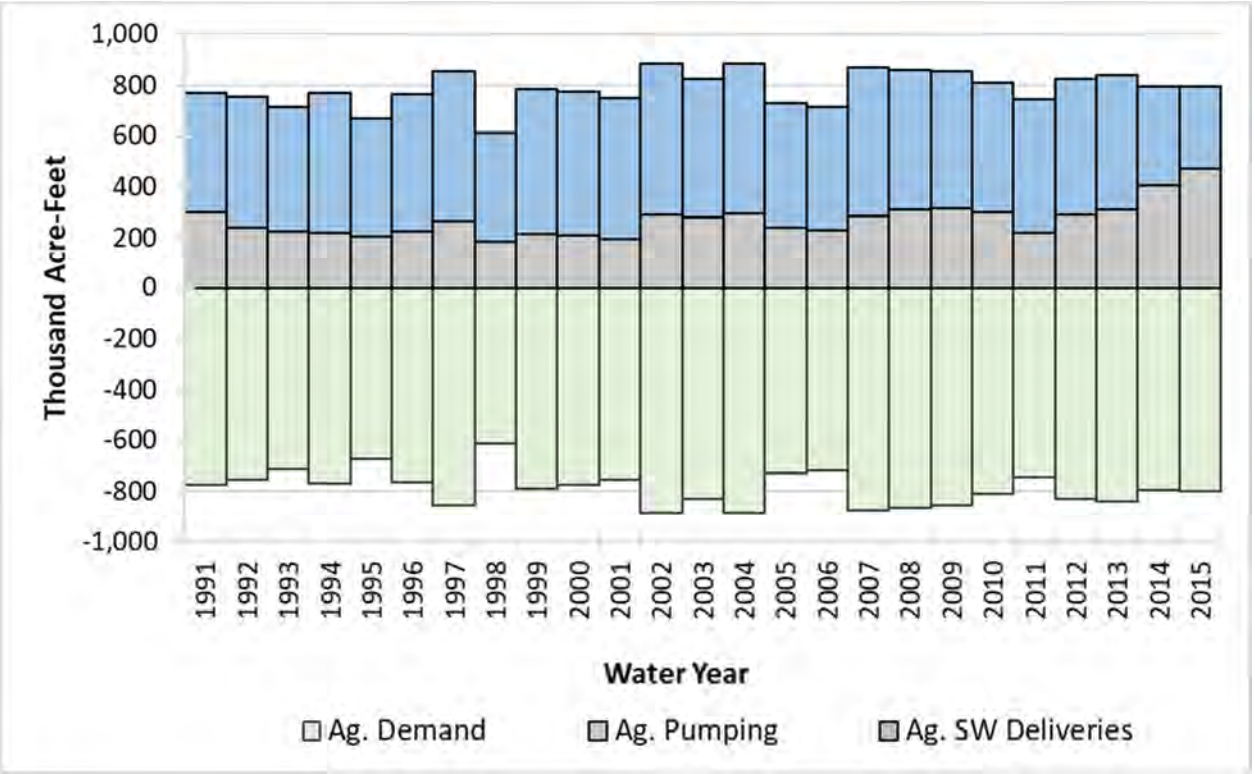


Figure 14: Turlock Subbasin Annual Urban Land and Water Use Budget

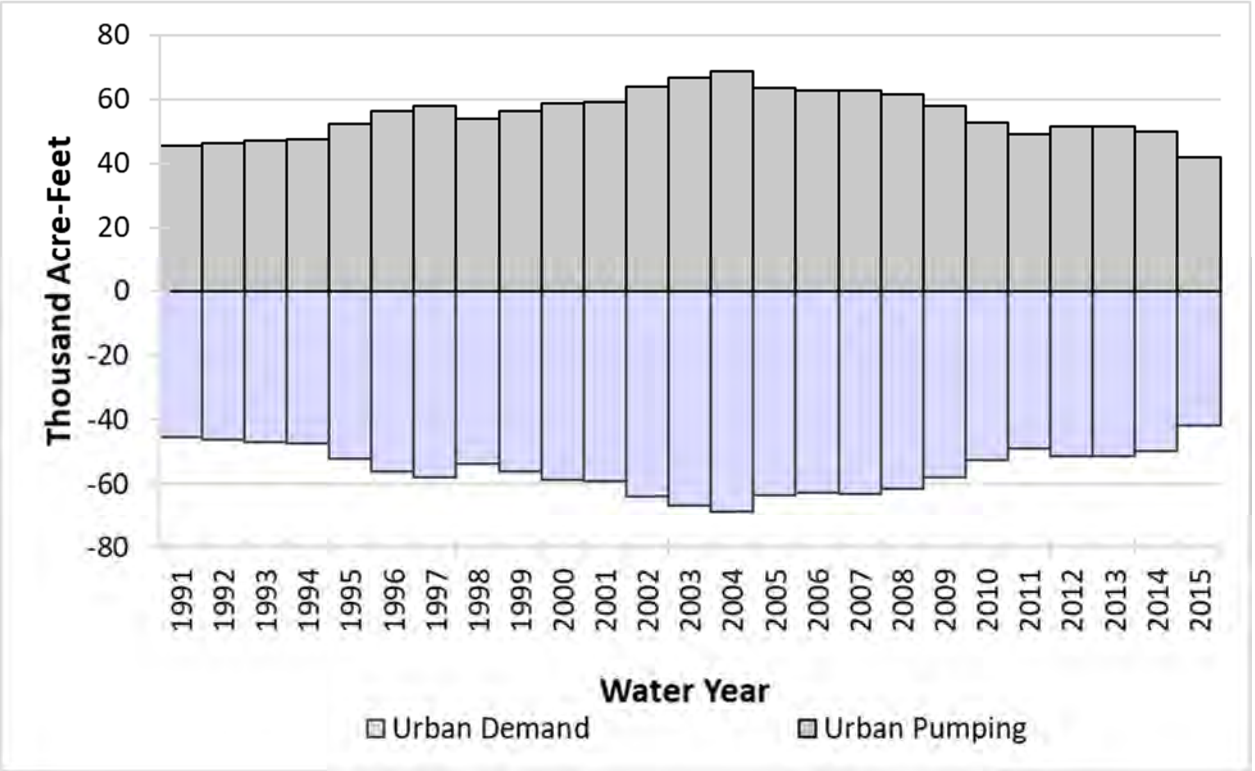


Figure 15: WTSGSA Annual Agricultural Land and Water Use Budget

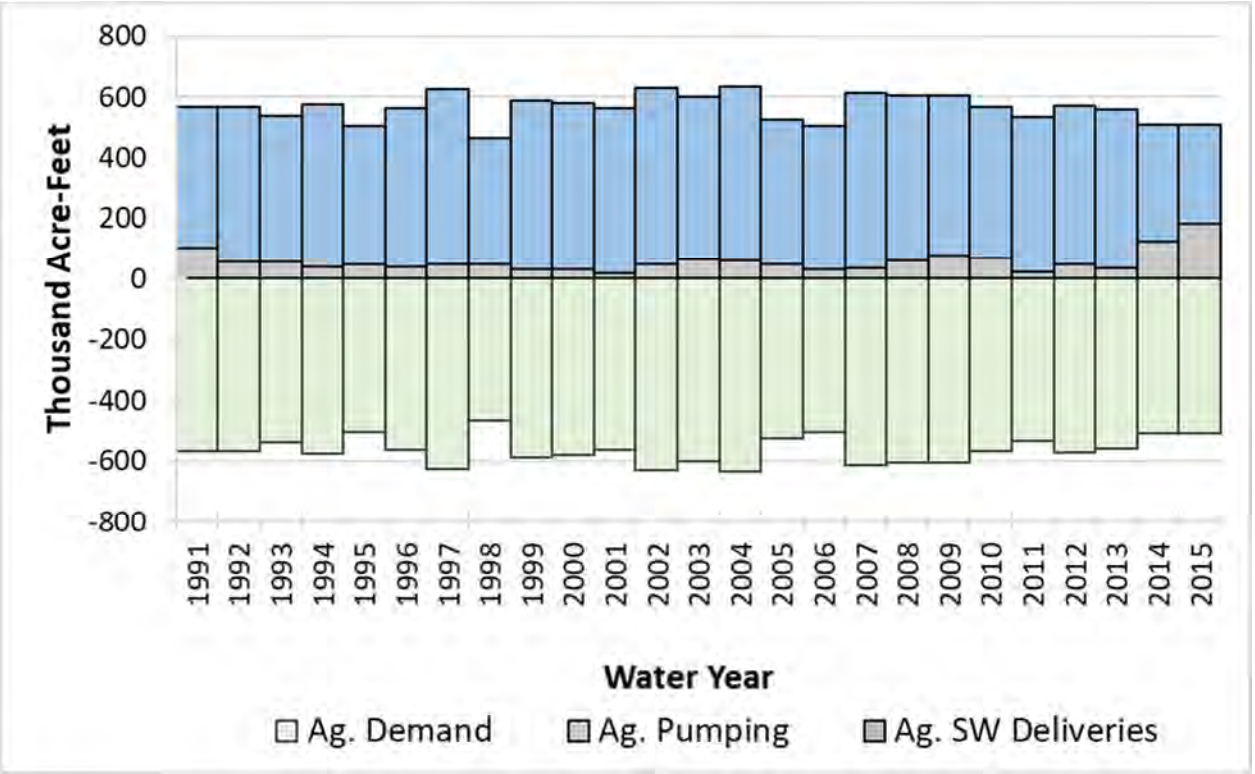


Figure 16: WTSGSA Annual Urban Land and Water Use Budget

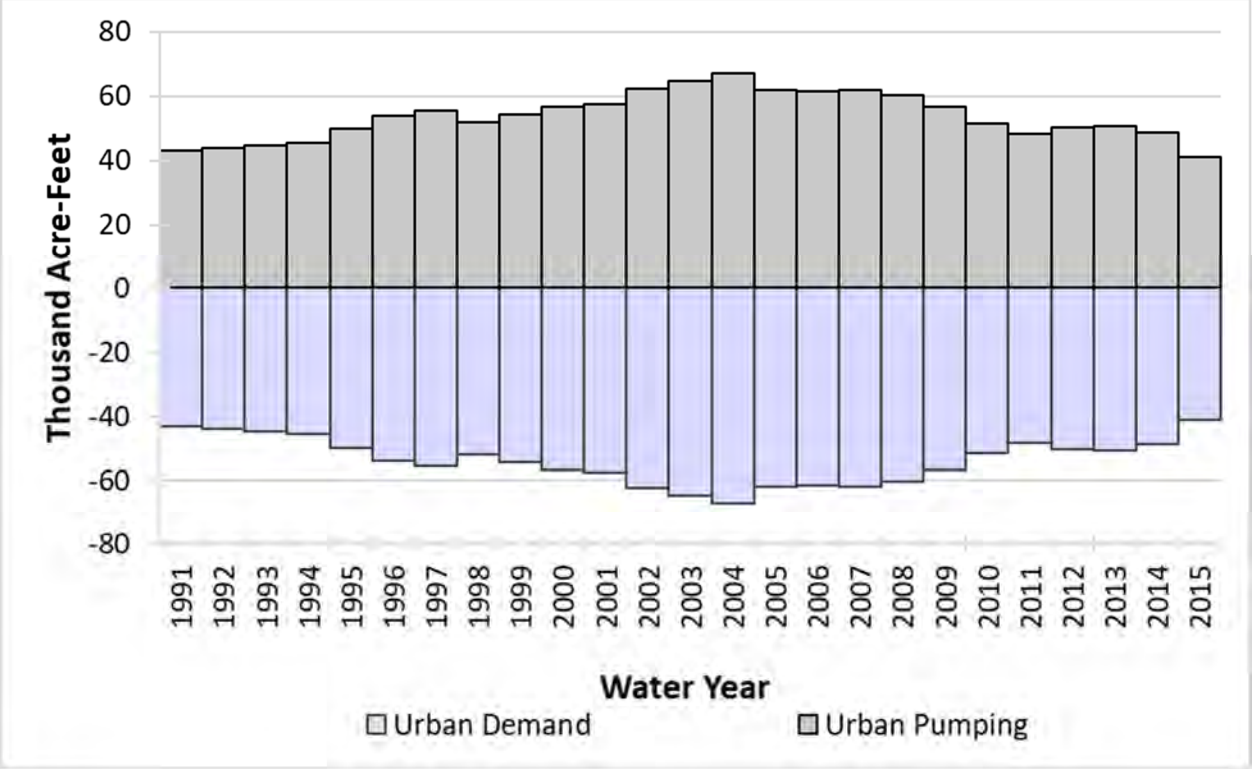


Figure 17: ETSGSA Annual Agricultural Land and Water Use Budget

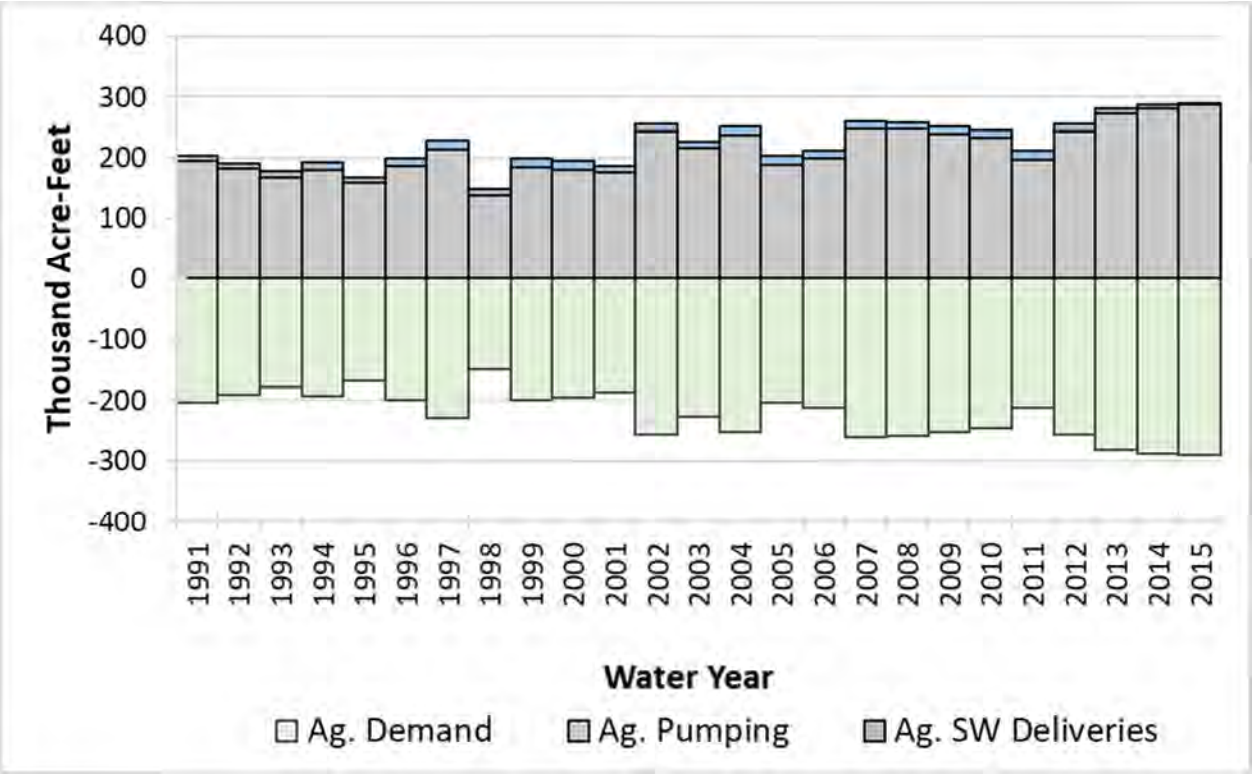
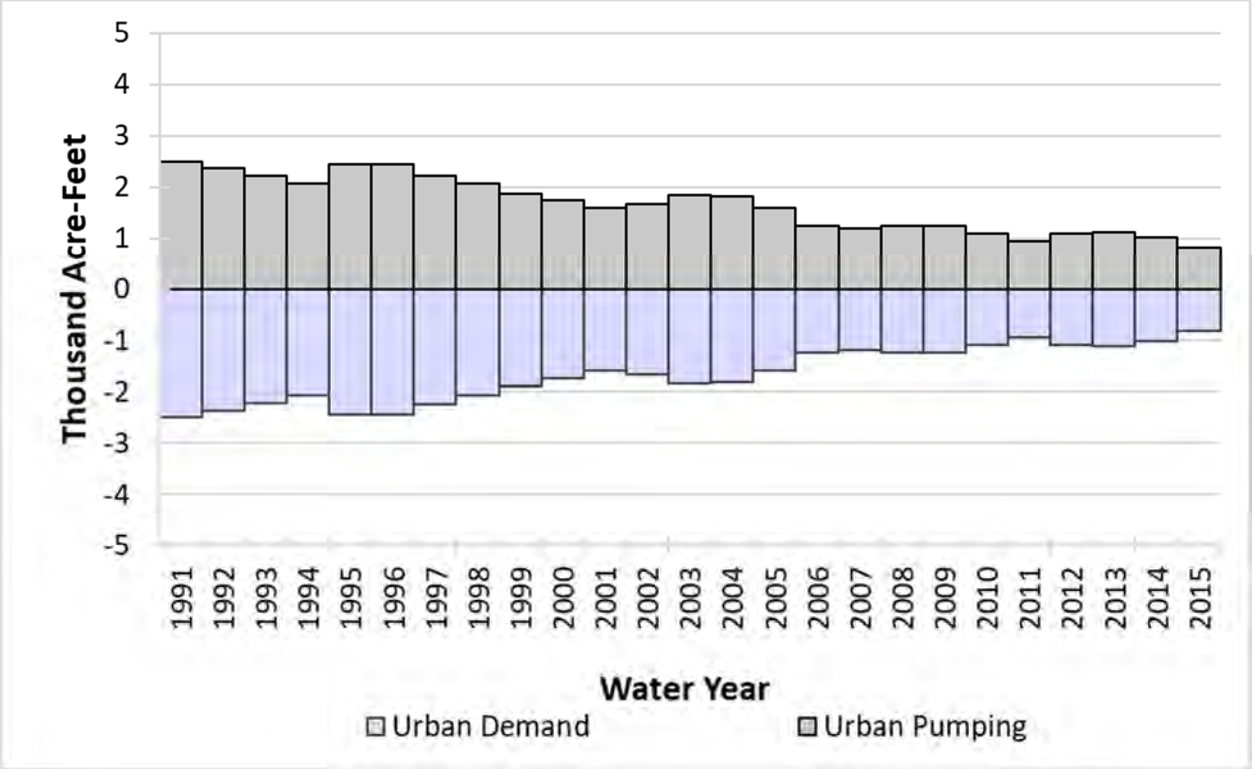


Figure 18: ETSGSA Annual Urban Land and Water Use Budget



5.2.2 Groundwater Budget Calibration

Groundwater budgets provide a valuable evaluation tool and a means of validating the calibration process to ensure that mass balance between demands and supplies are properly represented. The groundwater budget quantifies inflows and outflows from the groundwater system. The primary components of the groundwater budget, corresponding to the major hydrologic processes affecting groundwater flow in the model area, are:

- Inflows:
    - Deep percolation (from rainfall and applied water)
    - Gain from stream (recharge due to stream and river seepage)
    - Recharge (recharge due to Turlock Lake, conveyance losses, and other recharge facilities)
    - Boundary inflow (from outside the model area)
    - Subsurface inflow (from adjacent subbasins)
- Outflows:
    - Groundwater pumping (for both urban and agricultural use)
    - Loss to stream (outflow to streams and rivers)
    - Subsurface outflow (to adjacent subbasins)
- Change in aquifer storage

For the historical simulation of water years 1991-2015, the majority of Turlock Subbasin is irrigated agricultural land, and thus the main source of groundwater recharge is deep percolation of water from rain and applied irrigation water, which averages approximately 280,500 AFY. Seepage from canals and reservoirs, such as Turlock Lake, are the second largest source of groundwater