ATTACHMENT 4. PROJECT DESCRIPTION

District Background

Location

Tehachapi-Cummings County Water District (TCCWD) is located in the Tehachapi Mountains, east of the southern San Joaquin Valley and encompasses approximately 266,000 acres, as shown in **Figure 4.1**. TCCWD provides an imported water supply, water resource management, and flood protection to the public. The main groundwater supply is located in three adjudicated basins, the Tehachapi, Cummings, and Brite, as shown in **Exhibit 4.1**.

The Tehachapi, Cummings, and Brite Groundwater Basins (Basins) are located in the Tulare Lake Hydrologic Region, as described in California Department of Water Resources (DWR) Bulletin 118. Even though the Basins are grouped with the rest of the Tulare Lake Basin, it should be noted that the Basins are isolated from the Tulare Lake Groundwater Basin, as they are located at an approximate elevation of 4,000 feet above mean sea level. Because of this condition, it is unique that a single entity (TCCWD) has complete control and authority as Watermaster over three distinct groundwater basins. TCCWD and the other stakeholders must ensure management practices are implemented so that groundwater conditions in the Basins are well maintained.

District History

The Tehachapi-Cummings County Water District was formed February 16, 1965 by popular vote within the district, replacing the Tehachapi Cummings Water Conservation District. A citizens advisory committee composed of a cross section of community residents was established. This committee worked for more than a year on the basic solution to groundwater overdraft in the three major groundwater basins of the District. On May 16, 1966, the Citizens Advisory Committee recommended to the Board of Directors of the Tehachapi-Cummings County Water District that three separate adjudication actions be filed on the Tehachapi, Cummings, and Brite groundwater basins. The purpose of these actions was to establish groundwater rights of all parties and to establish a physical solution and a groundwater management program in each basin when necessary to prevent further damage to the basin. Also the District was charged with obtaining an imported water supply to supplement local groundwater supplies. Additional information regarding the Judgments is contained in **Attachment 3**.

Imported Water Supply

To supplement dwindling groundwater supplies, TCCWD pursued State Water Project (SWP) water as an imported water supply. In December 1966, TCCWD executed two contracts with Kern County Water Agency for access to the SWP supplies. One contract was for 5,000 acre-feet (AF) of agricultural water and the second was for 15,000 AF of M&I water. Construction of the water system to deliver SWP water began in May 1972. On November 4, 1973, the first imported water was pumped from the State Aqueduct near the A.D. Edmonston Pumping Plant through the Cummings Valley and into the Tehachapi area. TCCWD makes direct deliveries of SWP water to agricultural users and delivers water through conjunctive use to urban water purveyors. Recharge/recovery projects have been constructed and are in operation in the Tehachapi and Cummings Basins.

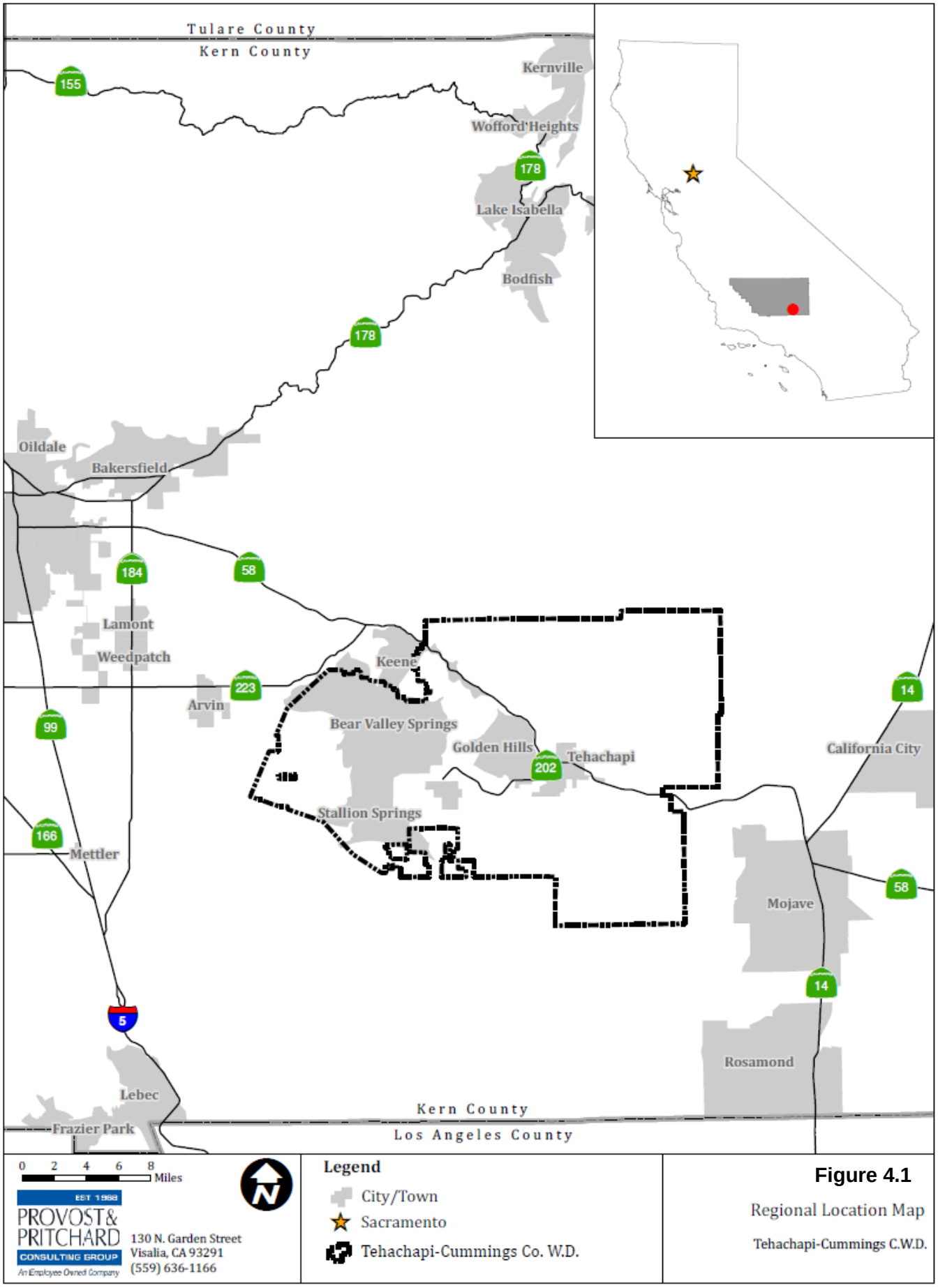


Figure 4.1

Regional Location Map

Tehachapi-Cummings C.W.D.

