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Martis Valley Groundwater Management Plan
5-Year Update
Nevada and Placer Counties, California

June 6, 2025

Prepared for:

Truckee Donner Public Utility District

On behalf of Truckee Donner Public Utility District, Northstar Community Service District, and Placer County Water Agency collectively referred to as the MVGB Agencies.

TRUCKEE DONNER PUBLIC UTILITY DISTRICT
SUMMARY REPORT – MARTIS VALLEY GROUNDWATER BASIN

GEI Certifications and Seals

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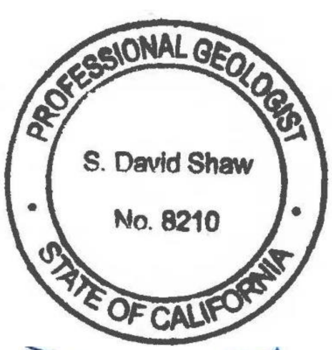

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Record of Revisions

Identification	Date	Description of Issued and/or Revision
GEI Consultants	11/15/2024	Draft 5-Year Update
GMP Partners	11/27/2024	Revisions and group discussion comments
GEI Consultants	5/8/2025	Revisions and additions based upon complete revisions and data.
GEI Consultants	5/22/2025	Final review Document
GEI Consultants	6/06/2025	Final Document

Acronyms and Abbreviations

AB 3030	Assembly Bill 3030
ac-ft/yr	acre-feet per year
Basin	Martis Valley Groundwater Basin
BMOs	Basin Management Objectives
CASGEM	California Statewide Groundwater Elevation Monitoring
cfs	cubic feet per second
CWC	California Water Code
DDW	Division of Drinking Water
DOI	U.S. Department of the Interior
DRI	Desert Research Institute
DWR	California Department of Water Resources
DWSAP	Drinking Water Source Assessment Program
GAMA	Groundwater Ambient Monitoring and Assessment
GCM	general circulation model
GMP	Groundwater Management Plan
gpm	gallons per minute
GSFLOW	Ground-water and Surface-water Flow Model
IRWMP	Integrated Regional Water Management Plan
LGA	Local Groundwater Assistance
LLNL	Lawrence Livermore National Laboratory
LRWQCB	Lahontan Regional Water Quality Control Board
LUST	leaking underground storage tank
MCL	Maximum Contaminant Level
mgd	million gallons per day
MODFLOW	Modular Three-Dimensional Finite-Difference Groundwater Flow Model
msl	mean sea level
MVGB	Martis Valley Groundwater Basin
NCSD	Northstar Community Services District
NOAA	National Oceanic and Atmospheric Association
PCWA	Placer County Water Agency
PRMS	Precipitation Runoff Modeling System
PUC	Public Utilities Commission
Reclamation	Bureau of Reclamation
SB	Senate Bill
SWG	Stakeholder Working Group
SWRCB	State Water Resources Control Board
TDPUD	Truckee Donner Public Utility District
TMWA	Truckee Meadows Water Authority
TROA	Truckee River Operating Agreement
T-TSA	Tahoe-Truckee Sanitation Agency

USACE	United States Army Corps of Engineers
USFS	United State Forest Service
USGS	United States Geologic Survey
UZF	Unsaturated Zone Flow

1. Introduction

In 1992, the State Legislature enacted the California Groundwater Management Act through Assembly Bill 3030 (AB 3030) to encourage local public agencies to adopt plans to manage groundwater resources within their jurisdictions. Provisions were created in the California Water Code (CWC) Sections 10750 et.seq. to manage the safe production, quality, and proper storage of groundwater and AB 3030 codified voluntary components of a Groundwater Management Plan (GMP). In 2002, Senate Bill 1938 (SB 1938) was signed into law which amended the CWC with required components of a GMP for any public agency seeking State funds administered through the California Department of Water Resources (DWR) for groundwater projects. In 2003, DWR published Bulletin 118 – Update 2003, California's Groundwater which includes seven recommended components of a GMP.

This GMP includes the following components: the partner agencies' authority, physical setting including groundwater conditions, management goals and Basin Management Objectives (BMOs), and GMP implementation activities.

1.1. Purpose of the Groundwater Management Plan

The Truckee Donner Public Utility District (TDPUD), Northstar Community Services District (NCSD), and Placer County Water Agency (PCWA) have voluntarily partnered to develop the Martis Valley GMP, a collaborative planning tool that assists the partner agencies with efforts to ensure long term quality and availability of shared groundwater resources in the Martis Valley Groundwater Basin (MVGB). This GMP is a "living document" that includes an overall goal, BMOs, and implementation actions that will be periodically updated to reflect changes in groundwater management and progress in meeting its goal and objectives.

The purpose of the Martis Valley GMP is to improve the understanding and management of the groundwater resource in Martis Valley, while providing a framework for the partner agencies to align policy and implement effective and sustainable groundwater management programs.

This GMP is not:

- *mandatory,*
- *regulatory,*
- *an enforcement effort, or*
- *land use or zoning ordinances*

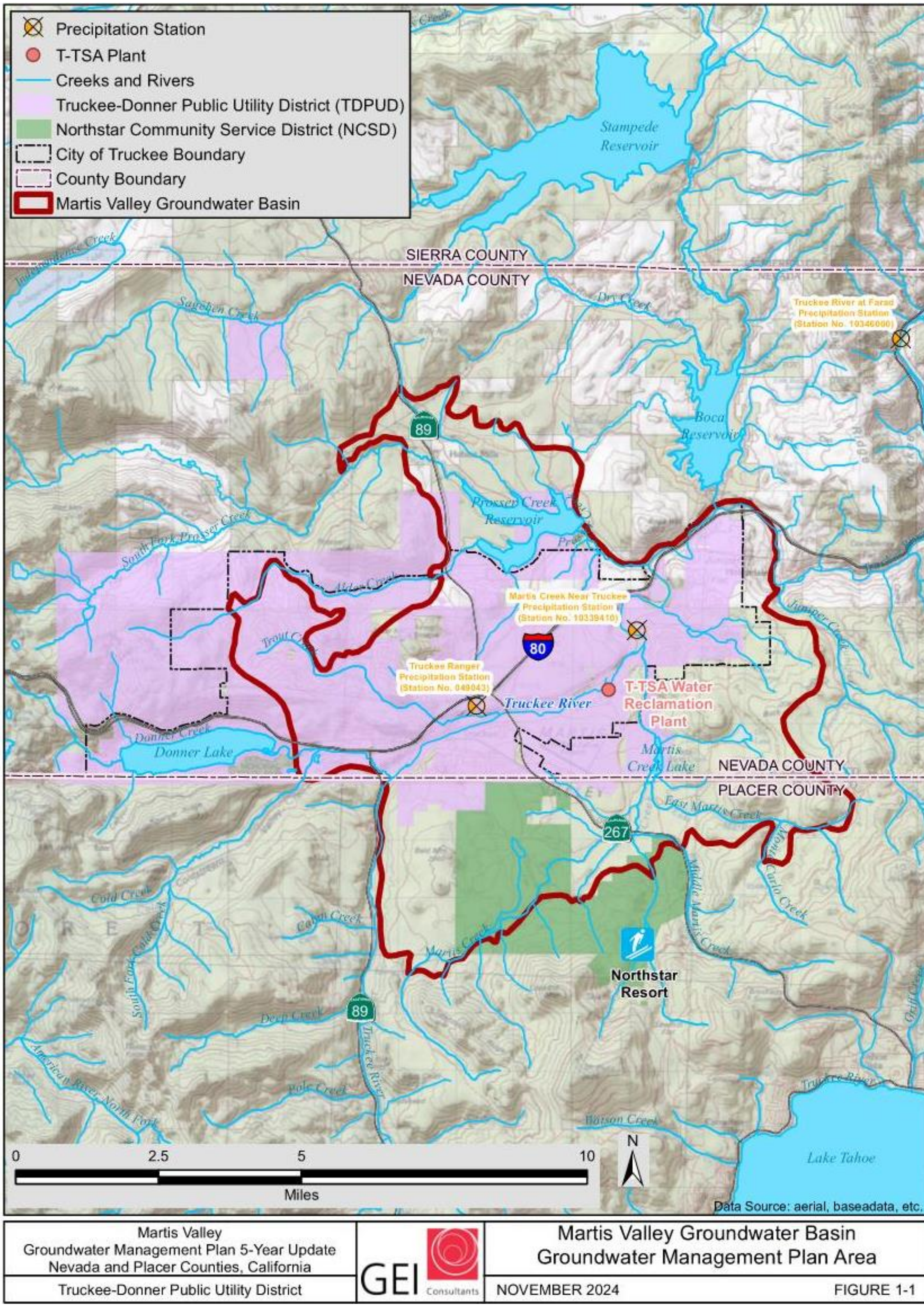
Older groundwater management plans by TDPUD (1995), PCWA (1998), and TDPUD, NCSD and PCWA (2013) are herein updated by this GMP which has been designed to meet the requirements set by SB 1938, addresses the voluntary and recommended components included in AB 3030, as well as address recommendations outlined in Bulletin 118-2003. The area covered by the Martis Valley GMP, as shown in Figure 1-1, includes each partner agencies' jurisdictional boundaries within Nevada and Placer Counties.

1.2. Groundwater Management Plan Authority and Administration

Each partner agency is an authorized groundwater management agency within the meaning of CWC § 10753 (a). In April of 2011, each partner agency adopted respective resolutions of intent to develop a GMP; the resolutions are included as Appendix A.

Beginning January 1, 2015, a new plan shall not be adopted and an existing plan shall not be renewed, except if the basin is prioritized as a low or very low priority basin CWC § 10750.1 (a and b). In 2018, DWR re-evaluated the Basin and changed its priority to very low priority. The MVGB Agencies recognize the importance of groundwater management and have voluntarily continued to implement the 2013 GMP and manage the groundwater resources in the Basin.