recharge in the Subbasin, totaling approximately 78,500 AFY. Turlock Subbasin also receives net groundwater inflows from neighboring subbasins in most years, gaining approximately 2,400 and 45,000 AFY from the Modesto and Merced Subbasins, respectively, and losing approximately 11,600 AFY to the Delta-Mendota Subbasin.

Groundwater pumping to meet agricultural and urban demands is the largest source of outflow from Turlock Subbasin at an average of 404,100 AFY during the model period, as both agricultural and urban areas in the subbasin rely to a large part on groundwater supplies. Groundwater discharges to local rivers at an average rate of approximately 56,700 AFY, with 35,400 AF discharging to the Tuolumne River, 38,500 AF discharging to the San Joaquin River, and 17,300 recharging from the Merced River. During the historical period modeled, total outflows from the groundwater in the Turlock Subbasin were greater than inflows to the Subbasin, leading to a long-term reduction in groundwater storage of over 1.5 million acre-feet or approximately 63,900 AFY of groundwater storage deficit.

The groundwater budgets, including cumulative change in storage, are summarized in **Table 15**, and are shown in **Figure 19** through **Figure 21** for the Subbasin, WTSGSA and ETSGSA respectively.

Table 15: Summary of Turlock Model Groundwater Budget
(Average Annual for the Period WY 1991-2015; Units are in Acre-Feet per Year)

	Turlock Subbasin	WTSGSA	ETSGSA
Deep Percolation	280,500	223,900	56,600
Canal and Reservoir Recharge	78,500	73,600	4,900
Subsurface Flow from Adjacent Areas	35,700	-74,900	110,600
Inflow from Foothills	2,200	200	2,000
Gain from Stream System	-56,700	-76,900	20,200
Groundwater Pumping	-404,100	-190,500	-213,600
Reduction in Groundwater Storage	63,900	44,600	19,300

Figure 19: Historical Groundwater Budget (Turlock Subbasin)

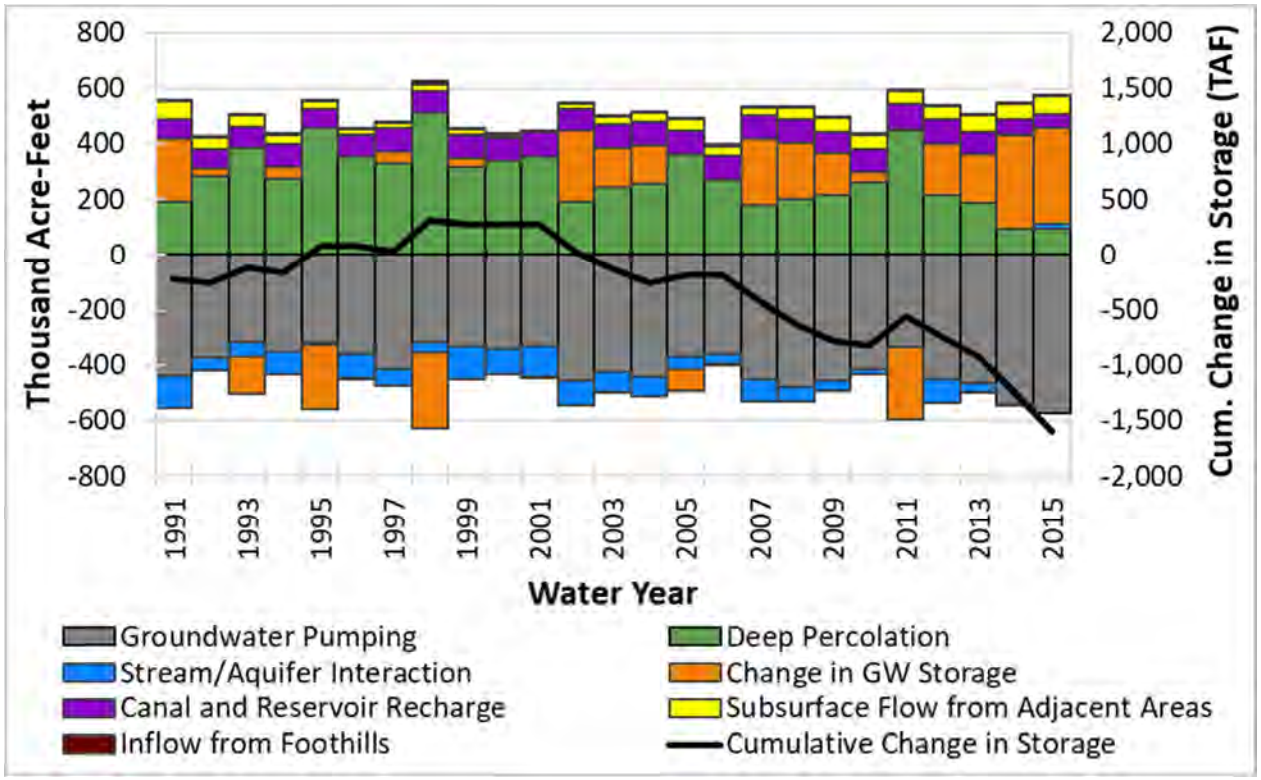


Figure 20: Historical Groundwater Budget (WTSGSA)