Adjudicated Groundwater Basins

The following three subsections describe each of the adjudicated groundwater basins and generally describe the main water uses, recharge activities, and condition of the aquifer.

Tehachapi Groundwater Basin

The Tehachapi Groundwater Basin surface is the Tehachapi Valley floor, encircled on the west by the foothill area of the low-lying ridge running between the Tehachapi Mountains on the south, the Sierra Nevada on the north, and on the east by a ridge of the Sierra Nevada and the Tehachapi Mountains, known as Proctor Gap, a subsurface barrier ridge. The Tehachapi Groundwater Basin is generally elongated east and west, approximately nine miles wide and approximately oval-shaped and five miles at its widest. The basin may be pictured as a bowl, the bottom and sides of which are composed of impervious materials. The bowl is filled with heterogeneous pervious alluvium deposited through geological time by the streams carrying eroded materials from the surrounding watershed areas. Groundwater is stored within the alluvium of the basin. Drainages within the Tehachapi basin include Brite Creek (which flows into Tehachapi Creek), Antelope Creek, and Blackburn Canyon Creek.

Tehachapi Basin

Referring to **Exhibit 4.1**, the Proctor Gap separates the adjudicated basin (shaded blue) from the eastern half of the Tehachapi Valley East groundwater basin (red line) as defined in DWR Bulletin 118. The eastern half of the basin was not included in the adjudication as water supplies are not of concern in that area due to low water use. Additionally, that portion of the basin drains directly to Cache Creek and east to the Mojave Desert.

With the adjudication of the basin, "allowed pumping allocations" were created for each party and party domestic rights which restricted total annual extractions within the Tehachapi Basin to the safe yield of 5,500 AF. Customers within the City of Tehachapi and Golden Hills CSD are the predominate water users in the basin. These urban water purveyors utilize their allowed pumping allocations and supplement with SWP water through conjunctive use by artificial recharge in the Water Canyon (also known as China Hill) and Antelope Dam recharge areas.

Due to concerns with environmental restrictions on the SWP, potential impacts of a prolonged dry climate, increased water demands due to urban growth, climate change impacts, potential water quality concerns, TCCWD, Golden Hills CSD, and the City of Tehachapi proactively contracted with Fugro West Inc. to assess the hydrogeologic conditions of the basin through the development of a groundwater flow model. The study, completed in 2009, evaluated future trends in GW levels and quality in response to current and future operations of the basin. The study found that based on baseline conditions over the next 20 years, the average annual recharge is about 5,300 AF which is somewhat less than the adjudicated safe yield of 5,500 AF.

Cummings Groundwater Basin

The Cummings groundwater basin's surface is generally the Cummings Valley floor, bordered on the south by the Tehachapi Mountains, on the north by the Sierra Nevada, with low lying ridges connecting these two ranges on the east and west sides of the basin. The basin is generally elongated in a northeasterly manner, approximately six miles at the longest point and four miles at the widest point. Inflow of surface and subsurface water from the surrounding watershed, including Cummings Creek, replenishes the basin. Surface inflow from Chanac Creek draining a portion of the Brite Valley also flows into the Cummings Basin. Subsurface outflow from the basin does not occur to any appreciable extent due to the rock outcroppings in the channel of Chanac Creek.

Chanac Creek Dam at Stallion Springs Road Bridge

Groundwater from the Cummings Basin is primarily used for agricultural uses. Other water users consist of the California Correctional Institution (CCI), various private entities, and rural single family residences. Stallion Springs CSD and Bear Valley CSD purchase imported water from TCCWD that is recharged in the basin; the Districts then pump the water from the Basin and export it to portions of their service areas that are outside the basin.

TCCWD also makes direct deliveries of imported water to agricultural users overlying the basin. These deliveries are made with the intent of accomplishing in-lieu recharge. Prior to 1995, TCCWD was able to make these deliveries for less than the cost of pumping groundwater, and the basin was kept in balance. Since then, agricultural users have been able to produce groundwater for less than the cost of purchasing and delivering imported water (in particular, due to natural gas costs for pumping over the Tehachapi Mountains). Because of this cost differential, the Cummings Basin is now in overdraft. Extractions have exceeded the safe yield in four of the past ten years. Water levels in the central portion of the basin dropped about 40 feet during this period (some of this may be due to localized cones of depression). The groundwater production in 2009 was 4,406 AF, exceeding the adjudicated safe yield of 4,090 AF. Since 2009, pumping has decreased to 3,650 AF in 2010 and 2,875 AF in 2011 allowing the groundwater levels to stabilize and rise, but have not recovered to levels prior to 10 years ago.

Brite Groundwater Basin

The Brite Groundwater Basin is a northwest to southeast trending valley basin bounded on the north by the Sierra Nevada and on the south by the Tehachapi Mountains, with low-lying ridges connecting the two ranges on its east and west sides. The northeast portion of the basin is drained by Brite Creek, which flows into the Tehachapi Valley. The northwest portion of the basin is drained by Chanac Creek, which flows into Cummings Valley.

At this time, groundwater levels are stable and no restrictions on groundwater production have been established within the basin. SWP water is distributed from Jacobson Reservoir (Brite Lake) which is located in Brite Basin. A portion of the water lost due to seepage from the lake is captured by wells operated by TCCWD and returned to Jacobsen Reservoir.

Jacobson Reservoir

Groundwater Quality

Considerable uncertainty exists in the quantification of historical and future nitrate inputs to Tehachapi, Cummings, and Brite Groundwater Basins. Groundwater nitrate measurements are limited to public wells that have been sampled since the early to mid 1990s. Bear Valley CSD, the City of Tehachapi, and Stallion Springs CSD, among others have had to take wells offline due to nitrates exceeding Maximum Contaminant Level (MCL) for public drinking water use. Many other wells throughout the basin have tested for nitrates approaching the MCL.

As part of the scope of work for the Tehachapi Basin Groundwater Study mentioned above, a nitrate transport model was initially constructed but ultimately abandoned, as it was concluded that insufficient historical nitrogen loading and groundwater nitrate monitoring data existed to adequately develop the model. The study recommended that a groundwater nitrate monitoring program be developed so that future nitrate analyses may be prepared. Sources of nitrate include effluent from the wastewater treatment facilities (WWTF), wastewater discharge from septic tanks, existing nitrates in the soils beneath the former wastewater lagoons, and nitrates from agricultural and domestic fertilizer applications. These sources of nitrate are approximately shown in **Exhibit 4.2** for the Tehachapi Basin and **Exhibit 4.3** for the Cummings and Brite Basins. Two time-series plots of groundwater nitrate levels of example wells are included in **Exhibit 4.4** and show the nitrate levels to be close to the MCL. The approximate location of these wells is located on **Exhibit 4.2** and **4.3**.