Figure 1-1. Groundwater Management Plan Area



1.3. Groundwater Management Plan Development Process

During the course of preparing the 2013 GMP, various entities were involved in developing, approving, and adopting the GMP. In addition to the partner agencies, a Stakeholder Working Group (SWG) was created to provide local knowledge, data and information, opinions, and review and comment on material prepared by the GMP team. The SWG was comprised of representatives of Federal, State, and local governments, environmental and special interest groups, and local land use interests. The partner agencies followed the five main steps for the development of the GMP, as defined under CWC §10753.2 through 10753.6. The five steps are described below and are illustrated on Figure 1-2.

Except as otherwise provided in CWC § 10753 (d), the process for developing and adopting a revised GMP shall be the same as the process for developing and adopting a new GMP. Documentation of the steps the partner agencies' actions is provided with each of the steps below.

Unless the annual monitoring report indicates that updates to the GMP are necessary, the period for adopting a new or revised GMP will be every 10 years or as needed.

A SWG meetings and a public meeting was held with the partner agencies during GMP update development. SWG participants and the agency represented are presented in Table 1-1.

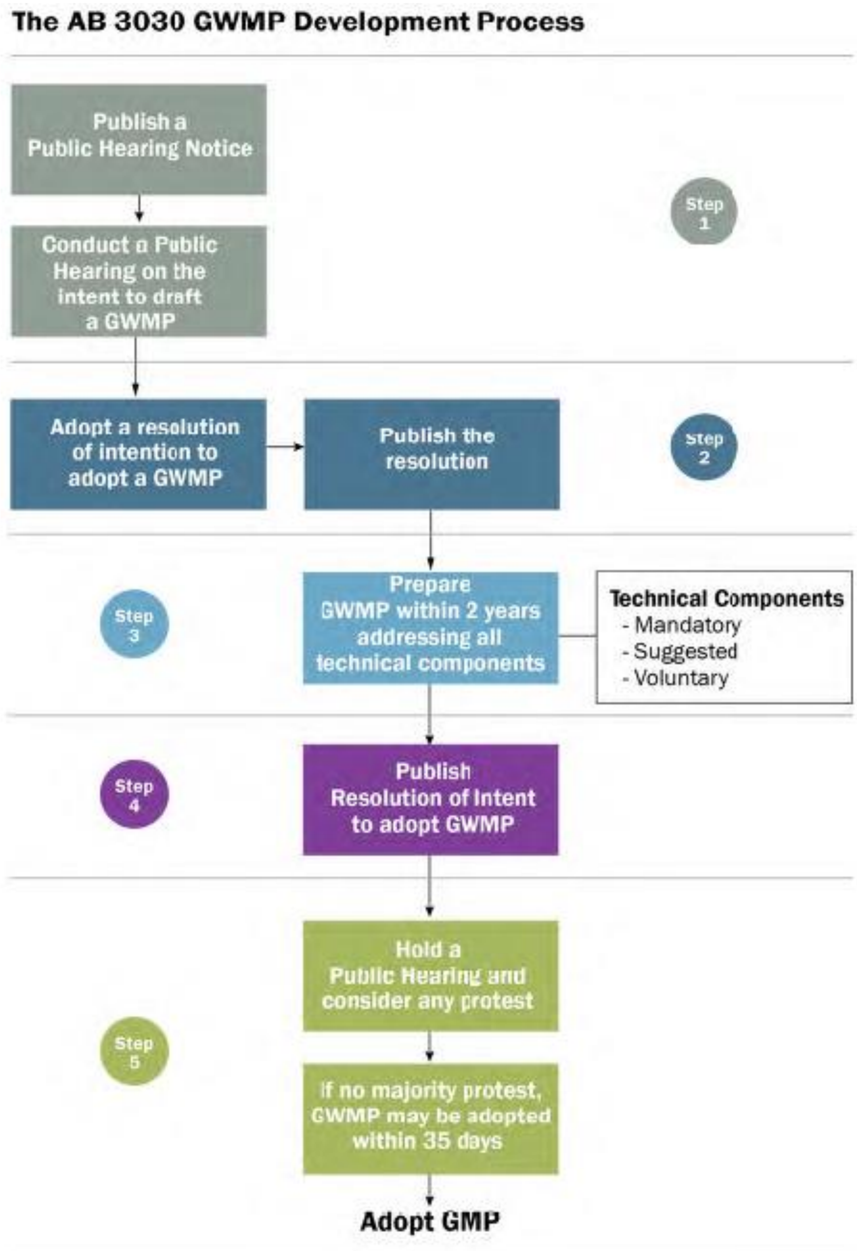
Table 1-1. Stakeholder Working Group Members

Working Group Participant	Representing

Step 1 – Provide public notification of a hearing on whether or not to adopt a resolution of intention to draft a GMP and subsequently complete a hearing on whether or not to adopt a resolution of intention to draft a GMP. Following the hearing, draft a resolution of intention to draft a GMP. The agencies provided public notification and held their respective hearings in XX 2025. Copies of newspaper notifications are included in Appendix A.

Step 2 – Adopt a resolution of intention to draft a GMP and publish the resolution of intention in accordance with public notification. The partner agencies' adopted their respective resolutions of intention to update a GMP in June 2025. The resolutions are included as Appendix A.

Figure 1-2. Groundwater Management Plan Development Process



Step 3 – Prepare a draft GMP within two years of resolution of intention adoption. Provide to the public a written statement describing the manner in which interested parties may participate in developing the GMP. The agencies provided notification and held one SWG meetings where meeting attendees gave input on the GMP goal, BMOs, and implementation actions. The agencies also held a public meeting on June 3, 2025 to receive public input.

Step 4 – Provide public notification of a hearing on whether or not to update the GMP, followed by holding a hearing on whether or not to adopt the GMP. Public notices of the scheduled hearings were provided in the Auburn Journal and the Sierra Sun newspapers and proof of publications are included in **Appendix B.**

Step 5 – The plan may be adopted within 35 days after the completion of Step 4 above if protests are received for less than 50 percent of the assessed value of property in the plan area. If protests are received for greater than 50 percent of the assessed value of the property in the plan area, the plan will not be adopted. XX public comments were received during the public comment period. In June 2025, each partner agency adopted the Martis Valley GMP and their respective resolutions are included in Appendix B.

Groundwater Management Goal

The GMP's goal provides the overarching purpose of the GMP, is used to identify the desired outcome of GMP implementation, is general in nature, and does not include quantitative components:

The goal of the Martis Valley GMP is to ensure long term quality and availability of groundwater in the Martis Valley Groundwater Basin.

1.4. Basin Management Objectives

The BMOs provide more specific direction to the GMP; they are generally protective of the groundwater resource and the environment, and each BMO identifies a distinct portion of the overarching goal which provides specific areas for focus. Summarized below are six primary areas that are emphasized and embodied in the BMO's that support the GMP goal:

1. **Manage groundwater to maintain established and planned uses**.

   Because the MVGB is the primary source of water to multiple users under separate jurisdictions, this objective encourages the partner agencies to pursue management of groundwater that is within their jurisdiction in order to protect existing uses.

2. **Manage groundwater use within the provisions of the Truckee River Operating Agreement**.

   The Truckee-Carson-Pyramid Lake Water Rights Settlement Act (Settlement Act), Public Law 101-618 (1990), established entitlements to the waters of Lake Tahoe, the Truckee River and its tributaries and how the storage reservoirs of the Truckee River are operated. Section 205 of the Settlement Act directs the Secretary of the Department of the Interior (DOI) to negotiate an operating agreement for the operation of Truckee River reservoirs, between California, Nevada, Truckee Meadows Water Authority (as the successor to Sierra Pacific Power Company), Pyramid Tribe, and the United States. The operating agreement is known as the Truckee River Operating Agreement (TROA) and was implemented December 1, 2015, effectively establishing the interstate allocation and the reporting requirements. TROA also includes a maximum depletion requirement for the Truckee River Basins, including Martis Valley. Depletion refers to the amount of water that is used or consumed but is not ultimately replenished into the watershed's streams or groundwater aquifers through percolation, treatment, etc. California's total annual allocation from surface and groundwater sources within the Lake Tahoe Basin is 23,000 acre-feet. The total annual allocation from the Truckee River Basin sources for use in California is 32,000 acre-feet, of which no more than 10,000 acre-feet can be from surface water sources. Additionally, the calculated annual depletion within the Truckee River Basin must not exceed 17,600 acre-feet, as determined by depletion calculations prescribed in TROA.

This objective documents the partner agencies' commitment to continue to comply with provisions of the TROA. Some provisions in TROA apply to groundwater and water wells within the Truckee River Basin (which includes the Martis Valley) to address potential adverse impacts to surface water.

3. **Collaborate and cooperate with groundwater users and stakeholders in the MVGB.**

   Collaborating and sharing information and resources with other groundwater users in the MVGB helps promote GMP goals. This objective encourages the partner agencies to reach out to other groundwater users within the MVGB.

4. **Protect groundwater quantity and quality.**

   Groundwater performs an integral function in a watershed, one of which is satisfying water supply needs. Improving the understanding of the groundwater basin is a critical step in protecting and sustaining the Martis Valley groundwater supply.

5. **Pursue and use the best available science and technology to inform the decision-making process.**

   Science and technology continue to develop new tools that may improve the understanding of the MVGB. This objective encourages the partner agencies to take actions that work with the best available science to help make informed agency decisions.

6. **Consider the environment and participate in the stewardship of groundwater resources.**

   The partner agencies are dedicated to stewardship of groundwater resources and this BMO ensures that stewardship is part of the GMP.

1.5. Plan Components

Required GMP components and their location in the GMP are summarized in Table 1-2, Voluntary GMP components and their location in the GMP are summarized in Table 1-3, and recommended GMP components and their location in the GMP are summarized in Table 1-4.