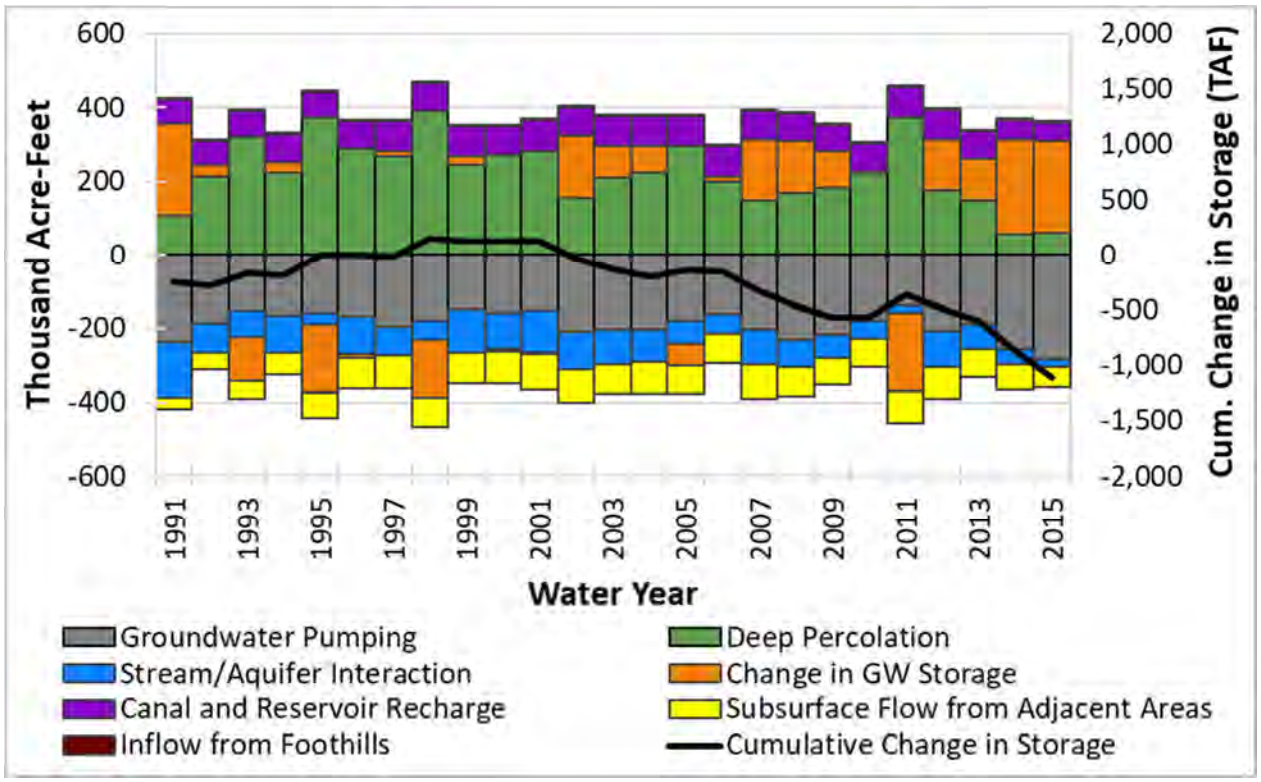
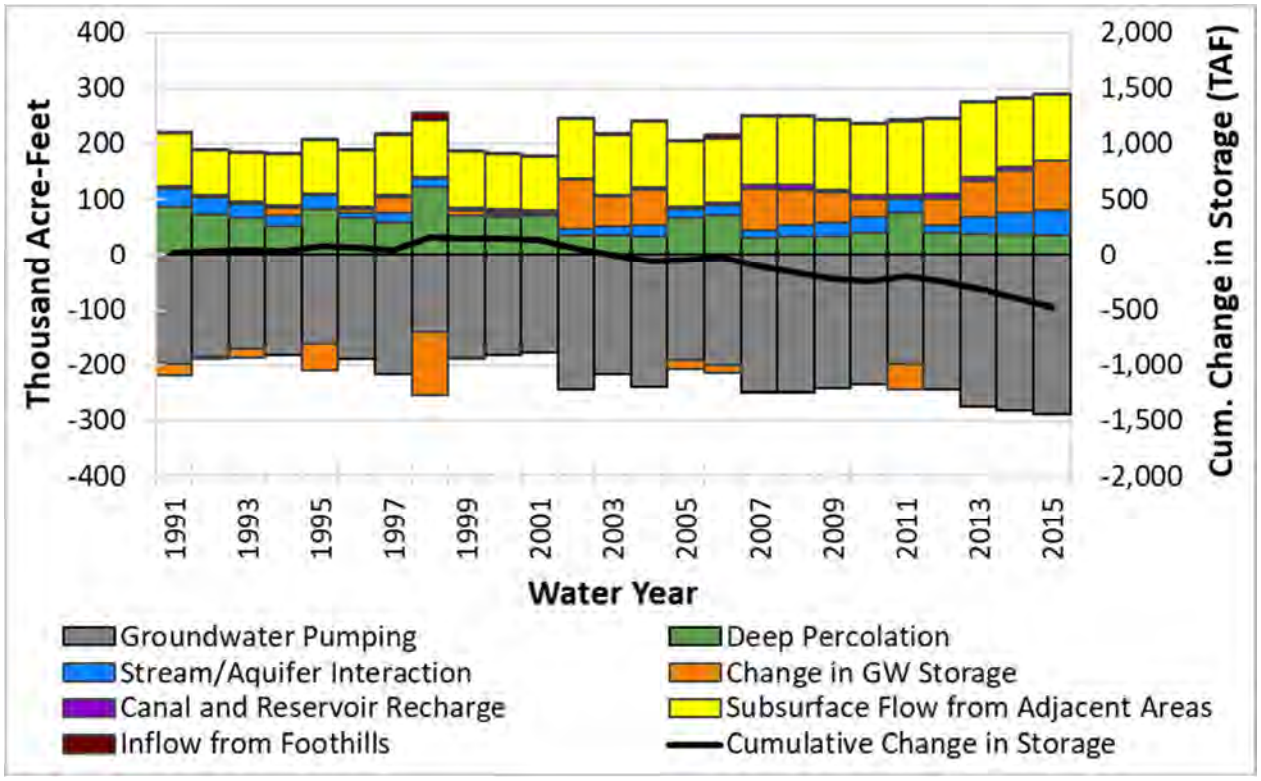


Figure 21: Historical Groundwater Budget (ETSGSA)



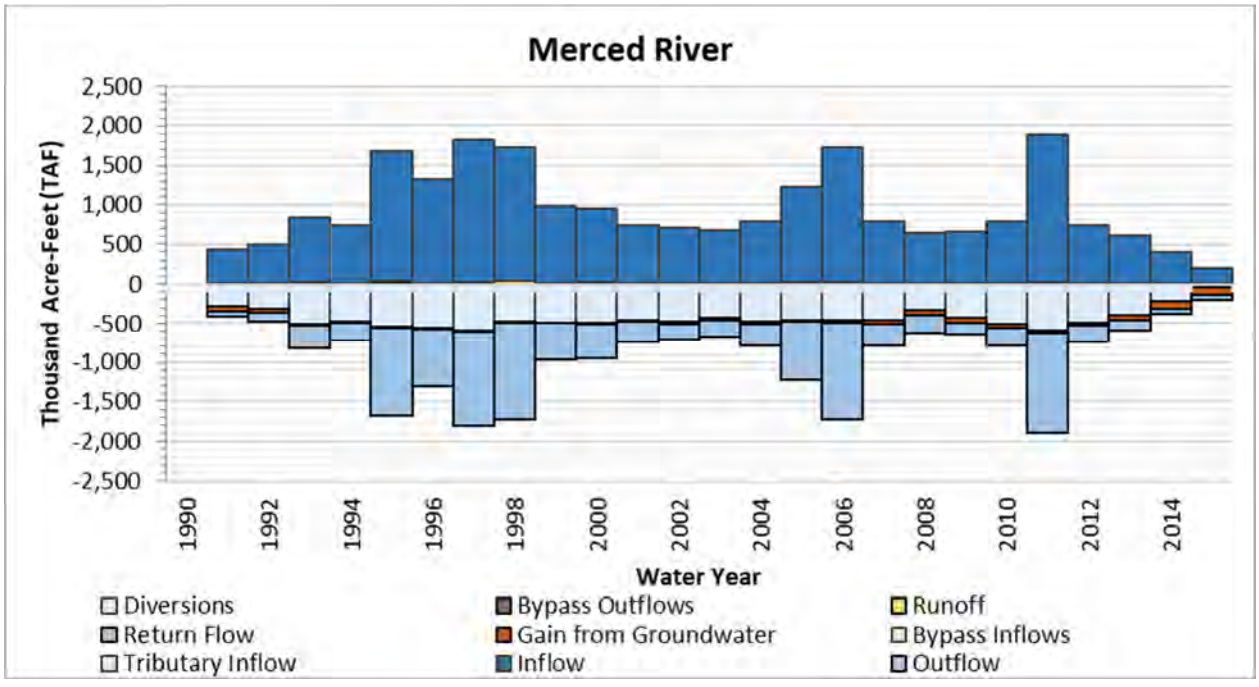
5.2.3 Stream Budget Calibration

Model stream flows were calibrated such that all monthly inflows and outflows of each stream reach aligned with observed data. Inflows to the stream system include flows from upstream reaches, tributary and bypass inflows, return flows, runoff, and gains from the groundwater system. Outflows from the stream system included downstream outflows, diversions, and losses to the groundwater system.

Merced River

The Turlock Model simulates the Merced River along the southern boundary of the Turlock Subbasin, extending from the eastern Merced County line to the San Joaquin River confluence. Inflows to the Merced River are represented by flows downstream of Merced Falls, as recorded based on measurements at United States Geological Survey (USGS) gauge Merced River at the Northside Canal. The average annual inflows to Merced River are approximately 927,000 AFY, with a high of 1,869,600 AF in 2011, and a reported low flow of 195,900 AF in 2015. Average annual diversions from the Merced River are reported to be 439,800 AFY including diversions to Merced Irrigation District's Northside and Main Canals, along with some riparian diversions. Due to variable hydrologic conditions, surface water diversions are higher during wet years, with a peak of 590,300 AF reported for 2011, and a low of 38,400 AF reported for 2015. Merced River flows are subject to seepage losses, estimated at an average of 38,700 AFY. Total tributary, runoff and return flows into the Merced River are estimated to be approximately 15,700 AFY. Merced River outflows to the San Joaquin River are estimated to average 456,700 AFY for the period WY 1991-2015. A culmination of all annual inflows and outflows to the Merced River are presented in **Figure 22**.