Perchlorate, arsenic, and methyl tertiary butyl ether (MTBE) have also been constituents of concern in the Tehachapi and Cummings Basins and need to undergo on-going monitoring and possible mitigation against future water quality impacts. Water quality issues associated with these contaminates are typically localized to certain areas of the basins.

In 2006, the USGS in cooperation with the California State Water Resources Control Board (SWRCB) conducted a groundwater quality study of the Southern Sierra Nevada Study Unit as part of the initial assessment of water quality for Priority Basins under the Groundwater Ambient

Monitoring and Assessment (GAMA) Program. This study unit includes the Tehachapi and Cummings Groundwater Basins in addition to the Lake Isabella/Kern River Valley areas to the north. The study unit has been identified as a priority basin due to the population that is mostly dependent upon groundwater supplies. The results of the study show arsenic to be the primary concern for the study unit, which tends to be focused in the Kern River Valley (see **Exhibit 4.5**). Nitrate was not shown to be a significant problem, due to the limited number of wells sampled as a part of the program. However, nitrate is known to be a significant on-going problem locally, especially in the Tehachapi and Cummings Basins. A more intensive water quality monitoring program can be accomplished at a local level to help supplement monitoring data to the GAMA Program.

Project 1-Groundwater Quality Monitoring Program

Project Overview

Groundwater quality is of concern throughout the Cummings, Brite Valley, and Tehachapi Groundwater Basins (Basins). In recent years, at least 5 public water supply wells in these Basins have been shut down due to high nitrates or other constituents. There is currently limited knowledge regarding the transport of water quality constituents within the Basins, much less what the potential future impacts are to the groundwater supply. Because of these groundwater quality issues, an effective Groundwater Quality Monitoring Program (GWQMP or Program) is needed as a first step towards assessing these potential impacts to the groundwater supply. The GWQMP will consist of developing and implementing a plan to monitor select wells within the Basins for certain groundwater quality constituents. Other supporting data and information will also be collected that will aid in future groundwater quality analyses. This data will be incorporated into a regularly updated Groundwater Data Management System that will be integrated into a geographical information system (GIS). This GWQMP will be instrumental in developing future nitrate transport models that will aid the District in its groundwater management role in each of the Basins.

Goal and Objectives of GWQMP

The goal of the Groundwater Quality Monitoring Program is to improve groundwater quality monitoring and protect groundwater used for drinking water supply with an emphasis on water quality constituents of concern (in particular nitrates) within the Basins. The Program is expected to result in significant amounts of new knowledge and an achievable improvement in groundwater management in the Tehachapi area.

The objectives of the GWQMP are:

- To establish the baseline groundwater quality of the Basins;
- To determine the significant trends in groundwater quality;
- To identify sites for multi-level monitoring wells to be constructed in the future;
- To obtain sufficient groundwater nitrate samples from wells to prepare a nitrate transport model to predict changes in nitrate levels resulting from the effects of various land use activities and sources of contamination;
- To obtain supporting hydrologic, water use, and other data for future groundwater modeling efforts including the development of the nitrate transport model;
- To disseminate water quality data to DWR, local agencies, and the public in summary reports, maps, and other media formats;
- To provide a planning tool to assist in decision making regarding the location of future water supply wells and water treatment needs.

Consistency with Groundwater Management Program

As mentioned previously, the adjudication of each of the three groundwater basins is a direct result of the over pumping of the aquifers. TCCWD was appointed by the Court as the Watermaster of each of the three adjudicated basins and has an active role in managing and monitoring the groundwater supply. Groundwater quality is of concern due to the fact that multiple public water purveyors and private well owners rely upon clean groundwater from wells in each of the basins. Groundwater quality affects the available water supply for drinking water purposes.

The Greater Tehachapi Area Specific and Community Plan's (GTASCP) sets the following goals and policy (see **Exhibit 3.4**) related to water quality issues:

> Goal COS.1 – Ensure that the Greater Tehachapi Area can accommodate projected future growth and development while maintaining a safe and healthful environment and prosperous economy by guiding development away from hazardous areas, and assuring the provision of adequate public services and infrastructure.
>
> Policy COS.2 – Ensure that water quality standards are maintained for existing users and future development and that water-related infrastructure is provided in an efficient and cost effective manner.

This Goal and Policy from the GTASCP are consistent with the goals and objectives of the GWQMP.

Area Covered

The area covered by the proposed project includes the Cummings, Brite Valley, and Tehachapi Groundwater Basins as shown in **Exhibit 4.1**. The three adjudicated groundwater basins are shaded in color and have similar boundaries to the basins defined in DWR Bulletin 118 as shown with the red boundary lines. The main difference is that the eastern portion of the Tehachapi Valley East (Basin Number 6-45) was not included in the adjudication of the Tehachapi Groundwater Basin.

Detailed Project Description

TCCWD proposes to use a portion of the grant funding to implement a Groundwater Quality Monitoring Program for these Basins. Nitrate data will be the key water quality parameter to be monitored, but other water quality constituents will be collected and monitored as a part of the Program. The GWQMP will include the development of a database to manage the collection of data and also quantify nitrogen loading from the different sources. Once this Program has been implemented the data gathered can be used to properly calibrate nitrate transport groundwater models for the Tehachapi and Cummings Basins and evaluate potential groundwater quality impacts to the Basins. Data that is collected will be integrated with a Geographical Information System (GIS) to geospatially relate groundwater quality levels to changes in land use and water management activities.

TCCWD, in coordination with other agencies, contracted with Fugro West, Inc. to prepare studies of the Cummings and Tehachapi Groundwater Basins. The Groundwater Modeling Study for the Cummings Groundwater Basin (completed in 2004) analyzed the hydrogeologic conditions of the basin through the use of a numerical groundwater model. The Tehachapi Groundwater Basin Study (completed in 2009) also analyzed the hydrogeologic conditions of the Tehachapi Basin through the use of a groundwater model. The initial scope of work for the later study was to also evaluate potential impacts of groundwater nitrate concentrations to existing and future public water supplies; however, it was concluded that the nitrate transport model could not be adequately developed due to insufficient spatial detail of groundwater nitrate levels and limited data for nitrate loadings from identified nitrate sources. The study did provide recommendations for developing a groundwater nitrate monitoring program to appropriately characterize long-term groundwater nitrate trends in the basin. This issue has become the primary impetus in developing a GWQMP for not only the Tehachapi Basin but also the Cummings and Brite Basins.

As mentioned above, the GWQMP will monitor multiple water quality constituents, but the primary need for the Program is to collect nitrate data in order to assess potential future impacts to groundwater basins. The GWQMP will consist of the following components:

1. Development of a groundwater data management system for all three basins;
2. A comprehensive network of wells to be sampled at regular time intervals for groundwater nitrate concentrations and other constituents of concern;
3. Consistent monitoring of nitrogen loadings in the effluent discharge from wastewater treatment facilities;
4. Estimation of nitrogen loadings from septic systems and agricultural lands;
5. Collection of other supportive data;
6. Reporting of data collection and analyses.