Table 1-2. Required Components and Associated Report Section

Category Required	GMP Components Required Components: (10753.7.)	Report Section
1	Establish Basin Management Objectives (BMOs)	1.5
2	Include components relating to the monitoring and management of groundwater levels, groundwater quality, and inelastic land subsidence	3.4
3	Include components relating to changes in surface flow and surface water quality that directly affect groundwater levels or quality or are caused by groundwater pumping in the basin	3.2
4	Include description of how recharge areas identified in the GMP substantially contribute to the replenishment of the groundwater basin	2.9
5	Prepare a GMP that enables the partner agencies to work cooperatively with other public entities whose service area falls within the plan area and overlies the groundwater basin	3.1 3.4

Category Required	GMP Components Required Components: (10753.7.)	Report Section
6	Prepare a map that details the area of the groundwater basin, the area subject to the GMP, and the boundaries of other local agencies that overlie the basin	1.1
7	Prepare a map identifying the recharge areas for the groundwater basin	2.9
8	Adopt monitoring protocols that detect changes in groundwater levels, groundwater quality, inelastic land subsidence, and surface water flow or quality that affects groundwater or groundwater pumping that affects surface water flow or quality	3.4
9	If the GMP area includes areas outside a groundwater basin as defined in Bulletin 118, the partner agencies will use the required components, and geologic and hydrologic principles appropriate for the area	Throughout GMP

Table 1-3. Voluntary Components and Associated Report Section

Category Required	GMP Components Required Components: (10753.8.)	Report Section
1	Control of saline intrusion	3.1
2	Identification and management of wellhead protection	3.4
3	Regulation of the migration of contaminated groundwater	3.1 3.2
4	Administration of a well abandonment and well destruction program	3.1
5	Mitigation of conditions of overdraft	3.1
6	Replenishment of groundwater extracted by water producers	3.1
7	Monitoring of groundwater levels and storage	3.4
8	Facilitating conjunctive use operations	3.1
9	Identification of well construction policies	3.4
10	Construction and operation by the partner agencies of groundwater contamination cleanup, recharge, storage, conservation, water recycling, and extraction projects	3.1 3.2
11	Development of relationships with State and Federal regulatory agencies	3.1 3.2 3.5
12	Review of land use plans and coordination with land use planning agencies to assess activities that create a reasonable risk of groundwater contamination	3.4

Table 1-4. Recommended Components and Associated Report Section

Category Required	GMP Components Recommended Components (From Bulletin 118-2003 Appendix C)	Report Section
1	Document public involvement and ability of the public to participate in development of the GMP, this may include a Technical Advisory Committee (Stakeholder Working Group)	1.3
2	Establish an advisory committee of stakeholders within the plan area that will help guide the development and implementation of the GMP and provide a forum for the resolution of controversial issues	1.3 3.1

Category Required	GMP Components Recommended Components (From Bulletin 118-2003 Appendix C)	Report Section
3	Describe the area to be managed under the GMP including: • The physical structure of the aquifer system • A summary of available historical data and issues of concern related to groundwater levels, groundwater quality, inelastic land subsidence, and surface water flow or quality that effects groundwater or groundwater pumping that effects surface water flow or quality • A general discussion of historical and projected water demands and supplies	2
4	Establish management objectives (MOs) for the groundwater basin subject to the GMP	1.5
5	Describe the GMP's monitoring program	3.4
6	Describe efforts to coordinate with land use, zoning, or water management planning agencies or activities	3.4
7	Create a summary of monitoring locations with frequency of wells monitored	Appendix D
8	Provide periodic reports summarizing groundwater conditions and management activities including: • A summary of monitoring results, with a discussion of historical trends • A summary of management actions during the period covered by the report • A discussion of whether actions are achieving progress towards meeting BMOs • A summary of proposed management actions for the future • A summary of any GMP changes that occurred during the period covered by the report • A summary of actions taken	3.1
9	Provide for the periodic re-evaluation of the entire plan by the managing entity	3.1

1.6. Area Covered by the GMP

The Martis Valley GMP includes the service areas of the TDPUD, PCWA, and NCSD that overlay and extend beyond the MVGB boundary, as well as the Nevada and Placer County portion of the MVGB. It is important to note that at the time of GMP development, there were no other agencies within the Placer County portion of the MVGB that fall within the service area of another local agency, water corporation regulated by the Public Utility Commission (PUC), or mutual water company without the agreement of the overlying agency, as defined in the CWC (CWC § 10750.7(a)). Figure 1-1 shows the Martis Valley GMP area.

1.7. Public Outreach and Education

The partner agencies developed a Public Outreach Plan to guide development of the GMP Update. Public outreach included working with the existing Stakeholder Working Group to provide input on GMP update, two informative public meetings, and publicly noticed public hearings (Appendix A) on the intent to update and adopt the GMP.

Groundwater Model

The partner agencies collaborated with the U.S. Bureau of Reclamation (Reclamation) and their subcontractor, Desert Research Institute (DRI), to develop an integrated watershed-groundwater model in conjunction with the Martis Valley 2013 GMP. The geologic investigation conducted and documented in Section 2 of this report has been used to develop a geologic framework database, which was used to guide the conceptual and numerical model components for the hydrogeology components (groundwater model) of the integrated watershed model. The integrated watershed model was under development in parallel with the 2013 GMP.

The integrated watershed model is comprised of a Precipitation Runoff Modeling System (PRMS) and Modular Three-Dimensional Finite-Difference Groundwater Flow Model (MODFLOW) coupled together using an Unsaturated Zone Flow (UZF) package. PRMS is used to model surface water within the watershed, whereas MODFLOW is used to model groundwater within the MVGB. The UZF model package is a kinematic wave vadose zone model used to simulate the interaction between surface water and groundwater. Each model was calibrated separately, and then calibrated together over a 10-year period using a coupled ground-water and surface-water Flow Model (GSFLOW). Predictive model simulations were performed using multiple general circulation model (GCM) projections of precipitation and temperature to estimate the influence of future climate on water resources within the MVGB. Calibration targets for fully coupled, GSFLOW model included head values measured from wells, meadow, and spring locations, streamflow's, measured snow depth, and remotely sensed snow cover.

The integrated model's model domain covered the entire Martis Valley Watershed, which includes the MVGB, as well as the watersheds that contribute surface water to the region, including Lake Tahoe. The model grid's cells are 300 by 300 meters in size. DRI used the PRMS component of the integrated modeling tool to estimate groundwater recharge across the MVGB and is discussed in more detail in Section 2.9.

1.8. Document Organization

The Martis Valley GMP is organized into the following sections:

- Section 2 Physical Setting: describes the physical setting of Martis Valley including items such as geologic setting, land use, water sources, and well infrastructure
- Section 3 Plan Implementation: discusses the implementation actions included in the Martis Valley GMP
- Section 4 References
- Appendices

2. Physical Setting

The MVGB is located in the transition zone between the Sierra Nevada and the Basin and Range Geomorphic Provinces, east of the Sierra Nevada crest and part of the larger Tahoe-Truckee River Basin of California and Nevada. Martis Valley is the principal topographic feature within the MVGB. The surrounding landscape is mountainous, underlain by volcanic and, to some extent, granitic bedrock, with apparent faulting and some portions that have been glaciated. A significant portion of the land within the MVGB boundary is privately owned with some areas managed as forest, open space and/or for recreation by special districts or agencies, including the U.S. Forest Service. This section of the GMP characterizes the physical setting of the MVGB, including: topography, climate, surface water hydrology, geology, hydrogeology, and water use.

2.1. Topography

The MVGB encompasses roughly 57 square miles, and lies within the Middle Truckee River Watershed. Elevations of the valley floor range from 5,700 to 5,900 feet above mean sea level (msl). The valley is accented by hills rising above the valley floor and mountains to the south and east of the valley. High points within or immediately adjacent to the MVGB include Bald Mountain at an elevation of 6,760 feet and Alder Hill at 6,733 feet, located on the western margin of the MVGB, and Lookout Mountain at 8,104 feet and Mt. Pluto at 8,617 feet, located on its the southern fringe. Martis Peak, further to the east, is at 8,742 feet. Figure 2-1 illustrates the MVGB location and topography.

2.2. Climate

The Tahoe-Truckee region experiences warm and dry summers, and cold, wet and snowy winters. Elevation and rain shadow play major roles in the spatial distribution of temperature and precipitation. Precipitation is highest at upper elevations in the western portion of the basin, toward the Sierra Crest, and decreases with elevation in the eastern portion of the basin (Figure 2-2). Mean annual precipitation (as snow water equivalent) ranges from approximately 30 inches below 6,500 feet to over 45 inches above 6,500 feet. Precipitation falls mostly as snow between October and April, though runoff and streamflow also responds to periodic mid-winter rain-on-snow events. Annual peak streamflow typically occurs during spring snowmelt in May or June. A small proportion of the total annual precipitation falls during brief thunderstorms in the summer months. The mean annual precipitation, as recorded at the USFS Truckee Ranger Station No. 049043 near the center of the watershed, for the period 1904 through 2023, is 29.78 inches. However, since about 2000, there appears to be more dry years and fewer wet years with more extreme precipitation events. The average for the last 20 years is less than the long-term average at about 28.08 inches. Average monthly precipitation is shown in Figure 2-3 for the period 2004 through 2023. This period was selected as potentially being more representative of current climate conditions. Monthly precipitation records are available that extend back to 1935. Average temperatures range from daily lows of 15°F in December and January to daily highs of 78°F in July, as recorded at SNOTEL Station Truckee #2 (1904 through 2023). In the last twenty years those same temperatures in December and January rose to 24°F and in July 80°F (2004 through 2023).