Figure 22: Merced River Annual Stream Budget

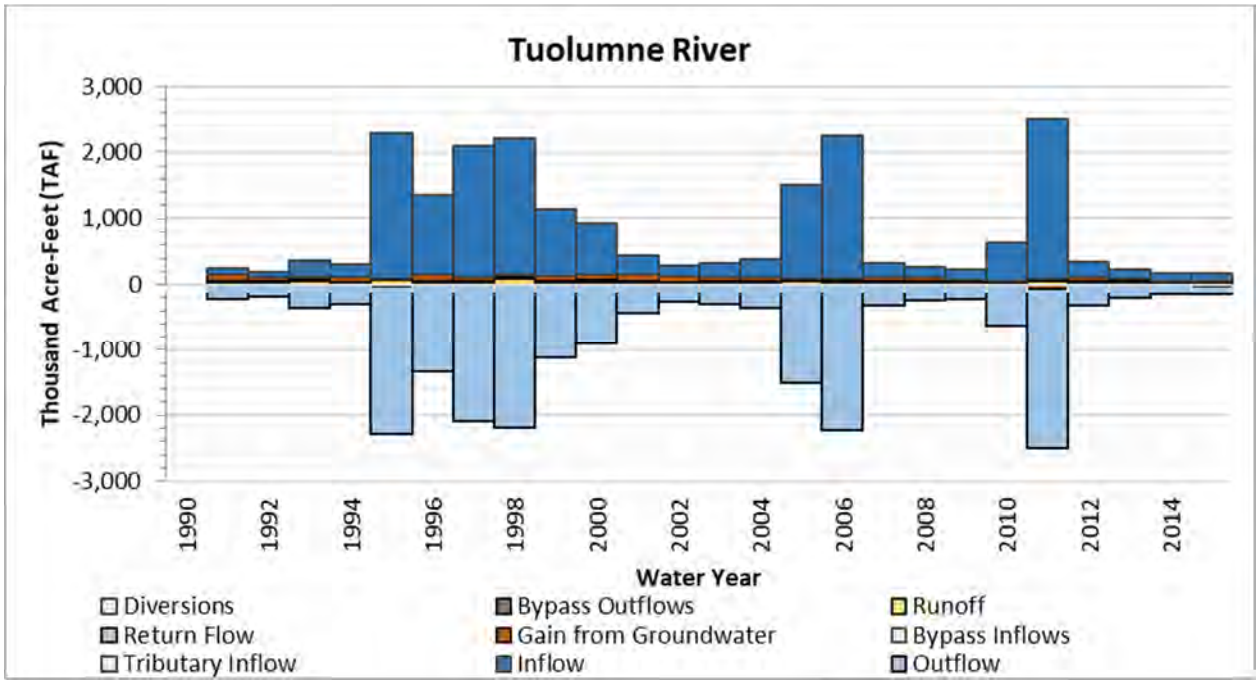


Tuolumne River

The Turlock Model simulates flow from La Grange Dam at the head of the Tuolumne River to the River's confluence with the San Joaquin River. Spills into the Tuolumne River are releases from La Grange, as reported by TID. These releases result in average annual inflows of 741,600 AFY, with an overall range from 82,200 AF in the critically dry year 1992 to 2,431,700 AF in the wet year 2011. As the Turlock Model

simulates the Tuolumne River downstream of La Grange Dam, TID diversion are not included in the river's water budget. As such, the only diversions off this reach of the Tuolumne River average 10,300 AFY for riparian water users. The Tuolumne River flows, on average, receives 44,700 AFY of net-inflows from the groundwater system. The Tuolumne River also receives tributary, runoff, and return flows estimated at 57,400 AFY combined. On average, the Tuolumne River outflows to the San Joaquin River at an average of 819,200 AFY from WY 1991 to 2015. A graphical representation for the Tuolumne River water budget is show below in **Figure 23**.

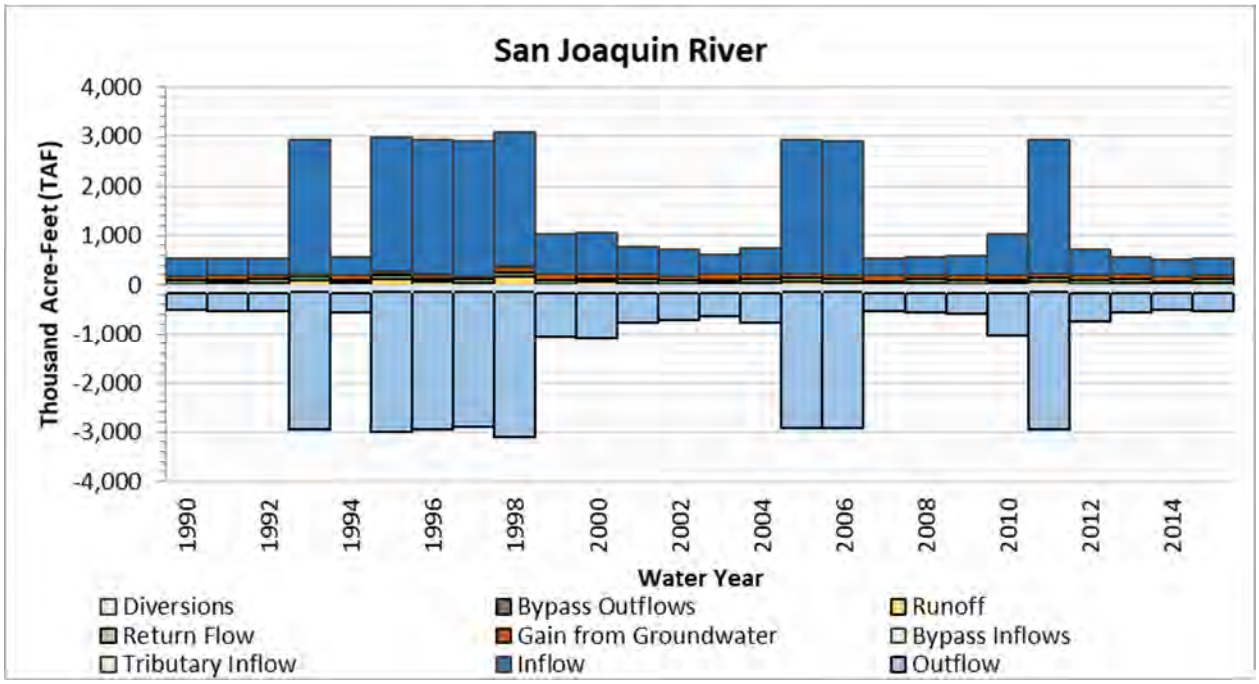
Figure 23: Tuolumne River Annual Stream Budget



San Joaquin River

The San Joaquin River is the second largest stream system in the Central Valley. The Turlock Subbasin is most heavily affected by the San Joaquin River from its confluence with the Merced River to its confluence with the Tuolumne River. Along this reach, the San Joaquin River predominantly receives inflows from the reach upstream of the Merced River, and from the tributary Orestimba Creek. Within the Turlock Model domain, annual inflows to the San Joaquin River average 1,192,000 AFY, with a high of 2,706,900 AF reported in 1996 and a low of 343,300 AF reported in 2014. Average annual diversions from this reach of the San Joaquin River totaled 155,400 AFY, with the highest annual volume diverted during 2002, a dry year, and the lowest annual volume diverted during 1998, a wet year. Along the Turlock Subbasin, the San Joaquin River receives average net inflows of 91,200 AFY from the groundwater system. Average annual tributary and runoff inflows to the San Joaquin River total approximately 123,900 AFY. Approximately an average of 1,256,800 AFY of water reaches the confluence of the Tuolumne River each year. Inflows for the San Joaquin River are shown in **Figure 24**.

Figure 24: San Joaquin River Annual Stream Budget



5.3 GROUNDWATER LEVELS AND STREAMFLOW CALIBRATION

After water budgets were refined and calibrated, the next step in the calibration process was calibrating groundwater levels and streamflow. This step in the calibration process included refining water budget components along with aquifer and streambed parameters to capture both the values and general trends throughout the subbasin over the simulation period.

5.3.1 Groundwater Level Calibration

The goal of this stage of calibration is to achieve a reasonable agreement between the simulated and observed groundwater levels at the calibration wells. The groundwater level calibration process included an iterative process of refining the water use budgets and adjusting system parameters to achieve a reasonable agreement between the simulated and observed groundwater levels at the calibration wells. As described in **Section 4.3**, 97 calibration wells selected as representative of the long-term conditions at both a local and regional scale. The selected calibration wells provide reliable historical data that has served as a fair representation of the conditions across the Subbasin. This information is presented in **Appendix A**.

The groundwater level calibration was performed in two stages:

- The initial calibration effort was focused on the regional scale to verify hydrogeological assumptions made during development and confirm the accuracy of water budgets and general groundwater flow vectors.
- The second stage of calibration of groundwater levels was to compare the simulated and observed groundwater level at each calibration well. This comparison provides information on the overall model performance during the simulation period. The simulated groundwater elevations at the 97

calibration wells were compared with corresponding observed values for long-term trends as well as seasonal fluctuations.

Calibration targets for the aquifer system focused on groundwater levels and were primarily driven by hydrologic conditions and land surface operations. To calibrate the model to observed groundwater levels, data from 97 wells throughout the Turlock Subbasin were compiled and analyzed for model input and use.

To minimize residuals between the simulated and observed groundwater levels, various aquifer parameters were adjusted with appropriate spatial distribution and interpolated to each of the model nodes. Aquifer parameter adjustments were limited to plausible value ranges established from available lithologic data. Calibration was performed in three steps. First, vertical conductivity of the upper aquitard unit (locally corresponding to the Corcoran Clay) was adjusted to reduce residuals. Then, the horizontal and vertical conductivities of the aquifer layers were modified. Lastly, the specific yield and specific storage values of the aquifers were adjusted until residuals between simulated and observed groundwater levels had been minimized. This is an iterative process and is implemented in a methodical way to obtain best fit with minimum deviation between the simulated and observed groundwater levels calibration observation wells.

The results of the groundwater level calibration indicate that the Turlock Model reasonably simulates the long-term hydrologic responses under various hydrologic conditions. **Figure 11**, presented in **Section 4.3** shows the spatial location of the calibration wells used in the model, while **Figure 25** through **Figure 32** offer a cursory overview of the groundwater level calibration across the model domain, while **Appendix A** contains groundwater hydrographs at all calibration wells.