After the Program has been implemented for approximately 10 years, the collected data can be used to parameterize the numerical nitrate transport model and evaluate future conditions and propose management scenarios.

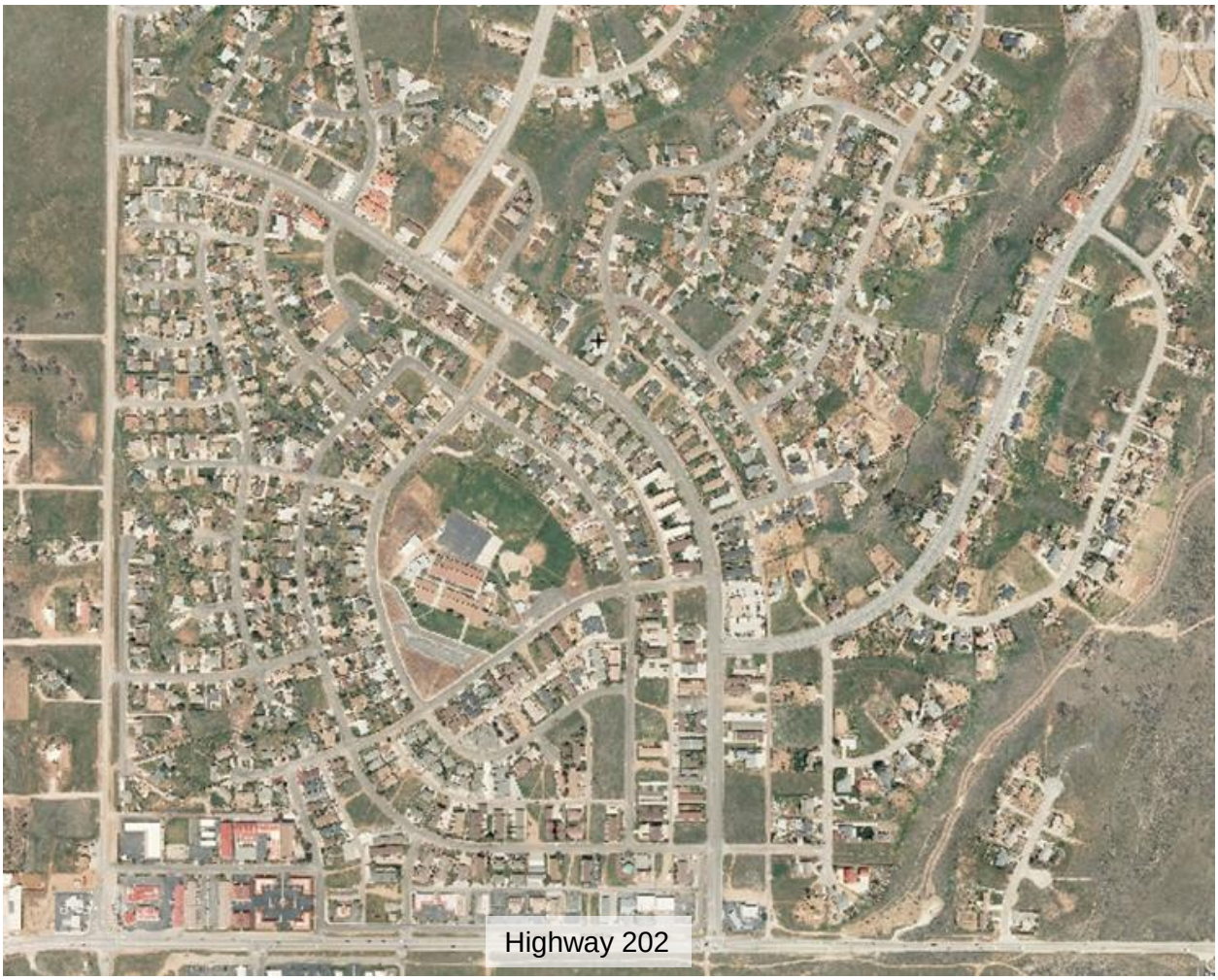
Groundwater Data Management System

An electronic database of the collected and estimated data as described in the following sections will be developed and updated on a regular basis. The data will be organized in a master database that will be linked to GIS. Even though the data may originally be generated by different agencies and organized in different formats, it will be consolidated into a single database system for the GWQMP. The Groundwater Data Management System will provide the following benefits:

- Ensure that all data needed for future analyses are collected to prevent potential data gaps.
- Improve quality control of data by developing data entry forms that will have background processes designed to minimize the potential for errors to occur.
- Improve data management by reducing the need for duplicate data and reports through use of a single database.
- Limit District staff time in manipulation of data and reports through the development of reporting templates. TCCWD staff will be able to quickly generate annual summary reports of the data collected.

Groundwater Monitoring Well Network

In order to sufficiently characterize groundwater quality in the Basin aquifer, a comprehensive groundwater monitoring well network will be developed consisting of existing wells. In particular, further understanding of the horizontal and vertical distribution of nitrates will be required to better characterize the source and transport of nitrates in the aquifer. The monitoring well network will include a number of areas of interest in which groundwater nitrate measurements are not currently being monitored. In particular, it is important to include monitoring wells in areas of Golden Hills CSD that predominately use septic systems to discharge residential wastewater. TCCWD will pursue locating monitoring wells in the predominant agricultural areas, in locations both upgradient and downgradient of treated wastewater effluent discharge areas, and in other key areas of hydrogeologic interest (e.g., in the vicinity of recharge basins). All production wells owned/operated by the City of Tehachapi, TCCWD, the CSDs, and CCI will be included in the monitoring network.



Portion of Golden Hills CSD with a High Density of Septic Systems

Due to high costs of constructing dedicated monitoring wells, TCCWD will strive to enlist the cooperation of existing well owners in the Basin to participate in the Program. These existing well owners would include private wells for irrigation and domestic water supply, private wells for miscellaneous M&I water supply. An important requirement for any well considered for inclusion in the sampling network is the availability of well construction details. This information often includes the well type (e.g., municipal, irrigation, domestic), the depths of well screens or perforations, the completed depth of the well, and a description of the borehole lithology. This data will be entered into the Groundwater Data Management System.

In order to evaluate the vertical as well as spatial distribution of nitrates in groundwater, wells in close proximity to one another that are screened at different depth intervals will be targeted for inclusion in the network. Well screens/perforations that are shallow, intermediate, and deep allow for the characterization of the vertical distribution of groundwater nitrate.