Figure 2-1. Groundwater Basin Location and Physiography

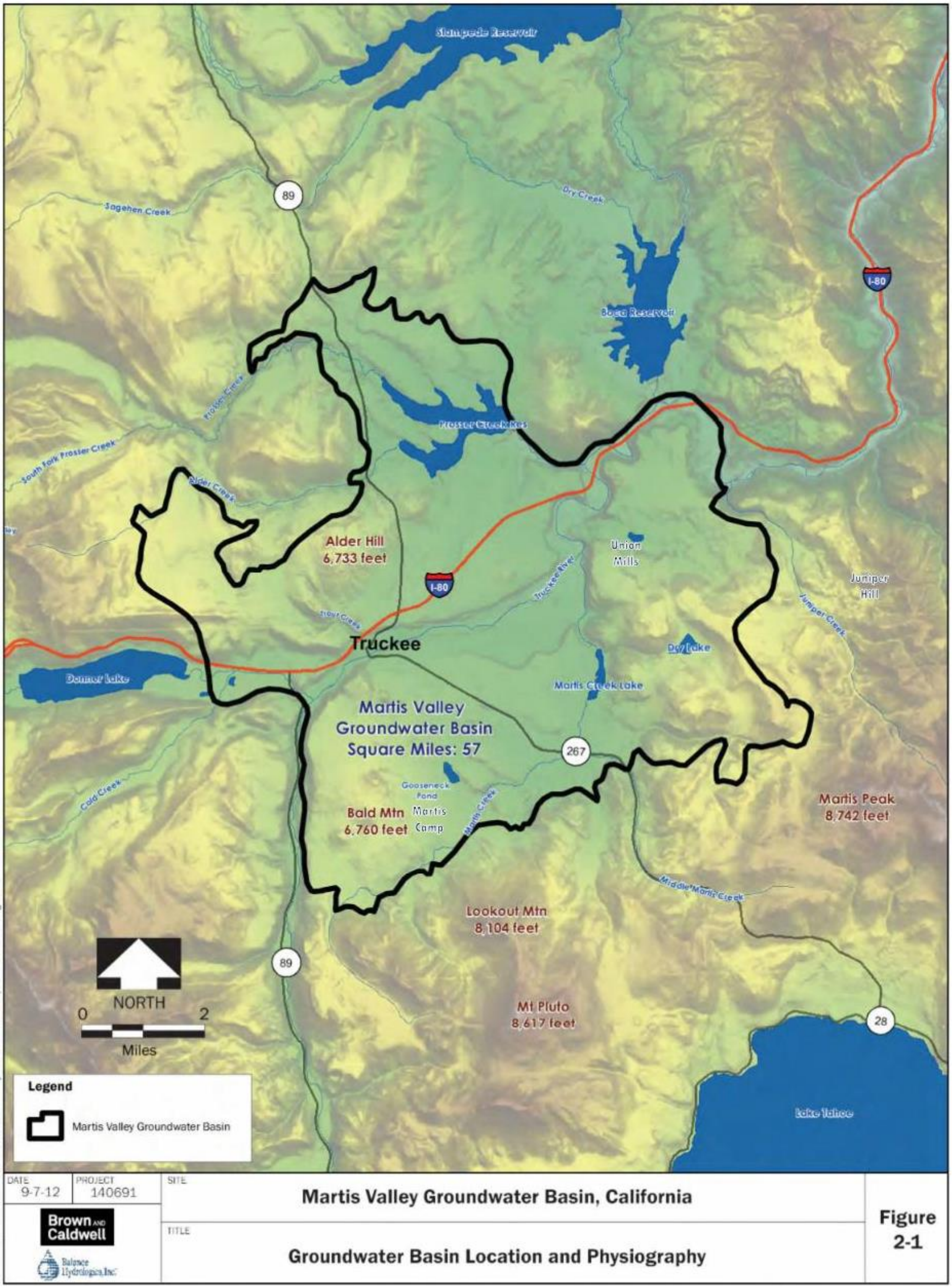


Figure 2-2. Mean Annual Precipitation

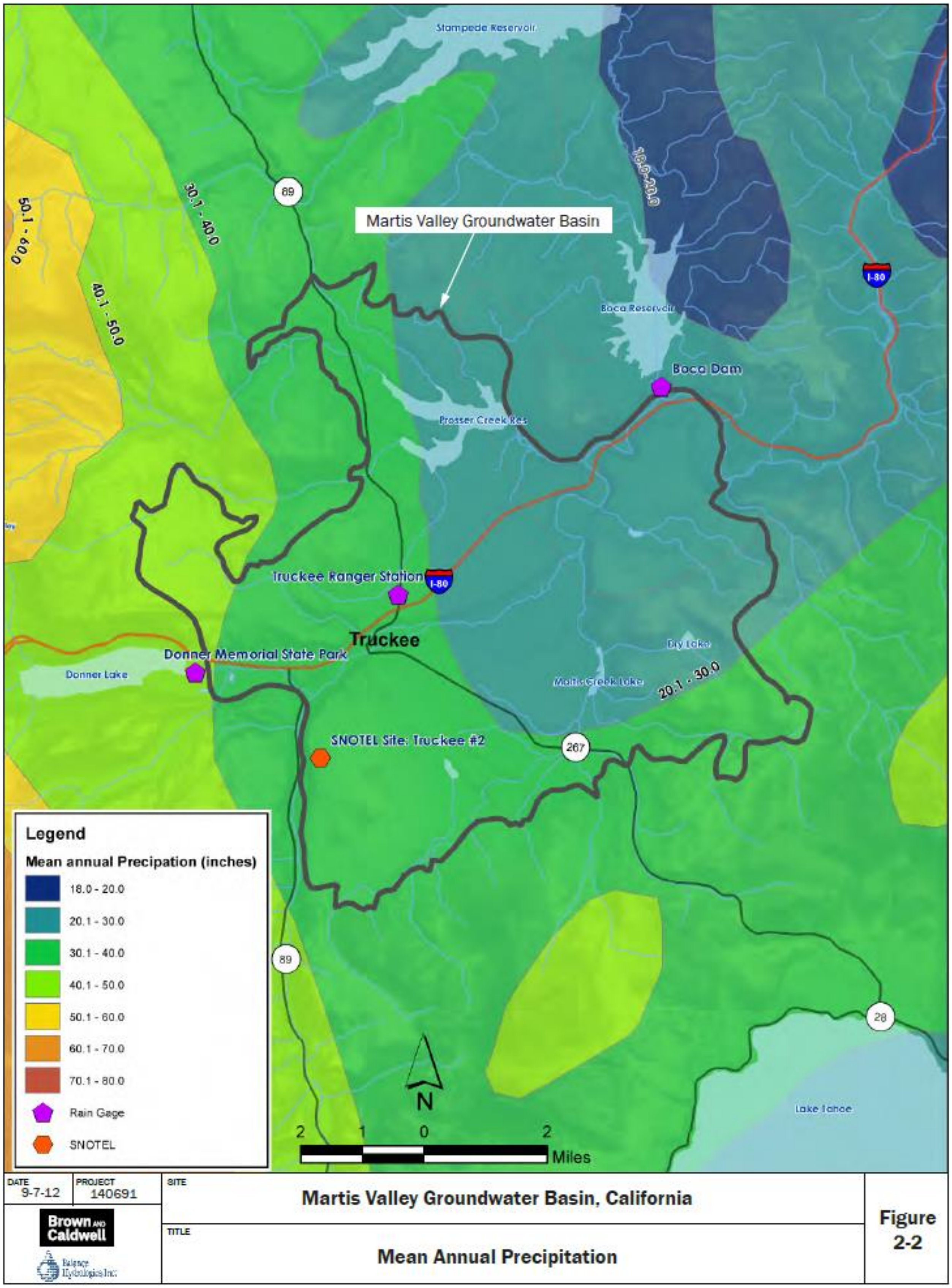
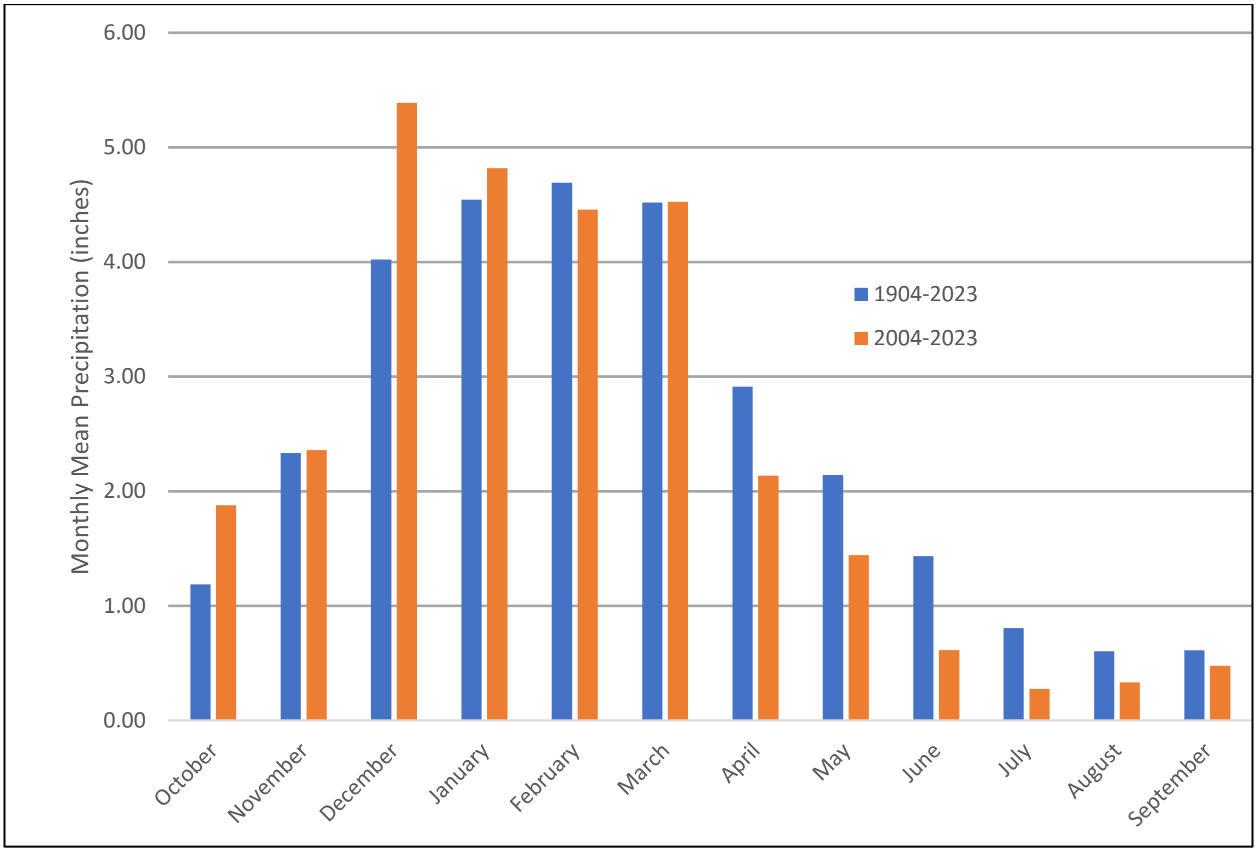