Figure 25: Turlock Calibration Well 10, Simulated and Observed

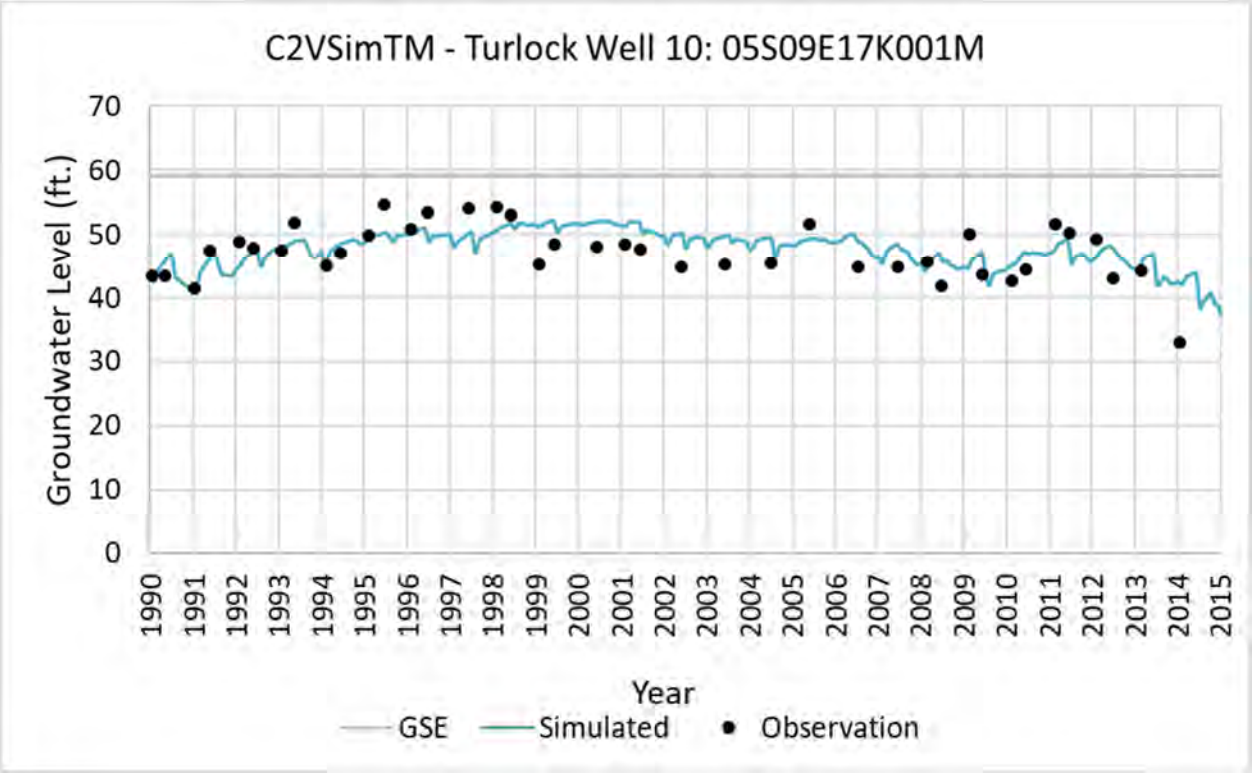


Figure 26: Turlock Calibration Well 32, Simulated and Observed

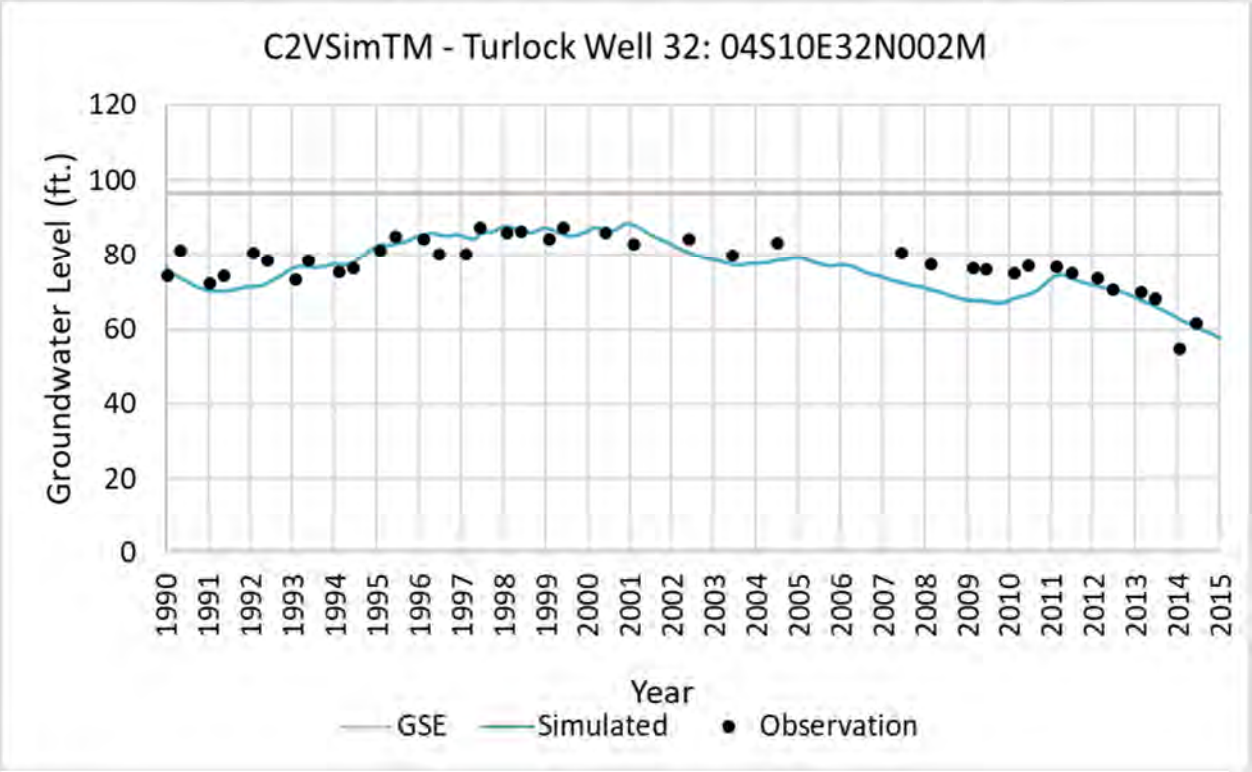


Figure 27: Turlock Calibration Well 48, Simulated and Observed

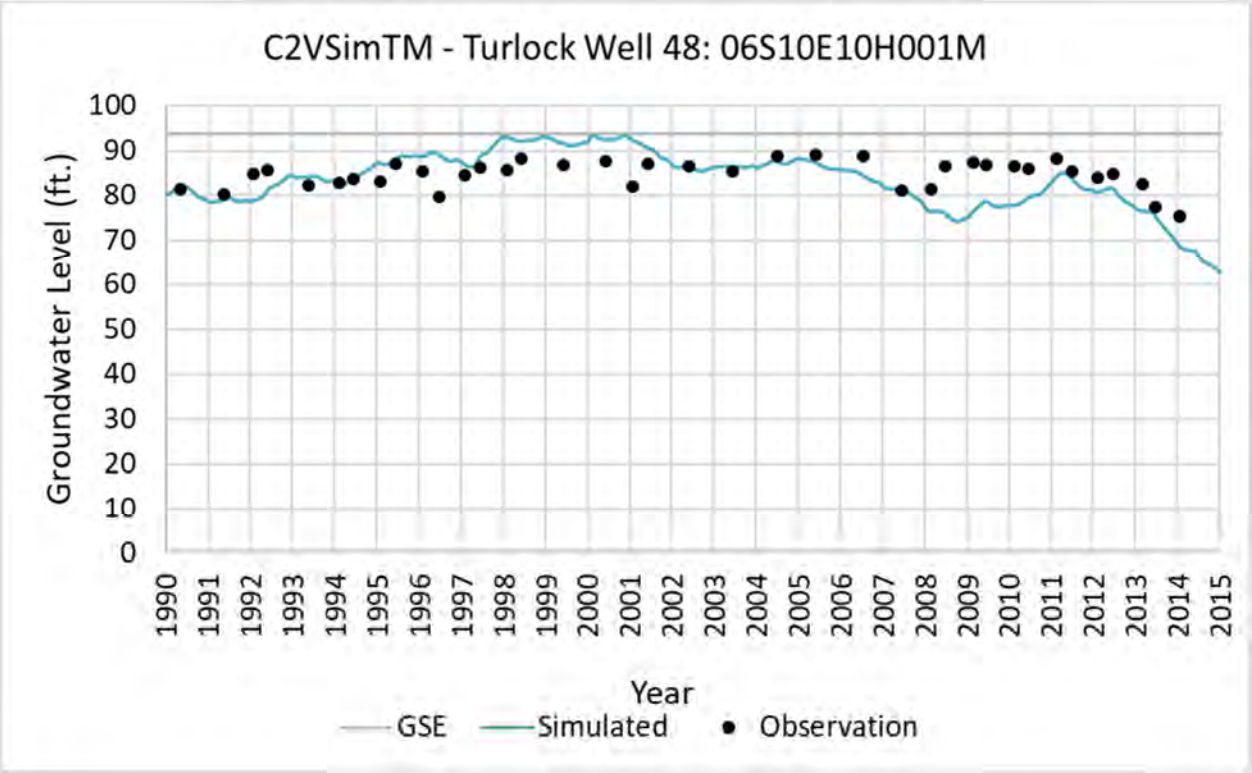


Figure 28: Turlock Calibration Well 70, Simulated and Observed

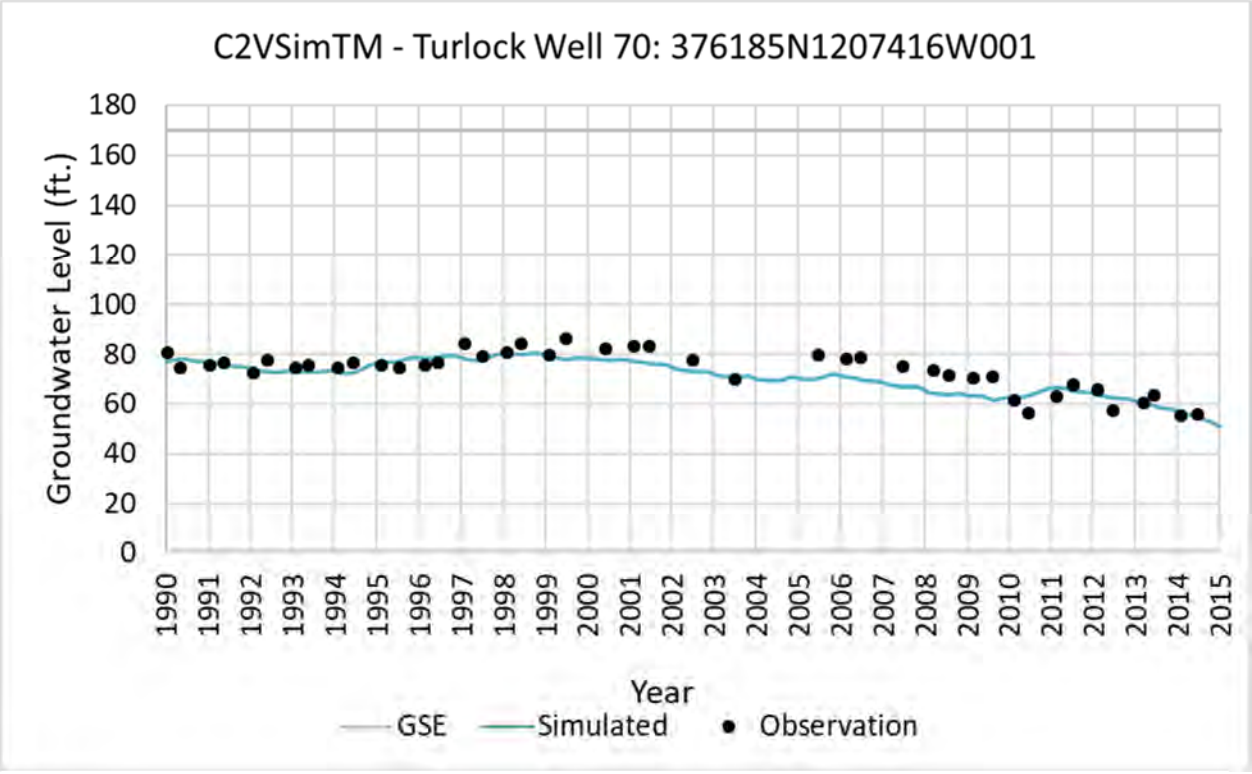


Figure 29: Turlock Calibration Well 71, Simulated and Observed

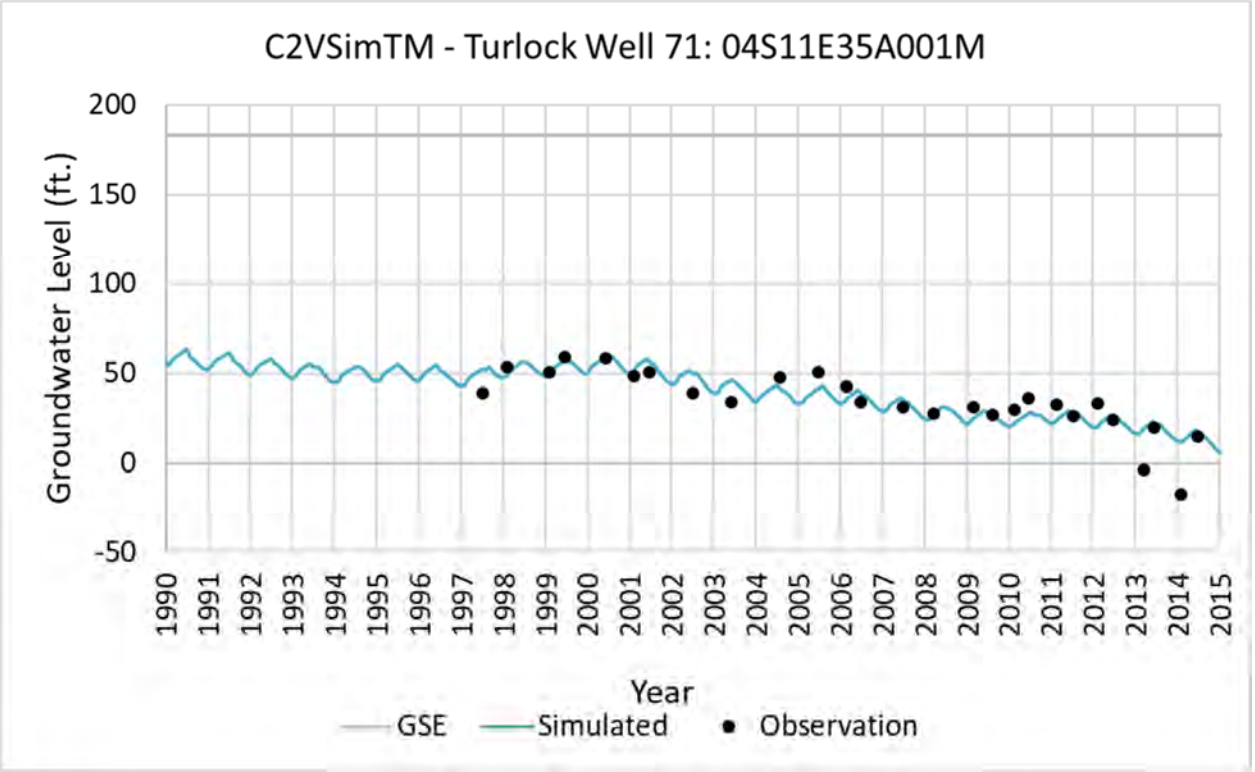


Figure 30: Turlock Calibration Well 113, Simulated and Observed

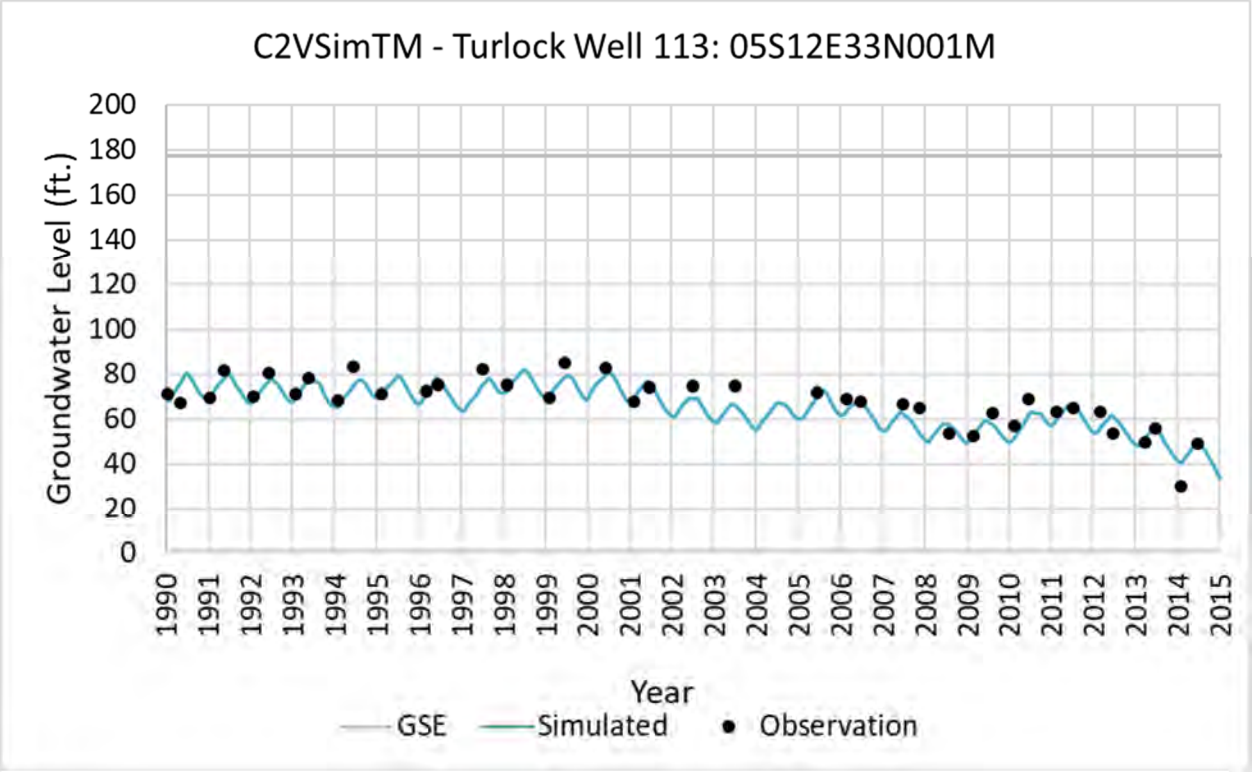


Figure 31: Turlock Calibration Well 115, Simulated and Observed

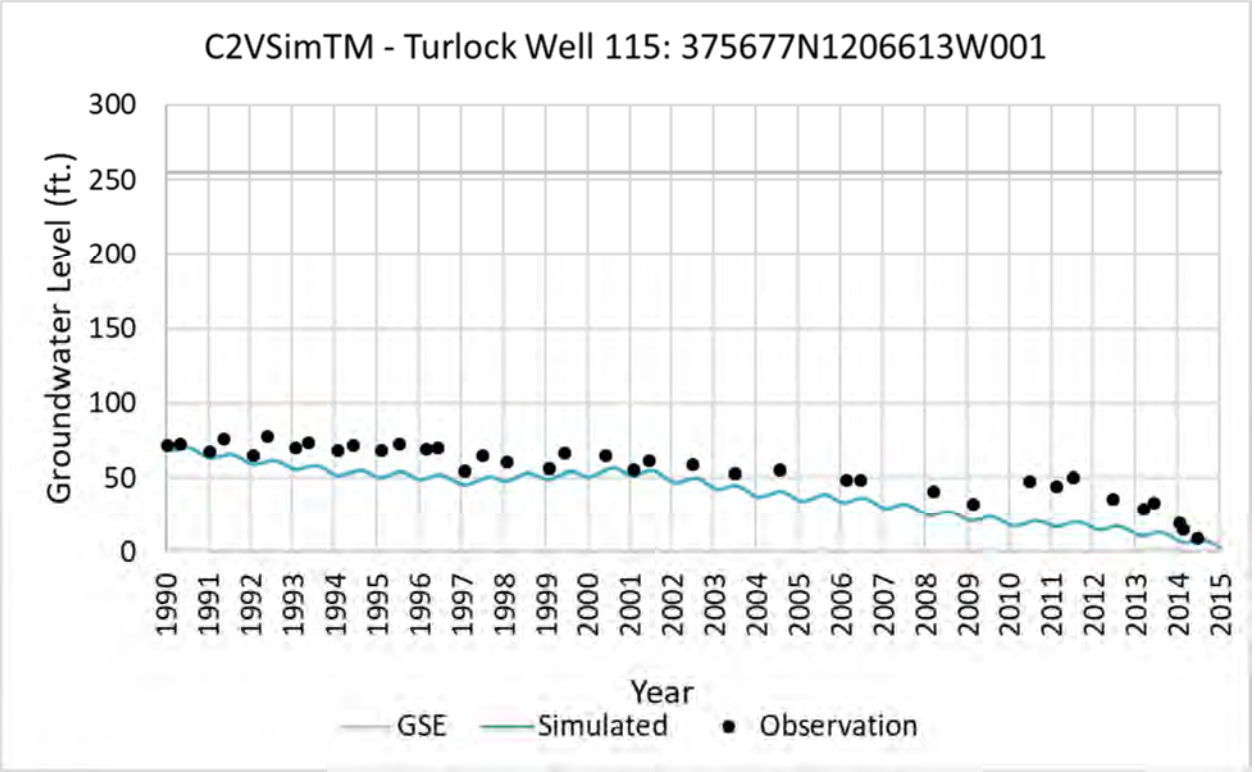
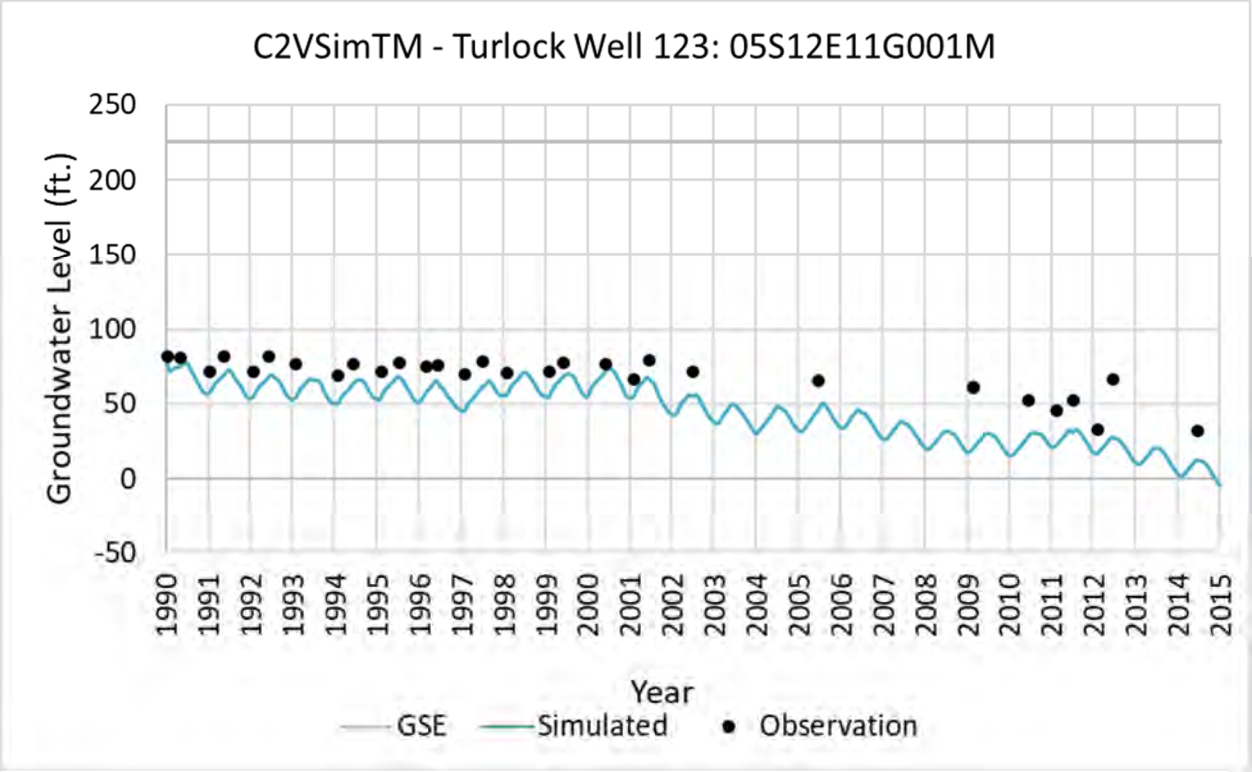


Figure 32: Turlock Calibration Well 123, Simulated and Observed



5.3.2 Stream Flow Calibration

Stream flow in the three major rivers in the Turlock Subbasin are calibrated to achieve reasonable agreement between the simulated and observed values (in this case, streamflow at the gaging stations). Inflow to the stream system is measured by releases to the Tuolumne and Merced Rivers from La Grange Dam and Merced Falls respectively. Other streamflow gaging stations are downstream of these inflow points and associated observed streamflow data can be compared to simulated streamflow in the calibration process. Streamflow calibration is primarily performed by comparing the simulated streamflow with local data from the five stream gages listed in **Table 16**.

Streamflow calibration included refinement of the streambed conductance originally from C2VSimFG. Simulated streamflow was compared with observed records, and exceedance charts were also used to evaluate the model performance when simulating variable conditions, particularly to check the quality of calibration under high and low flows at each gage location. Calibration results from primary calibration well for each river are presented below in **Figure 33** though **Figure 38**.

Table 16: Summary of Turlock Model Stream Calibration Gauges

Stream	Stream Node	Description	Station ID
Merced River	1807	Merced River at Stevinson	USGS: 11272500 CDEC: MST
San Joaquin River	1817	San Joaquin River at Newman	USGS: 11274000
San Joaquin River	1866	San Joaquin River at Crows Landing	USGS: 11274550 CDEC: SCL
San Joaquin River	1888	San Joaquin River Near Patterson	CDEC: SJP
Tuolumne River	2005	Tuolumne River at Modesto	USGS: 11290000 CDEC: MOD