Finally, groundwater nitrate concentrations and other constituents of concern will be measured in the monitoring wells at least semi-annually, ideally when basin groundwater elevations are generally at their annual lowest and highest levels. The lowest groundwater levels typically occur in the fall season and the highest levels often occur in the spring season. Semi-annual monitoring in wells with screens at different depths allows for the determination of seasonal

groundwater quality fluctuations. Additional sampling will be required in the first few months, as the network is developed to determine if selected wells are suitable for long-term sampling.

Monitoring of Nitrogen Loading from Wastewater Treatment Facilities

In the Tehachapi Basin, the City of Tehachapi Wastewater Treatment Plant (WWTP) discharges treated effluent into the treatment plant pond, the Borrow Pit, and the Reclamation Area for irrigation (see **Exhibit 4.2** for locations). Daily discharge volumes to each of these locations and monthly water quality analyses of the nitrogen components of the effluent should continue. Similarly, measured daily discharge volumes of treated effluent from the Golden Hills Sanitation Company treatment facility into Tom Sawyer Lake and anywhere else the effluent is discharged in the future. In the Cummings Basin, the CCI WWTP discharges wastewater into treatment plant ponds, and uses the effluent for irrigation on fields owned by CCI and sends some treated effluent to the golf course in Stallion Springs. For these facilities, monthly water quality analyses of the nitrogen components of the effluent will continue to be monitored by the operators. Data collected from these facilities will be included in the Groundwater Data Management System.

Estimation of Nitrogen Loading from Septic Systems and Agricultural Lands

Significant non-point sources of nitrogen include agricultural lands, urban septic systems, and rural septic systems. Direct monitoring of nitrogen levels in soils beneath septic systems and in soils underlying agricultural lands is both labor and cost intensive and are beyond the scope of this Program. A number of extensive studies have been performed that report field-measured nitrogen levels in soils beneath septic systems (e.g., Rosen et al., 2006) and in soils underlying agricultural lands (e.g., Harter et al., 2005; Stonestrom et al., 2003) in semi-arid environments. For the proposed Program, reported ranges of soil water nitrate concentrations beneath septic systems and beneath agricultural lands that use nitrogen-based fertilizers will be used in conjunction with calculated septic system discharge volumes and crop water balances to estimate nitrogen loadings to the subsurface for these land uses.

Irrigation in Cummings Basin

Collection of Supportive Data

Other types of data will be collected for the purpose of correlating long-term trends in groundwater nitrate to changes in climate, conjunctive use water management, population levels and distribution, and hydrogeologic conditions. This data can be used in the future for

performing rainfall-runoff modeling, and computing recharge from direct precipitation. Data describing water management activities and hydrogeologic conditions will continue to be collected and will be integrated into the monitoring database and GIS system. This data includes the regular monitoring of groundwater levels in wells throughout the Basin and continued recording of SWP water delivery volumes and destinations (e.g., agricultural lands and recharge basins). Groundwater levels will also be collected in the monitoring network wells when the semiannual water quality measurements are made.

Reporting and Data Analyses

Collected data and subsequent analyses will be documented in a report that is updated annually. This Annual Monitoring Report will provide a description of the GWQMP and the results of the data collection and analyses. The report will include time-series plots of groundwater nitrate levels and other constituents of concern in key monitoring wells and GIS maps displaying the spatial distribution of groundwater nitrate for wells screened at different depths.

Need for the Project

The Program is critically needed to better understand and document the reasons for elevated nitrates in certain areas, help predict migration of contaminants, and develop mitigation measures to proactively prevent loss of viable drinking water supplies by improving groundwater quality monitoring in the Basins. The District has recognized the need for the GWQMP for several years, and the need became apparent when the nitrate transport model for the Tehachapi Basin Groundwater Study was abandoned due to insufficient groundwater nitrate monitoring data available. Specific reasons for the need of the Program are included in the following subsections.

Obtain Data for Future Analyses

Groundwater quality data are needed to prepare future contaminant transport models. Hydrologic, water use, and other data will be collected as well to assist in developing groundwater flow model updates that are used for building these contaminant transport models. Through the use of these groundwater modeling tools, stakeholders can assess potential long-term impacts to the groundwater quality (and supply) and assess ways to maximize the reduction of these contaminants through different groundwater management scenarios.

Data will be collected from multiple sources and input into an overall Groundwater Data Management System. The system will provide a centralized source of data that will assist the stakeholders in efficiently analyzing large amounts of data to better understand water quality trends in the Basins.

Other data that is needed for the future nitrate transport models include of nitrate loading from septic systems and agricultural lands based on local conditions. As an immediate benefit, stakeholders will also be able to use this information to implement better water management practices to help reduce nitrate loading from these sources.

Long-term Planning Needs

None of the urban water purveyors provide treated surface water to their customers; therefore, it is of paramount importance that good groundwater management practices be implemented to improve the long-term water quality in the groundwater basins. Otherwise, costly wellhead treatment facilities and/or regional water treatment plants may be required in the future. Additionally, many property owners obtain drinking water from private wells that would also be

impacted by degradation of the groundwater supply. If these private wells are impacted, there would be serious health risks to the families that obtain their water from these wells. Furthermore, these families would endure a significant financial hardship if they were required to install a water treatment system, drill a new well, or connect to a public water system.

The GWQMP will be an essential tool for planning purposes of the communities. The data collected will provide the urban water purveyors information that can be used to help locate new wells in areas of low contamination ensuring the delivery of high quality water to the communities. These new wells will also provide water for growth of the City of Tehachapi and the surrounding communities. This is the lowest cost strategy for increasing water supply available to the communities.

Based upon the monitoring data obtained, the water purveyors may need to construct regional water treatment plants to provide water that meets drinking water standards. Alternatively, if contamination of the groundwater is localized to certain areas, then wellhead water treatment facilities or construction of new wells may be more cost effective. The GWQMP will provide the data needed to assess if and when these measures may need to be implemented. The communities will use this guidance to plan for future capital improvements resulting in the wise use of capital expenditure funds.

New Data and Knowledge

Quality of Information Obtained

Several measures are in place to help ensure high quality information will be obtained. These measures are described in other sections of this application and are referenced as follows:

- Work will be performed using standard and accepted methods and analyses, as described below under 'Data, Methods and Analyses to be Used'.
- The Program will be implemented according to the detailed and focused Work Plan (**Attachment 5**).
- The quality assurance measures described in **Attachment 8** will also help to ensure that all information that is gathered is of high quality.
- The public outreach/information dissemination efforts described in the **Project Workplan** will help ensure that the project is proceeding in the right direction and that the project provides information that is needed, useful, and understood by stakeholders. Comments, suggestions and criticisms from the stakeholders will be used to improve the project.