Figure 2-3. Mean Monthly Precipitation, Truckee Ranger Station

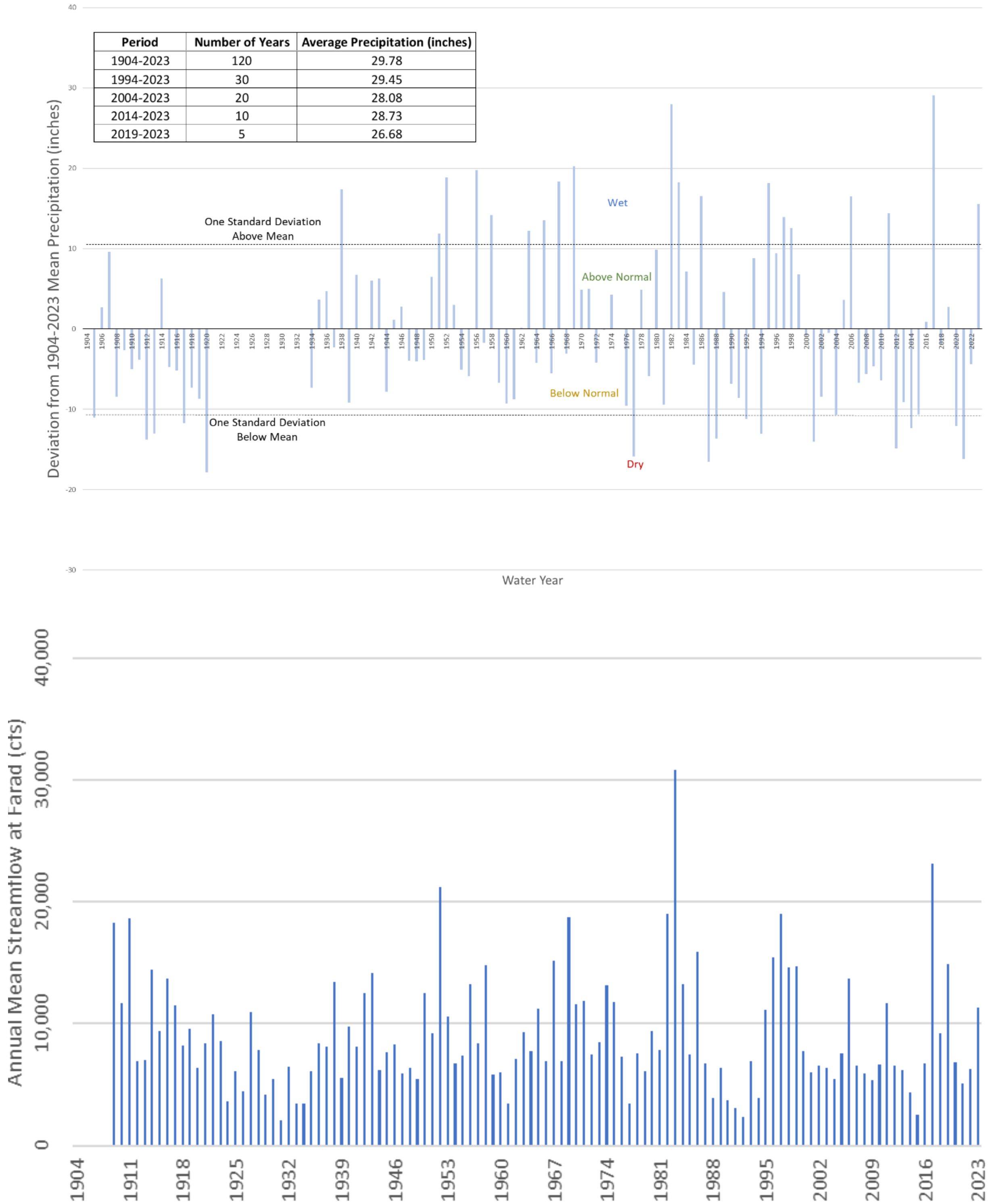


2.2.1. Climate Variability

The region experiences a wide range in climate variability. Variability is marked by periods of greater than average precipitation ('wet periods') and periods of below average precipitation or drought periods. Droughts have been historically common in the Sierra Nevada; Figure 2-4 illustrates the annual percent deviation from mean annual precipitation in Truckee and annual streamflow recorded at Farad from 1904 to 2023. The data shows that recent dry periods (periods of below average precipitation) generally have longer duration (e.g., 1987-1994, 2012-2016 and 2020-2022) than wet periods, which are typically short-lived and more extreme (e.g., 1982-1983, 2016-2017, 2018-2019, 2022-2023). This change in climate appears to have started about 2000.

The worst drought in the 110 records of recorded streamflows at Farad was from 1987 to 1994. A similar pattern is recorded in tree-ring data since 1600 (Fritts and Gordon, 1980), with longer, more extreme droughts recorded. Lindström and others (2000) have described climate changes and details of wet and dry periods over the past 10,000 years, noting evidence of several dry periods when Lake Tahoe, and Donner and Independence Lakes dropped below their natural rims for consecutive years or decades (700-500 years ago and 200-100 years ago).

Figure 2-4. Percent Deviation from Mean Annual Precipitation at the Truckee Ranger Station and Total Annual Streamflow at Farad



Period	Number of Years	Average Precipitation (inches)
1904-2023	120	29.78
1994-2023	30	29.45
2004-2023	20	28.08
2014-2023	10	28.73
2019-2023	5	26.68

2.2.2. Climate Change

The National Oceanic and Atmospheric Association (NOAA), Coats and others (2010), and Dettinger, M. (2018) predicted a future shift from snowfall to rain in the next century in this region as a result of projected increases in average, minimum, and maximum air temperatures. Associated changes in surface water hydrology include potential increases in the frequency and magnitude of major flooding, such that more water may leave the basin as runoff, rather than infiltrating and recharging groundwater resources. NOAA has also predicted that climate change may result in increased drought frequency, and generally reduced water supplies (U.S. Bureau of Reclamation, 2011).

The U.S. Bureau of Reclamation manages water supply in the Truckee River Basin (from Lake Tahoe to Pyramid Lake in Nevada) and has undertaken a number of studies to evaluate the degree to which water supply and demand may be impacted by future changes in climate. This includes the Truckee Basin Study, Basin Study Report (2015) as well as funding researchers at DRI to develop an integrated groundwater, surface water, and climate change model of the MVGB (Rajagopal, et al. 2015). While changes in average annual precipitation are uncertain, increases in temperature are likely (Reclamation, 2011b). Temperature alone has important effect of both supplies and demands—increases in temperature could amplify evaporation and evapotranspiration and diminish the portion of winter precipitation that accumulates as snow and could also cause earlier runoff.

Projections for average annual temperature is anticipated to increase by up to 5 to 6 degrees Fahrenheit by the end of the 21st century (Reclamation 2011a, 2011b). Annual precipitation may decrease slightly by the end of the 21st century. Potential increases or decreases in average annual precipitation would directly influence the availability of water supplies by changing the amount of water running off as well as the amount of water recharging groundwater resources (Rajagopal, et al. 2015).

2.3. Surface Water Hydrology

The Truckee River bisects the MVGB, with several tributaries upstream, within, and downstream of the MVGB. This section provides a brief discussion of the flow regimes of the Truckee River and the primary tributaries within the MVGB. Watershed areas are based on data available from CalAtlas, but sub-watersheds shown have been modified in places for consistency with other regional studies, including the Water Quality Assessment and Modeling of the California portion of the Truckee River Basin (McGraw and others, 2001), the Truckee River Water Quality Monitoring Plan (Nichols Engineers, 2008), the Martis Watershed Assessment (Shaw and others, 2012).

2.3.1. Truckee River

The Middle Truckee River[1] flows out of Lake Tahoe at Tahoe City with a number of tributaries contributing streamflow upstream of Martis Valley, including Bear, Squaw, Deer, Pole, Silver, and Cabin Creeks. The Truckee River then enters the MVGB near the junction of State Highway 89 and Interstate 80,

[1] Definitions of the Upper, Middle, and Lower Truckee River vary among numerous published studies. The definition used in this report of the "Middle Truckee River" definition used in this report conforms to nomenclature used by the California Lahontan Regional Water Quality Control Board, but differs from that used by the U.S. Bureau of Reclamation.

flows west to east across Martis Valley before exiting the basin near Boca, just upstream of its confluence with the Little Truckee River. Main tributaries within Martis Valley are Donner, Cold[2], Trout, Martis and Prosser Creeks (Figure 2-5). Below Boca, the Truckee River descends into the Truckee Canyon before flowing through Reno and Sparks, Nevada, and terminating at Pyramid Lake.

Streamflow from Lake Tahoe, Donner Lake, Martis Creek, and Prosser Creek is controlled by major dams or impoundments, with the timing of releases and streamflows guided by a number of court decrees, agreements, and regulations that govern the flow rate from California to Nevada. These streamflow rates are known as 'Floriston Rates' and measured at Farad, California just upstream of the State line. The Truckee River is currently operated according to the Truckee River Operating Agreement (USBOR, 2008). The Truckee River falls under the jurisdiction of TROA, which is further discussed in Section 3.2.

[2] Though it is not a direct tributary to the Truckee River, Cold Creek flows into Donner Creek below Donner Lake, approximately 1.5 miles upstream of the confluence with the Truckee River, and therefore accounts for a significant portion of the unregulated flow into the MVGB.