Figure 33: Observed vs. Simulated Streamflow for the Tuolumne River

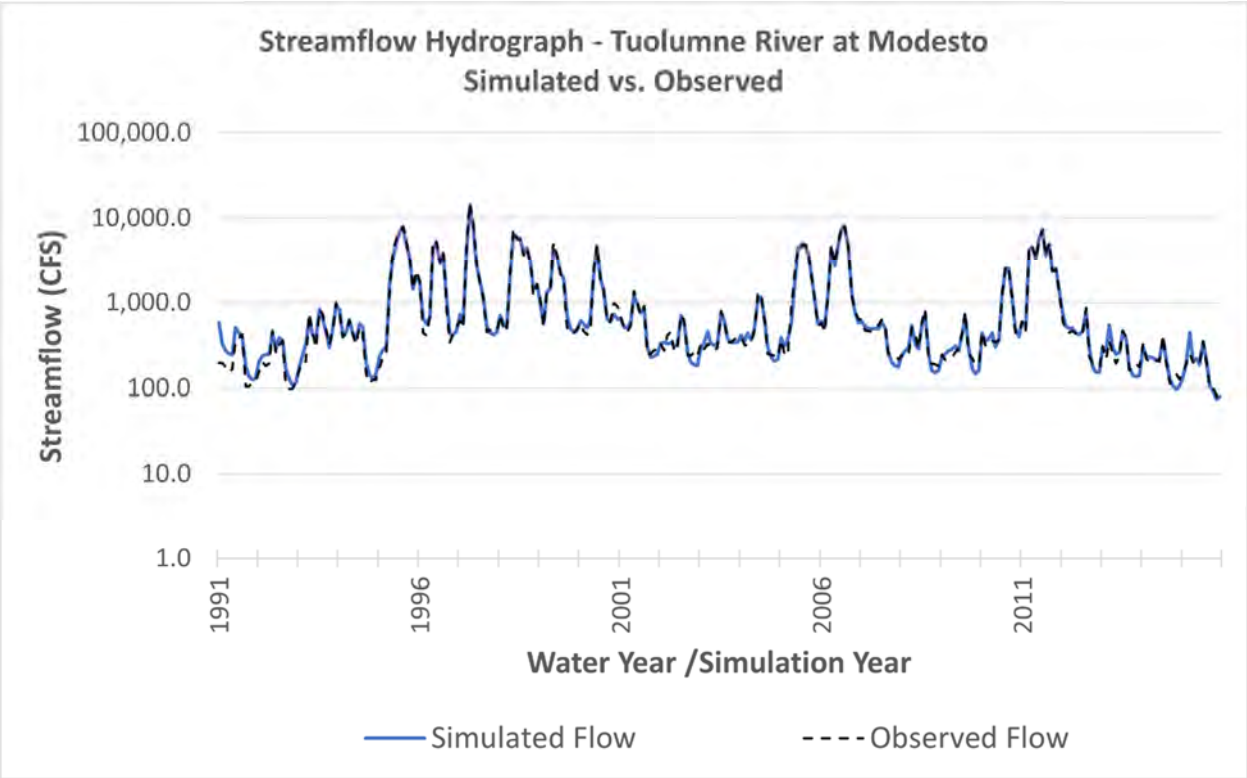


Figure 34: Streamflow Exceedance Probability for the Tuolumne River

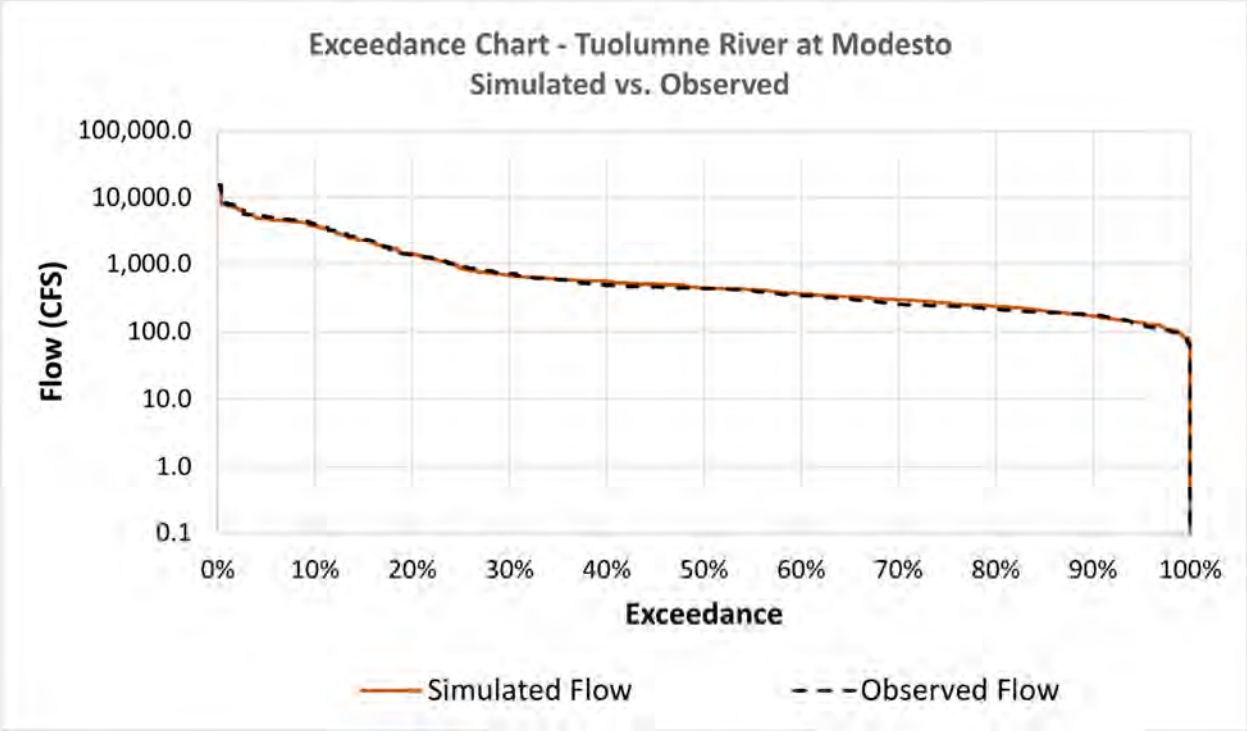


Figure 35: Observed vs. Simulated Streamflow for the Merced River

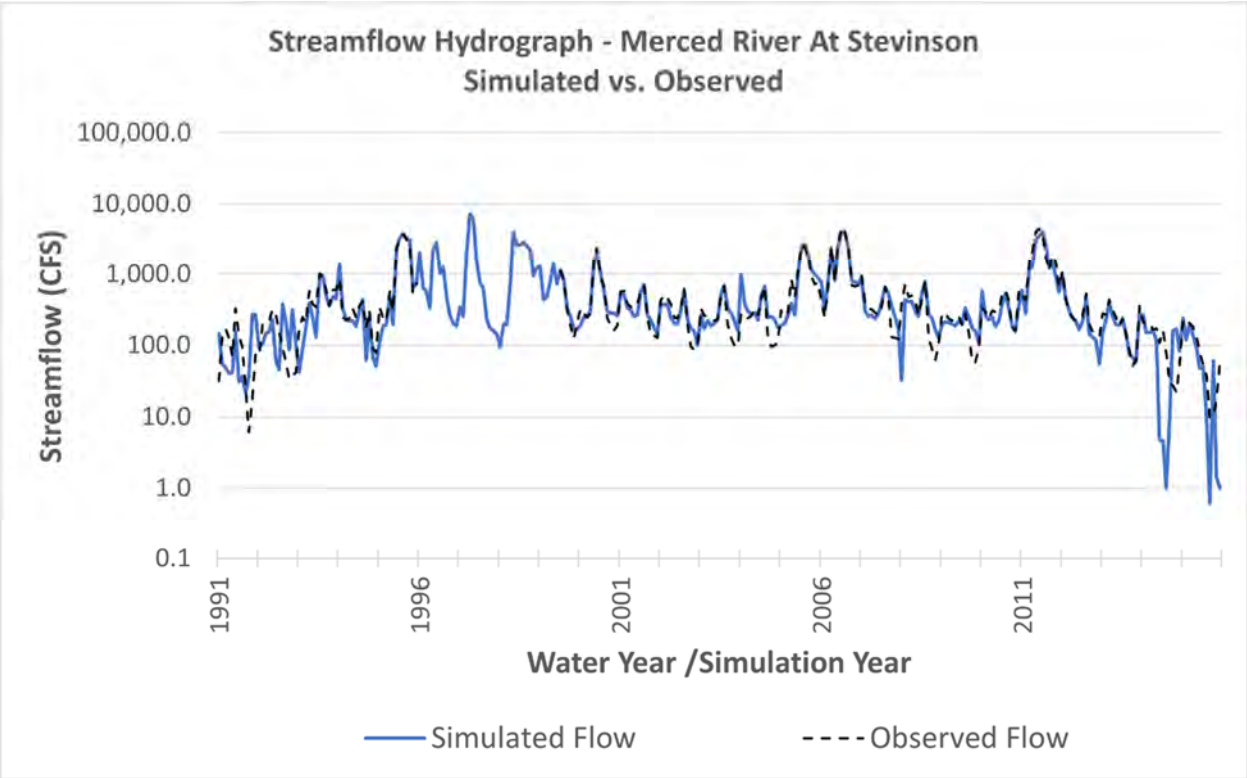


Figure 36: Streamflow Exceedance Probability for the Merced River

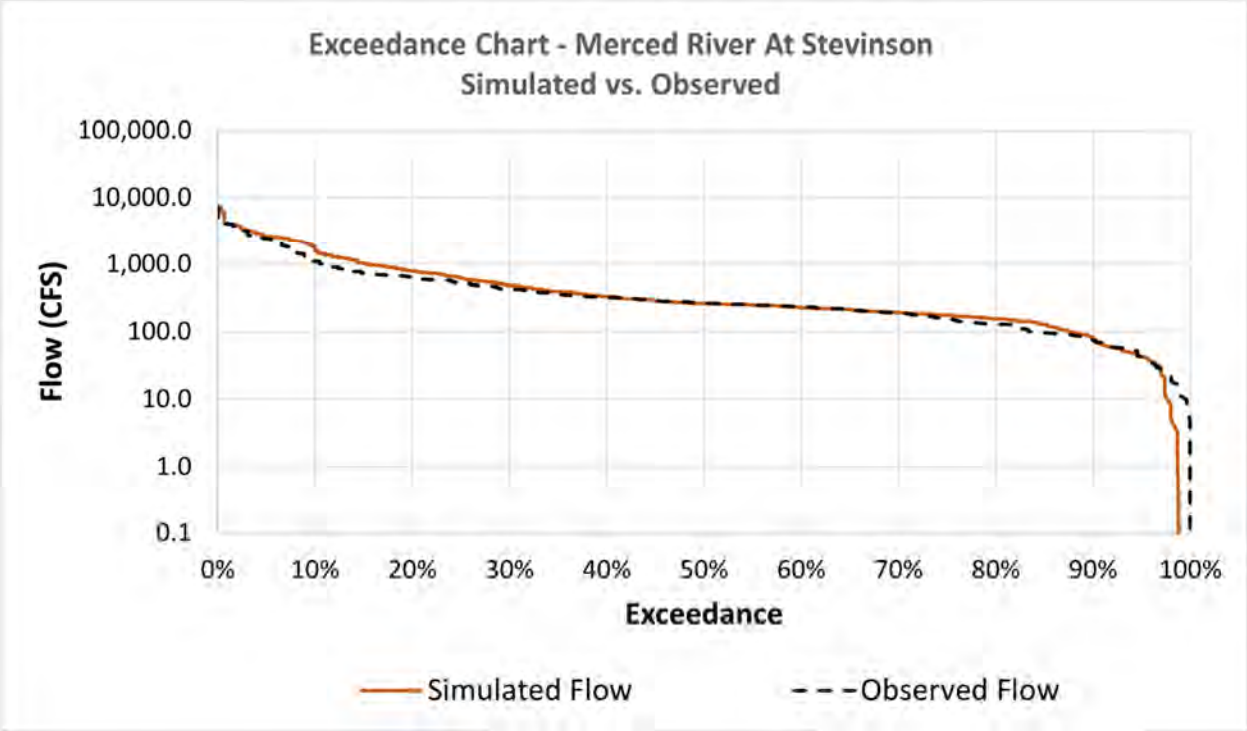


Figure 37: Observed vs. Simulated Streamflow for the San Joaquin River

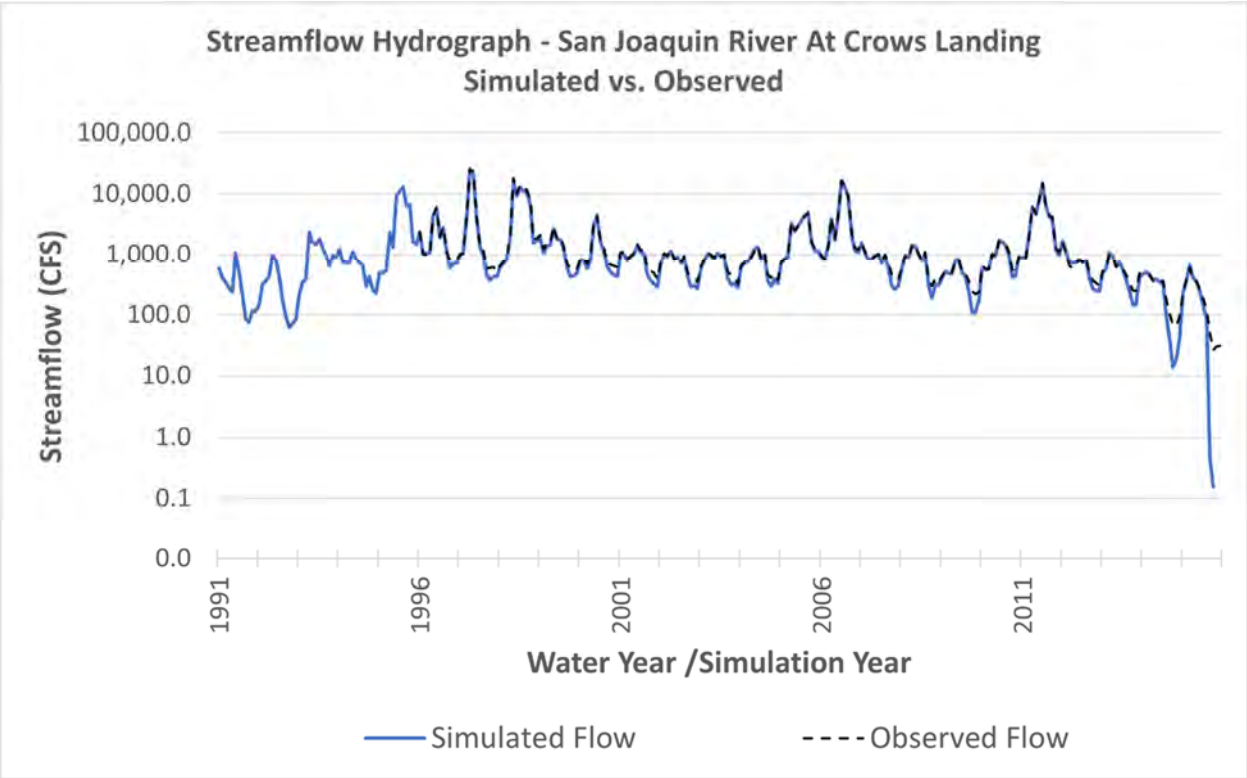
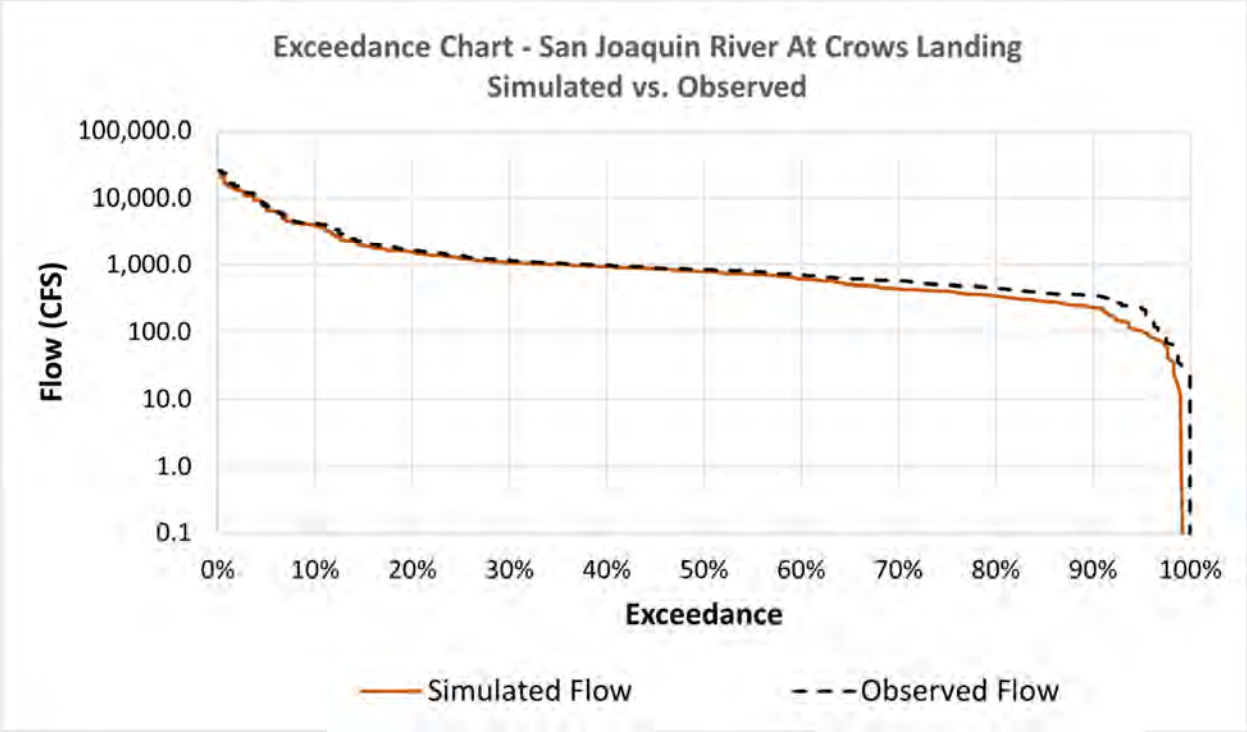


Figure 38: Streamflow Exceedance Probability for the San Joaquin River



5.4 MODEL PERFORMANCE

5.4.1 Final Calibration Parameters

The C2VSimFG served as the initial basis aquifer parameters within the Turlock Model. These parameters were adjusted throughout the calibration process such that water budgets, groundwater head, and streamflow of the simulated model were better aligned with the observed data. The parameters resulting from the calibration process are listed in the subsection below. Table 17 presents summary of the range of each parameter as calibrated and used in the final model.

Horizontal Hydraulic Conductivity (K_H) in the Turlock Model varies across the horizontal direction and across model layers. The fully calibrated values remain descriptive of the initial hydrogeologic analysis and range from 3.24 ft/day in Layer 4 to 100 ft/day in Layer 1. Values for the Unconfined Aquifer (Layer 1) average 63.69 ft/day while those in the confined, freshwater aquifers (Layers 2 and 3) average to 21.53 ft/day. The spatial distribution is represented in **Figure 39** through **Figure 42**.

Vertical Hydraulic Conductivity (K_V) facilitates the separation between each of the vertical layers simulated in the Turlock Model. Average values typically range from 0.89 ft/day in the unconfined aquifer, to 0.23 ft/day in the lower freshwater layer.

Aquitard Vertical Hydraulic Conductivity (K_{AV}) is primarily a constraining factor across the Corcoran Clay. The vertical conductivity of the Corcoran aquitard is generally found to be between one-thousandth and one-ten-thousandth of the horizontal conductivity of the surrounding aquifer systems.