Data, Methods and Analyses to be Used

The TCCWD will use methods and analyses that are accepted in the engineering and hydrogeologic community and have proven effective on similar projects in the Tehachapi area. These methods are briefly described below:

Development of Groundwater Monitoring Well Network

It is very important that the groundwater monitoring well network be developed in accordance with sound technical and scientific principles. As described in the USGS *Guidelines and Standard Procedures for Studies of Ground-water Quality: Selection, and Installation of Wells, and Supporting Documentation (Water Resources Investigations Report 96-4233)*, "the criteria used by a specific water-quality study to guide well selection…are determined within the context

of the study's scope, conceptual framework, objectives, testing hypothesis, and scientific approach." Utilizing the guidelines and procedures from the USGS document will ensure that the network meets these criteria.

Also a Groundwater Monitoring Plan will be developed and implemented for the Program. This plan is essential to the GWQMP by having standard protocols setup to ensure consistency in monitoring efforts so that evaluations of the data are valid. Development of the plan is discussed further in the Work Plan.

Water Quality Sampling and Testing

Water quality samples will be collected from each well by an experienced technician with TCCWD to ensure protection of sample integrity. The samples will be collected according to sampling protocols developed by the USGS for the National Water-Quality Assessment Program that have also been recently used in the California Groundwater Ambient Monitoring and Assessment (GAMA) Program. TCCWD's consultant will perform quality assurance/quality control (QA/QC) field reviews of TCCWD's technician's work. Water quality testing will be performed by accredited, experienced, state-certified testing laboratories to ensure appropriate testing methods and chain of custodies are maintained. Travel blank and duplicate samples will be collected to validate the results of the laboratory.

Methodology for Nitrogen Loading Estimation

As discussed further in Task 4 of the Project Work Plan, multiple references will be utilized in estimating the nitrogen loading from septic tanks and agricultural lands. Recent studies will be beneficial in determining these parameters including the recent UC Davis Nitrate Study's Technical Reports (http://groundwaternitrate.ucdavis.edu/). Refer to **Exhibit 5.1** for technical references that will be utilized for these analyses.

New Knowledge and Improvement in Groundwater Management

New Knowledge

The following is a list of new data and knowledge that will be collected as part of the Program:

1. Increased water quality data available to prepare future contaminant transport models.
2. Collection of data from multiple sources into an overall Groundwater Data Management System. Data can be utilized in different graphic formats and analyzed geospatially.
3. Improvement of knowledge of nitrate loading from septic systems and agricultural lands based on local conditions.
4. Capability of reviewing trends in water quality measurements from wells.
5. Ability to review groundwater data as a whole to determine potential future impacts.
6. Ability to provide groundwater quality datasets to the SWRCB to supplement data available through the GAMA Program.

Improvement in Groundwater Management

This new data and knowledge will allow for improvements to be made to groundwater management in many ways, as described below:

1. Groundwater quality and transport of contaminants will be better understood.
2. Groundwater level data will be more readily available for analysis by inclusion into the database. Hydrograph plots can be prepared in a matter of minutes. In the future, the District could also generate contours of groundwater elevations and depths with the assistance of GIS tools.

3. Additional data will be available to more accurately assess long-term changes.
4. Assess nitrogen loading from septic systems and agricultural lands so that better water management practices can be implemented to help reduce nitrate loading from these sources
5. Stakeholders will have better information available for making decisions regarding water management practices and future capital improvements.

By implementing these groundwater management tools, the communities will have access to clean drinking water that is provided in an efficient and cost effective manner. The most cost effective approach to providing this water is by maintaining the water quality of the groundwater basin into the future.

On-going Monitoring and Funding

The TCCWD has adequate funding to continue monitoring the water quality of the wells in the long-term and also has adequate funding to produce Annual Monitoring Reports. The District receives property tax revenue that currently funds tasks related to management of the groundwater basins including the preparation of the annual Watermaster Reports for the three adjudicated basins. The preparation of the Annual Monitoring Report for the proposed Program will be prepared in conjunction with the annual Watermaster Reports by District staff. These responsibilities will be handled by existing District staff.

The proposed Groundwater Data Management System will be created to account for future data entry needs as much as possible; if modifications to the system are required, they are expected to be minor changes that would not result in a significant cost. The system will be developed using non-propriety database software (i.e. Microsoft Access) to reduce costs that would otherwise be associated with annual maintenance fees, software upgrades, and or discontinuation of the software. The database can be edited by District staff and/or other consultants to minimize costs. Potential costs of minor updates to the system are estimated to be less than $3,000 per year (if required) and would be funded as mentioned above. Data collection and entry into the system will be handled by existing District staff.

The collection of the samples for water quality testing will be included as a responsibility for existing District staff experienced in performing groundwater level measurements and water sampling. Water quality samples shall be retrieved twice a year during the months of April and October, which is timed to coincide with the District's current groundwater level measurements. The additional expense of water quality tests for private wells is expected to be approximately $3,000 per year, which can easily be accommodated within the budget. Other urban water purveyors will continue to perform water quality testing of their wells, as required by the California Department of Public Health, and will submit this data to the District for inclusion into the database.

To ensure on-going funding of the GWQMP, the District will include a line item for expenses from the Program to cover sampling costs and updates to the Groundwater Data Management System; the starting amount will be set at $8,000 per year. In summary, the requested funding will be used for organizing and implementing the GWQMP, and after the grant contract period has been completed, no additional grant funding will be required to maintain the Program.

Project 2-Cummings Basin Groundwater Model Update

Project Overview

A numerical groundwater model was prepared about ten years ago for the Cummings Groundwater Basin (Basin) and covered a base period from 1981 to 2001. Since that time period, multiple changes to water use and land use have occurred and additional data has been collected that can refine gross assumptions that were made during the preparation of the previous model. The updated model will provide a tool that will assist the District in evaluating the current condition of the groundwater supplies in the Basin and, through future work, determine potential impacts on groundwater resources in the Cummings Basin in response to scenarios that will be defined at a later date.

Goal and Objectives of Project

The objectives of the project are to update the existing Cummings Basin groundwater model with the past ten years of data and calibrate the model so that the District can assess the current condition of the Basin. The goal of this effort is to provide TCCWD with a tool to enhance the District's ability to manage and protect the groundwater resource in the Cummings Valley. Analysis of potential impacts resulting from changes in water production, new development and land use will be addressed in subsequent work. This Project is the first step in the overall assessment of the Cummings Groundwater Basin and will be used to improve groundwater management.

Consistency with Groundwater Management Program

As mentioned previously, the adjudication of the Cummings Groundwater Basin is a direct result of the over pumping of the aquifer. While the Judgment for the Cummings Groundwater Basin resulted in the basin being adjudicated, the adjudication did not include implementation of a physical solution. Thus, while a safe yield was established at 4,090 AFY, there is no restriction on groundwater pumping within the basin (overlying use). Extractions have exceeded the safe yield in four of the past ten years resulting in lower water levels. Because of this issue, there is a need to update the existing numerical groundwater model that was prepared prior to this period. By updating the groundwater model, the condition of the aquifer can be reassessed based on current data allowing the District to better manage and protect the groundwater resource in the Cummings Valley.