Figure 2-5. Hydrography and Long-term Monitoring Stations

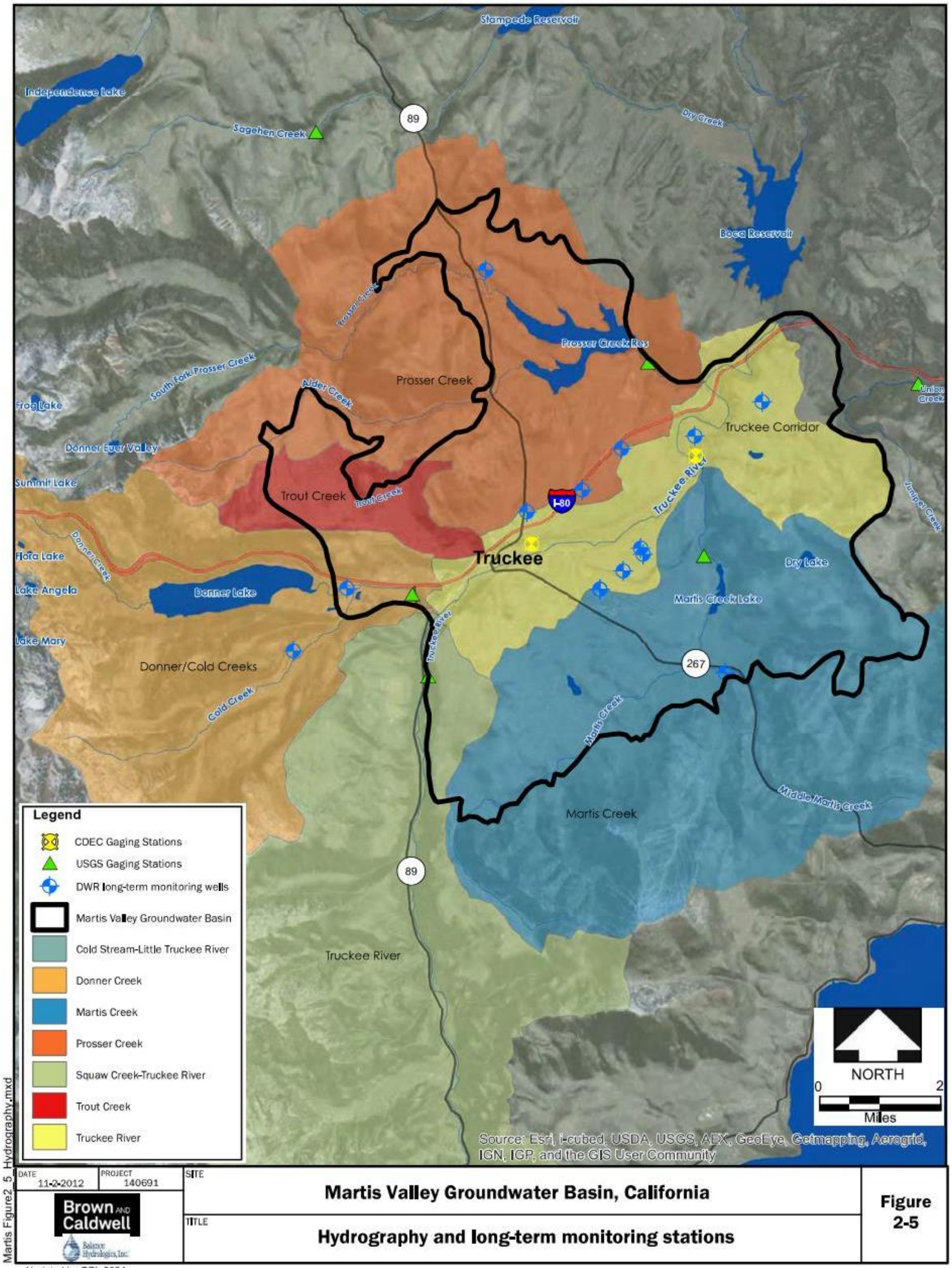


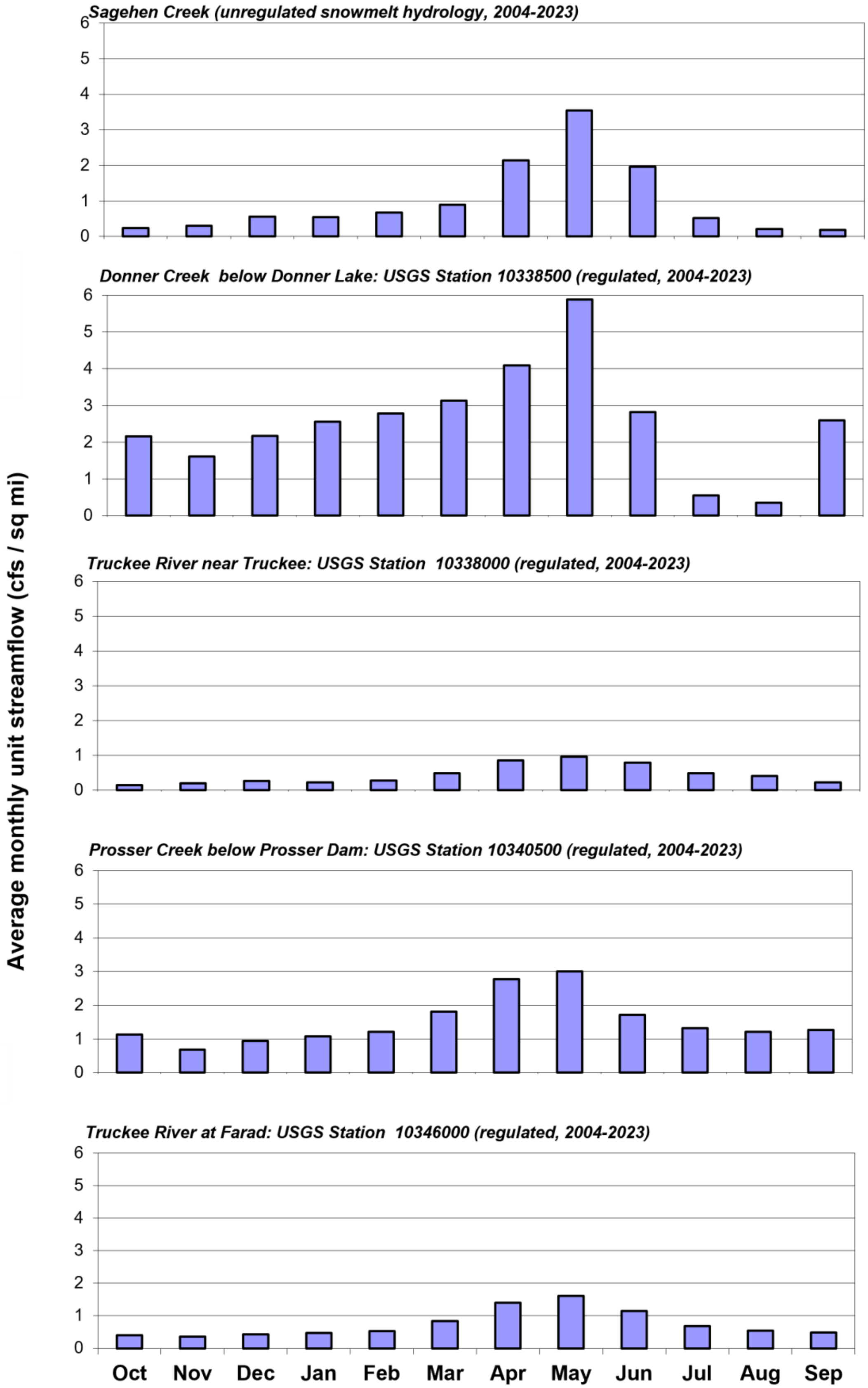
Table 2-1 summarizes historical monthly and average annual flow of the Truckee River and its tributaries, and Figure 2-6 correspondingly shows the average monthly streamflow at a number of gaging stations in the Truckee Basin. This data illustrates how the regulation of streamflows in the Truckee Basin alters the timing of discharge. Unregulated streams in this region tend to experience seasonal low flows in the late summer and early fall, with the bulk of total annual runoff occurring as snowmelt in May and June. This pattern is illustrated by monthly streamflow data collected at Sagehen Creek, an unregulated watershed approximately 5 miles north of the MVGB. In contrast, streams in the MVGB tend to have the total annual streamflow more uniformly distributed during the year, due to timed releases from the various impoundments.

Table 2-1. Average Monthly Streamflow on the Truckee River and Select Tributaries (2004-2023)

	Sagehen Creek	Donner Creek below Donner Lake	Truckee River near Truckee	Prosser Creek below Prosser Dam	Martis Creek below Martis Dam	Truckee River at Boca	Truckee River at Farad	Truckee River Below Martis Creek
USGS Station ID	10343500	10338500	10338000	10340500	10339400	10344505	10346000	10339410
Watershed Size (sq mi)	10.5	14.3	553.0	52.9	39.9	873	932	639
Period of record	2004-2023	2004-2023	2004-2023	2004-2023	2004-2023	2004-2023	2004-2023	2016-2023
(cfs)								
Oct	3	31	79	60	7	341	378	119
Nov	3	23	114	36	8	308	338	224
Dec	6	31	150	50	17	364	402	272
Jan	6	37	129	57	26	390	439	286
Feb	7	40	156	64	30	446	493	371
Mar	9	45	268	96	49	711	774	647
Apr	23	59	474	147	70	1190	1,300	1250
May	37	84	530	159	50	1340	1,500	1220
Jun	21	40	437	91	20	917	1,070	840
Jul	6	8	273	70	7	554	639	325
Aug	2	5	227	64	5	459	508	230
Sept	2	37	123	67	5	415	457	157
Mean annual (cfs)	10	37	247	80	24	620	692	495
Mean annual (ac-ft)	7,469	26,488	178,662	57,978	17,661	448,558	500,623	358,424

Note: Table updated by Balance Hydrologic November 2024; cfs: cubic feet per second; ac-ft: acre-feet; sq mi = square mile
Source: U.S. Geological Survey; U.S. Army Corps of Engineers.

Figure 2-6. Mean Monthly Streamflow in the Middle Truckee River Watershed (2004-2023)



Note: Figure updated by Balance Hydrologic November 2024

2.3.2. Martis Creek

Martis Creek generally flows from south to north in the southern portion of the groundwater basin, with four named tributaries - Martis, West, Middle, and East Martis Creeks comprising the majority of its 42.7 square-mile watershed. Martis Creek Dam was completed in 1972 in order to provide storage for flood control, recreation, and potential water supply (USACE, 1985). Shortly following construction, seepage was observed in the dam face, posing a significant failure risk. As a result, the reservoir has rarely been filled to capacity, and is now maintained at a minimum pool elevation located entirely within the boundaries of the MVGB. The maximum outlet capacity of the dam is 580 cubic feet per second (cfs) prior to spilling and 4,640 cfs at maximum spilling capacity. The United States Army Corps of Engineers (USACE) currently operates the dam in a 'gates wide open' position, such that minimal regulation or disruptions in the timing of streamflow occurs under most circumstances.