Specific Storage – Specific Storage (S_S) is used to represent the available storage at nodes in a confined aquifer, where the hydraulic head is above the top of the aquifer. Specific Storage is the unit volume of water released or taken into storage per unit change in head.

Specific Yield – Specific Yield (S_Y) is representative of the available storage in an unconfined aquifer and defined as the unit volume of volume released from the aquifer per unit change in head due to gravity.

Streambed Conductance (C_S) is represented in the Turlock Model as the product of streambed thickness and the streambed hydraulic conductivity. Due to the uncertainty related to the streambed thickness, C2VSimFG defines all streambed thicknesses as one foot so that the hydraulic conductivity input parameter (CSTRM) represents streambed conductance for each node.

A summary of parameters resulting from the calibration process are listed in **Table 17** and **Table 18**.

Table 17: Range of Aquifer Parameter Values

Data		Layer 1	Layer 2	Layer 3	Layer 4
Horizontal Hydraulic Conductivity (ft/day)	Maximum	100.00	54.94	100.00	79.28
	Average	63.69	22.32	22.53	21.33
	Minimum	12.17	6.35	3.84	3.24
Vertical Hydraulic Conductivity (ft/day)	Maximum	7.00	1.92	1.25	2.77
	Average	0.89	0.28	0.23	0.29
	Minimum	0.12	0.06	0.04	0.03
Aquitard Vertical Hydraulic Conductivity (ft/day)	Maximum		5.60E-02		
	Average		6.33E-03		
	Minimum		1.00E-03		
Specific Yield (unitless)	Maximum	0.200	0.200	0.200	0.200
	Average	0.109	0.104	0.102	0.105
	Minimum	0.050	0.050	0.050	0.050
Specific Storage (1/ft)	Maximum	1.00E-04	1.00E-04	1.00E-04	1.00E-04
	Average	3.54E-05	4.08E-05	4.07E-05	4.33E-05
	Minimum	1.45E-06	1.99E-06	2.28E-06	2.38E-06

Table 18: Range and Average of Streambed Conductance (C_S) by River

River	Average Conductance (day^{-1})	Minimum Conductance (day^{-1})	Maximum Conductance (day^{-1})
Tuolumne River	1.9	1.4	2.8
Merced River	2.2	1.1	4.7
San Joaquin River	2.0	1.7	3.0

Figure 39: Calibrated Horizontal Hydraulic Conductivity of Layer 1

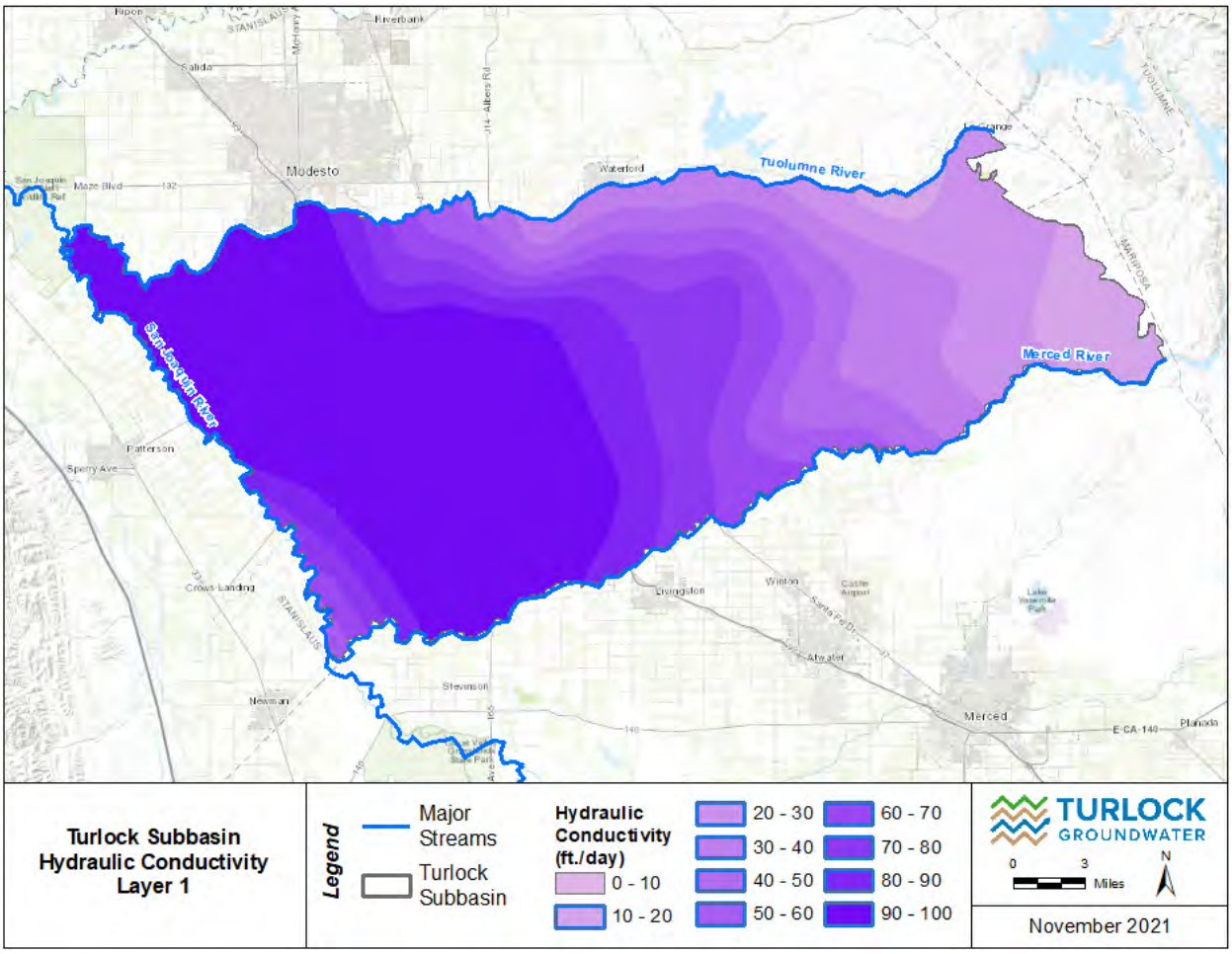


Figure 40: Calibrated Horizontal Hydraulic Conductivity of Layers 2