Additionally, the GTASCP sets the following goal and policies (see **Exhibit 3.4**) related to water supply issues:

> Goal COS.2 – Encourage water conservation to reduce demand for limited water resources and maintain a balance between water supply and water consumption.
>
> Policy COS.3 – Support water purveyors in developing plans for responding to droughts and the effects of global climate change, including contingency plans and the sharing of water resources to improve overall water supply reliability for the existing and future needs of GTA.
>
> Policy COS.7 – Encourage effective groundwater management while promoting conservation and water recycling/reuse in all new development and building design.

This goal and policies from the GTASCP are consistent with the goals and objectives of the proposed project. The groundwater model will be used to assess the current balance of the groundwater aquifer, and, in the future, will be used to determine potential impacts based on scenarios developed with consideration of these policies.

Area Covered

The area covered by the proposed project consists of the Cummings Groundwater Basin as shown in **Exhibit 4.1** and **4.3**. It should be noted that both the Bear Valley and Stallion Springs CSDs purchase imported water from TCCWD that is recharged in the basin and then pump the groundwater to areas of their districts outside the basin.

Cummings Basin

Detailed Project Description

The project consists of updating the Cummings Basin groundwater model that was prepared about ten years ago. For that study, a groundwater flow model was developed for the Cummings Basin and covered a base period from 1981 to 2001. Since that time period, multiple changes to water use and land use have occurred and additional data has been collected that can refine gross assumptions that were made during the preparation of the previous model. The updated model will assist the District and other stakeholders in accurately evaluating the potential impacts on groundwater resources in the Cummings Basin in response to future scenarios, with an emphasis on determining groundwater overdraft, safe yield, pumping and recharge, as well as water quality. After the current condition of the aquifer is generally understood, these future scenarios will be further defined (not a part of this scope of work).

The groundwater modeling study, included as **Exhibit 4.6**, for the Cummings Groundwater Basin was performed in 2004 by Fugro for the District (Fugro West, Inc. and ETIC Engineering, *Final Report, Groundwater Modeling Study for the Cummings Groundwater Basin, Kern County,*

California, March, 2004). For that study, a transient groundwater flow and solute transport model was developed for the Cummings Basin over the base period of 1981 to 2001. In addition to the groundwater model construction and calibration, the study included tasks for data collection, development of a hydrogeologic conceptual model, water balance estimation, and evaluation of five different future scenarios (including a groundwater remediation evaluation for a localized MTBE contamination issue at CCI).

As development in the basin has progressed and groundwater conditions have changed since the completion of the model and submittal of the report in March 2004, the need to update the model and utilize it as a tool to analyze potential impacts has become more apparent. Changes in water use and/or land use by some of the basin stakeholders—including (1) increased groundwater pumpage by some agricultural users (refer to **Figure 4.2**), (2) continued groundwater production in the northern edge of the basin by Bear Valley Community Services District, (3) expansion of groundwater production in the southern part of the basin by Stallion Springs Community Services District, and (4) changes in land use by some of the major agricultural interests—reflect the need to update and maintain the model. Additionally, CCI has recently constructed a new wastewater treatment facility (WWTF) that produces disinfected tertiary recycled water that now delivers recycled water to the golf course in Stallion Springs CSD and is expected to deliver additional recycled water to agricultural landowners in the future.

Additionally, the previous study used indirect data to determine annual agricultural pumpage. Specifically, TCCWD estimated annual pumpage attributed to specific wells based on land use and water importation records. The agricultural water use was calculated by multiplying the irrigated acreage by a crop water duty factor. This method had produced an average annual groundwater pumpage of 1,234 AFY, which was determined to be an underestimate of actual groundwater pumpage. Through the calibration of the groundwater model, the average annual groundwater pumpage was increased to 1,958 AFY to better match hydrographs of wells. This increase in pumpage is represented as the purple bars in **Figure 4.2**. Since this last study, a database of groundwater pumpage data has been developed using water meter readings at each well site that were installed subsequent to the study.

Based on these changes to conditions since the last groundwater model was developed, TCCWD proposes to use a portion of the grant funding to update and re-calibrate the model using the new data and provide an updated calculation of the safe yield of the basin.

Analysis of potential impacts resulting from changes in water production and/or land use, and the development and preparation of scenarios to answer specific questions, would be developed in future proposals. As mentioned previously, groundwater extractions from the Cummings Basin have exceeded the safe yield in multiple years since the model was prepared. In these later proposals, it will be important to analyze the potential impacts to the basin caused by exceeding the safe yield and estimating future groundwater use to determine long-term impacts to the basin.