The United States Geologic Survey (USGS) maintained a streamflow gaging station on Martis Creek between Martis Dam and the Truckee River from October 1959 through September 2010 and transferred the gage to the USACE in October 2010. Since Martis Dam was constructed in 1972, these data have been used by the USACE, along with Martis Reservoir water level data and stage-storage information, to develop a record of inflow to Martis Reservoir. Daily reservoir inflow indicates average annual runoff into and out of the reservoir to be on the order of 19,630 acre-feet (about 27 cfs).

Placer County operates streamflow gaging stations on lower West Martis Creek (since 2012), Middle Martis Creek (since 2015) and upper West Martis Creek (since 2020) for the purposes of calculating pollutant loadings as part of the Truckee River Water Quality Monitoring Program (Nichols Consulting Engineers, 2008). Data from these stations are reported annually and available in PDF format on the Placer County website as most recently described in the 2023 Annual Monitoring Report (CDM-Smith, 2024).

2.3.3. Donner and Cold Creeks

Donner Lake has a watershed area of approximately 14.3 square miles, all of which lies west of the MVGB boundary. The lake discharges into Donner Creek near the western boundary of the groundwater basin, and then flows toward the east and into the Truckee River (Figure 2-5). A dam was constructed at the lake outlet in 1928 (Berris and others, 2001) allowing for a reservoir capacity of 9,500 ac-ft. The Donner Lake dam is operated by the Nevada Energy (formerly Sierra Pacific Power Company), with a typical release season to provide flood control space from September 1 to November 15. TDPUD holds rights to 990 acre-feet in Donner Lake (TDPUD, 2021). The USGS has maintained a streamflow station on Donner Creek below Donner Lake (Station 10338500) since 1931. Average annual streamflow is 25,794 acre-feet (35.9 cfs), and Figure 2-6 illustrates the effect of dam operations on the timing of streamflow during the year.

2.3.3.1. Cold Creek

Cold Creek has a watershed area of approximately 12.5 square miles and flows from Coldstream Canyon into Donner Creek in the western portion of the groundwater basin. The confluence of these streams historically migrated across the Coldstream Canyon alluvial fan, but now both channels area confined by transportation infrastructure and historical aggregate mining operations. Cold Creek is the largest unregulated watershed that flows into the MVGB; with a runoff regime typical of a snowmelt-dominated system, with peak flows in May and June and low flows in the late summer and early fall.

A streamflow gage was installed on Cold Creek by Balance Hydrologics for the Truckee River Watershed Council in October, 2010 and operated until September 30, 2014 (Hastings and Shaw, 2014). Cold Creek is the only significant tributary to Donner Creek between USGS gaging station 10338000 (Donner Creek at Donner Lake) and 10338700 (Donner Creek at Highway 89), therefore, historical streamflow estimates are made by calculating the difference in streamflow between these stations. Based on these data, average annual streamflow from Cold Creek for the period from 2004 to 2023 is approximately 26,982 ac-ft (37.3 cfs).

2.3.4. Trout Creek

With a watershed area of approximately 5 square miles, Trout Creek is the only other unregulated stream (besides Cold Creek) which flows into the MVGB. The headwaters of Trout Creek are located within the Tahoe-Donner residential subdivision, part of the Town of Truckee and largely within the boundaries of the MVGB. The runoff regime is predominately snow-melt dominated, but with portions of the watershed covered with impervious surfaces such as roads and rooftops, rainfall events result in slightly more runoff and less infiltration and recharge from this watershed compared to others. A streamflow gage on Trout Creek was installed in January 2011 for the Truckee River Watershed Council and discontinued in July 2014 (Hastings and Shaw, 2014), so long-term streamflow statistics are not available.

2.3.5. Prosser Creek

Prosser Creek's approximately 32 square-mile watershed area includes Alder Creek and lies largely outside the MVGB. Prosser Creek Reservoir however, is entirely within the groundwater basin and is operated by the U.S. Bureau of Reclamation for water supply and flood control under the conditions provided in TROA. The reservoir provides up to 20,000 acre-feet of storage for flood control but is capable of storing as much as 29,800 acre-feet for flood control, recreation, and improvement of fishery flows in the Truckee River (Hastings and others, 2022).

2.3.6. Reservoir releases for flood control typically occur between September 1 and October 31 (Berris and others, 2001), as reflected in the pattern of average monthly flows depicted in Figure 2-6. Truckee Corridor

The Truckee Corridor includes intervening areas that do not drain to the tributaries mentioned above. This includes the Union Creek sub-watershed, which encompasses much of the Glenshire subdivision in the eastern portion of the MVGB, as well as urban and open space areas within the Town of Truckee.

2.3.7. Other Impoundments

A number of small impoundments are located within the boundaries of the MVGB, including Union Mills Pond in the Glenshire subdivision, Dry Lake adjacent to the Waddle Ranch Preserve, and Gooseneck

Reservoir, near the Lahontan Golf Club. Though originally constructed for cattle-grazing and/or millpond operations, these impoundments are now managed primarily for open space, recreational/aesthetic, or wildlife purposes.

2.4. Geology

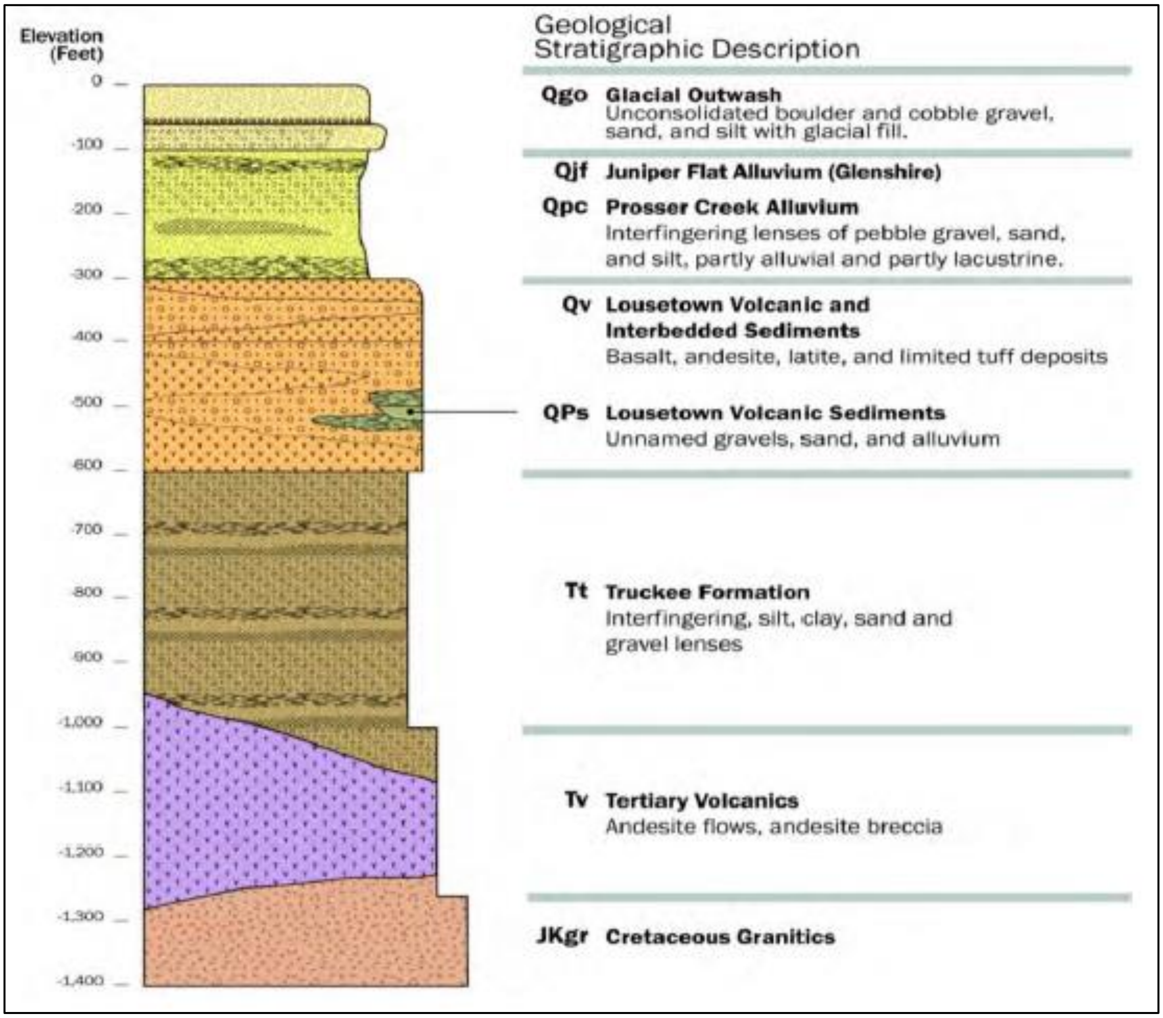
The Martis Valley is located in the Sierra Nevada physiographic region, which is composed primarily of igneous and metamorphic rocks, with sedimentary rocks in its valleys. The MVGB's complex geology is dominated by sedimentary deposits left by glaciations, volcanic rocks, and faulting. A component of the Martis GMP was the development of geologic cross-sections to improve the understanding of MVGB geology and stratigraphy.

2.4.1. Geologic Database Development

Approximately 200 well logs obtained from the DWR, TDPUD, PCWA, NCSD, and the Tahoe-Truckee Sanitation Agency (T-TSA) were interpreted to better understand depths and thicknesses of the various geologic formations comprising the MVGB. The filtered geologic and selected well data were entered into an ESRI ArcGIS Geodatabase, a spatially-referenced database. The benefit of the Geodatabase allowed a visual representation of the geologic data and was also used as the geologic framework for the DRI groundwater model that provides consistency between the GMP geologic interpretation and the groundwater model.