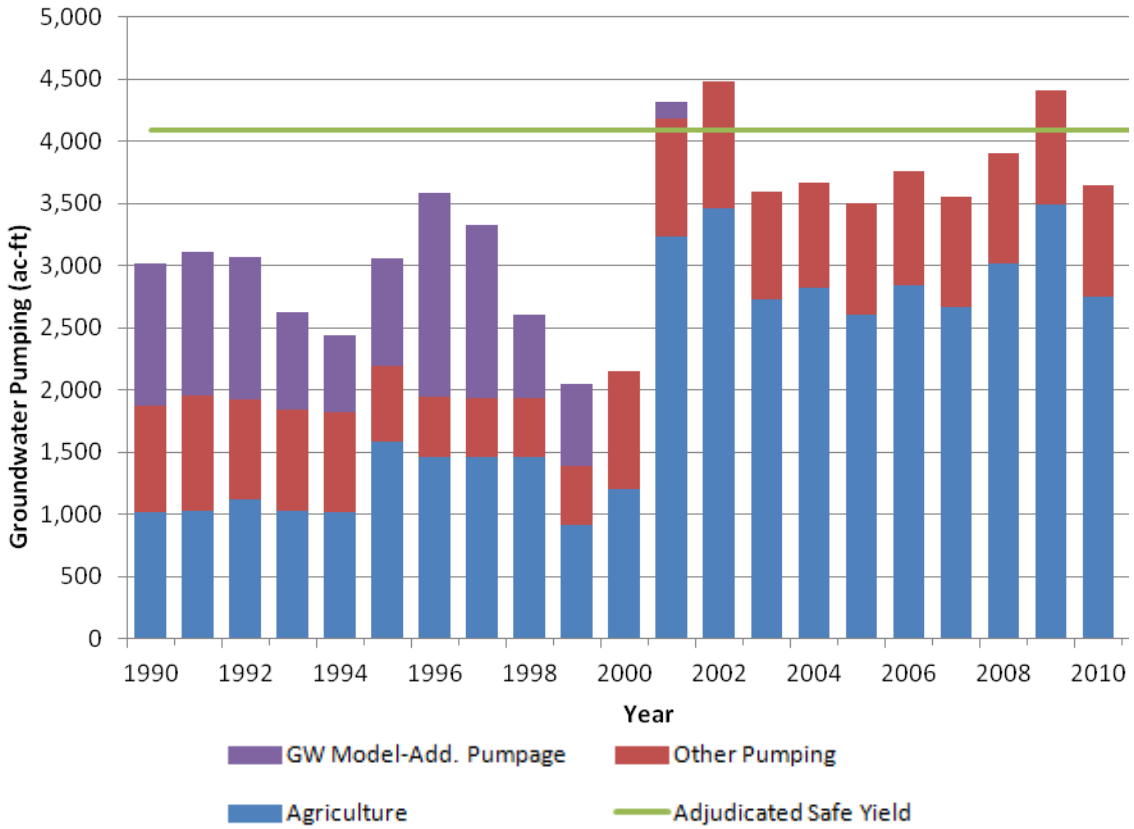


Figure 4.2: Cummings Basin Groundwater Pumping

Need for the Project

The update for the Cummings Basin Groundwater Model is needed in order understand the reasons for declining groundwater levels and changes in water quality in certain portions of the Cummings Basin. The model will be used to assess the current condition of the Basin based on changing land use, increased groundwater pumpage, and availability of additional data. This model update is the first step in developing a tool that can be used to predict potential impacts to the Basin based on future scenarios to be defined. Additionally, the update to the model will be needed for the construction of a future nitrate transport model that will utilize data generated from the proposed Groundwater Quality Monitoring Program. As the urban water purveyors, agricultural water users, CCI, and private well owners rely upon the Basin for the majority of their water supply, it is extremely important that the Basin is well managed. This tool will help the District and other stakeholders to meet this goal by providing useful knowledge regarding the Cummings Basin.

New Data and Knowledge

Quality of Information Obtained

Several measures will be in place to help ensure high quality information will be obtained. These measures are discussed in other locations as mentioned previously for Project 1.

Data, Methods and Analysis to be Used

The TCCWD will use methods and analyses that are accepted in the engineering and hydrogeologic community and have proven effective on similar projects in the Tehachapi area as well as other groundwater basins. These methods are briefly described below:

Groundwater Modeling Software

The original groundwater model was developed using MODFLOW-2000 (Modular Finite-Difference Groundwater-Flow Model) but will likely be recast in MODFLOW-2005, a three-dimensional groundwater flow model developed by the United States Geological Survey. MODFLOW-2005 is well documented and is the "de facto" standard for groundwater flow modeling worldwide. A commercially available graphic user interface was utilized for pre-processing and post-processing of model files. The update to the model will continue to utilize these software programs.

Calibration and Model Sensitivity Analysis

Calibration of the groundwater model and model sensitivity analysis will be performed in accordance with generally accepted practices in the hydrogeologic community. Standards that will be used for this task include American Society of Testing and Materials (ASTM) as well as USGS references. Some of the standards that will be utilized are as follows:

- ASTM D 5981–96 (Reapproved 2002). Standard Guide for Calibrating a Ground-Water Flow Model Application
- ASTM D 5611–94 (Reapproved 2008). Standard Guide for Conducting a Sensitivity Analysis for a Ground-Water Flow Model Application

New Knowledge and Improvement in Groundwater Management

New Knowledge

The following is a list of new data that will be collected as part of the project:

1. Gathering of multiple data sources for past ten years and combining with previous data set creating a repository of 30 years of hydrogeologic and hydrologic data.
2. A calibrated numerical groundwater model that can be used to assess the current condition of the groundwater aquifer.
3. GIS maps, hydrographs, and other graphical representations of data showing groundwater trends will be created.
4. Improved knowledge of potential impacts to groundwater supplies, including the current estimate of the sustained yield of the Basin.
5. Knowledge of how recharge activities have benefited the Basin.

Improvement in Groundwater Management

This new knowledge will allow for improvements to be made to groundwater management in many ways, as described below:

1. Water agencies and other stakeholders will have a better understanding of the Basin and can further develop water management strategies to positively impact the reliability and groundwater quality of the Basin.
2. Scenarios with varying conditions can be developed to determine potential impacts to the Basin through the groundwater model. Stakeholders can use this information to set water use targets and increase conservation.

3. The groundwater model can be used to assess locations of future recharge facilities and recovery wells to provide additional water supplies to Bear Valley CSD and Stallion Springs CSD, maintaining production of agricultural wells, and ensuring balance in the Basin.

On-going Monitoring and Funding

As discussed in the project description, there will be a need to prepare additional studies to analyze the potential impacts to the basin caused by exceeding the safe yield and estimating future groundwater use to determine long-term impacts to the basin. The cost of preparing these analyses is yet to be determined. In the past, these studies have been jointly funded by the local CSDs and CCI and will continue to be funded in this manner. An example of a funding agreement is included as **Exhibit 4.7**. In the long term, the next update of the model will occur in approximately 10 years after the Groundwater Quality Monitoring Program has developed sufficient data for the preparation of a nitrate transport model.

Public Outreach

Collaboration with Other Agencies

Within TCCWD's district boundaries, there are multiple public water purveyors, private water companies, agricultural water users, and domestic well owners. Because of these multiple interests, the District understands the importance of inter-agency cooperation. Historically, the District has effectively collaborated with multiple other water management agencies. An important example of this collaboration is the recent preparation of the 2010 Regional Urban Water Management Plan for the Tehachapi area. Even though none of the agencies were over the thresholds requiring that a UWMP be prepared, the Plan was still jointly prepared by the agencies demonstrating a strong desire to improve water management in the Tehachapi area.

Additionally, the Water Availability Preservation Committee (WAPC), formerly the Long-Term Water Supply Committee, has been meeting since the early 1990s and is a critical component to groundwater management and collaboration among the agencies. The WAPC includes public water purveyors, mutual water companies, private water companies, and other water professionals. At this monthly meeting, representatives from each of the agencies discuss issues related to groundwater management, imported water supplies, and other matters to improve collaboration between the individual agencies.

The City of Tehachapi, Golden Hills CSD, Bear Valley CSD, and Stallion Springs CSD have expressed their support of the projects and a willingness to share data collected by each of the agencies for the benefit of the GWQMP and the Cummings Basin Groundwater Model Update. Copies of these letters are included as **Exhibit 4.8**.

Information Dissemination

Information will be disseminated to the State of California, local water agencies, local growers and the general public through a variety of methods. Refer to **Attachment 5**, which provides a detailed discussion on information dissemination efforts.