The geochronology and stratigraphic relationships of water-bearing formations was based on Birkeland's (1961; 1963; 1964) work, as well as subsequent investigations by Latham (1985), and Hydro-Search (1995), and mapping published by Saucedo (2005) and Melody (2009). The stratigraphic relationships, lithologies, and formation locations described in these studies, as well as through field observations, formed the basis for the designation of the primary hydrostratigraphic units, as displayed in Figure 2-7. Figure 2-8 shows the approximate locations of wells (available through 2013) used to develop the geologic database.

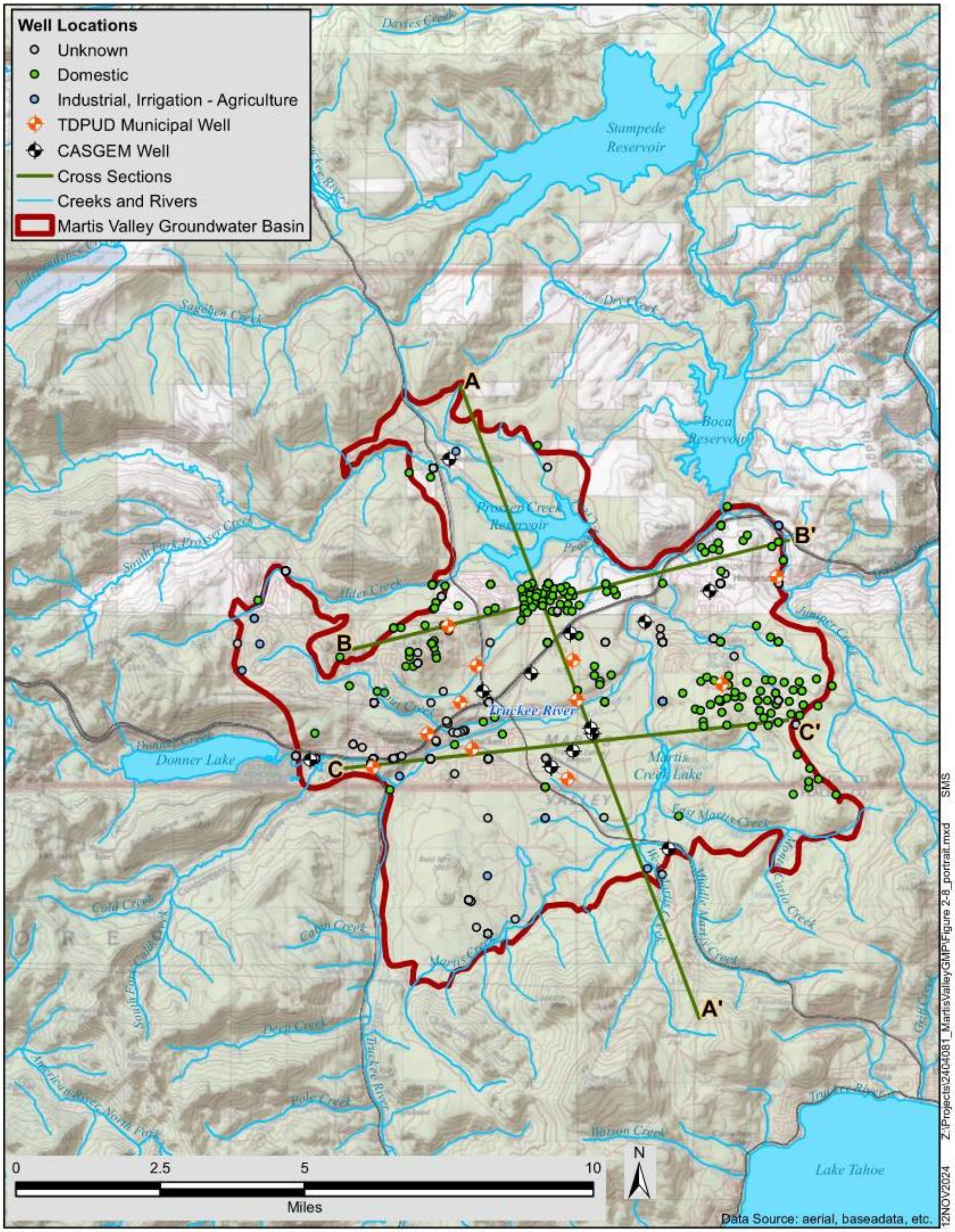
Figure 2-7. Stratigraphic Column showing Primary Hydrostratigraphic Units



Stratigraphic interpretations shown in Figure 2-7 and in Section 2.4.3 (below) are consistent with published geologic maps of the basin (Birkeland, 1961; 1963; Saucedo, 2005; Melody, 2009), and delineate four primary water-bearing stratigraphic units that make up the aquifer, and underlying rocks that are considered to be relatively water-limited (see Figure 2-9). The primary units shown in Figure 2-7 include a number of subunits mapped by previous investigators and shown on Figure 2-9 and noted in parenthesis with the descriptions below. When available, information regarding potentially confining (fine grained) or water-bearing (coarse) subunits are also delineated. Following well log interpretation, three representative geologic cross-sections were located and developed. Figure 2-9 shows the cross-section locations; Figure 2-10 shows cross-section A-A'; Figure 2-11 shows cross-section B-B', and Figure 2-12 shows cross-section C-C'.

It should be noted that Figure 2-9, a geologic map of the MVGB and surrounding areas, is based on published geologic mapping by Saucedo (2005), Melody (2009), and Saucedo and Wagner (1992). The Saucedo and Wagner (2009) mapping was completed at a statewide scale and is therefore, less precise than other portions of the map and geological cross-sections. Accordingly, portions of the geologic map in Figure 2-9 do not correspond to the more detailed geological mapping and cross-sections.

Figure 2-8. Well Locations



Martis Valley Groundwater Management Plan 5-Year Update Nevada and Placer Counties, California	GEI Consultants	Martis Valley Groundwater Basin Well Locations	
Truckee-Donner Public Utility District		NOVEMBER 2024	FIGURE 2-8

Figure 2-9. Geology and Cross-section Locations

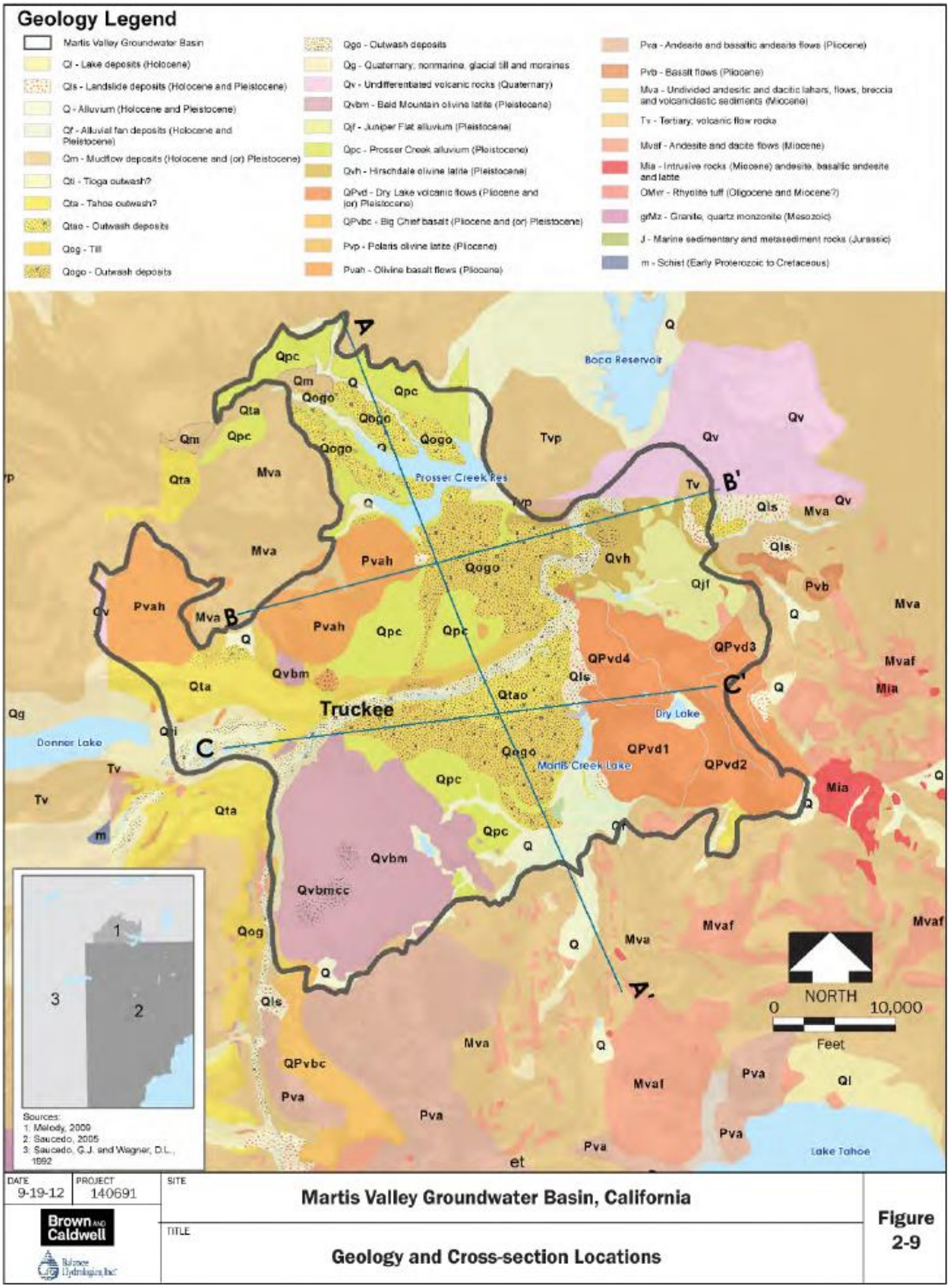


Figure 2-10. Cross-section A-A'

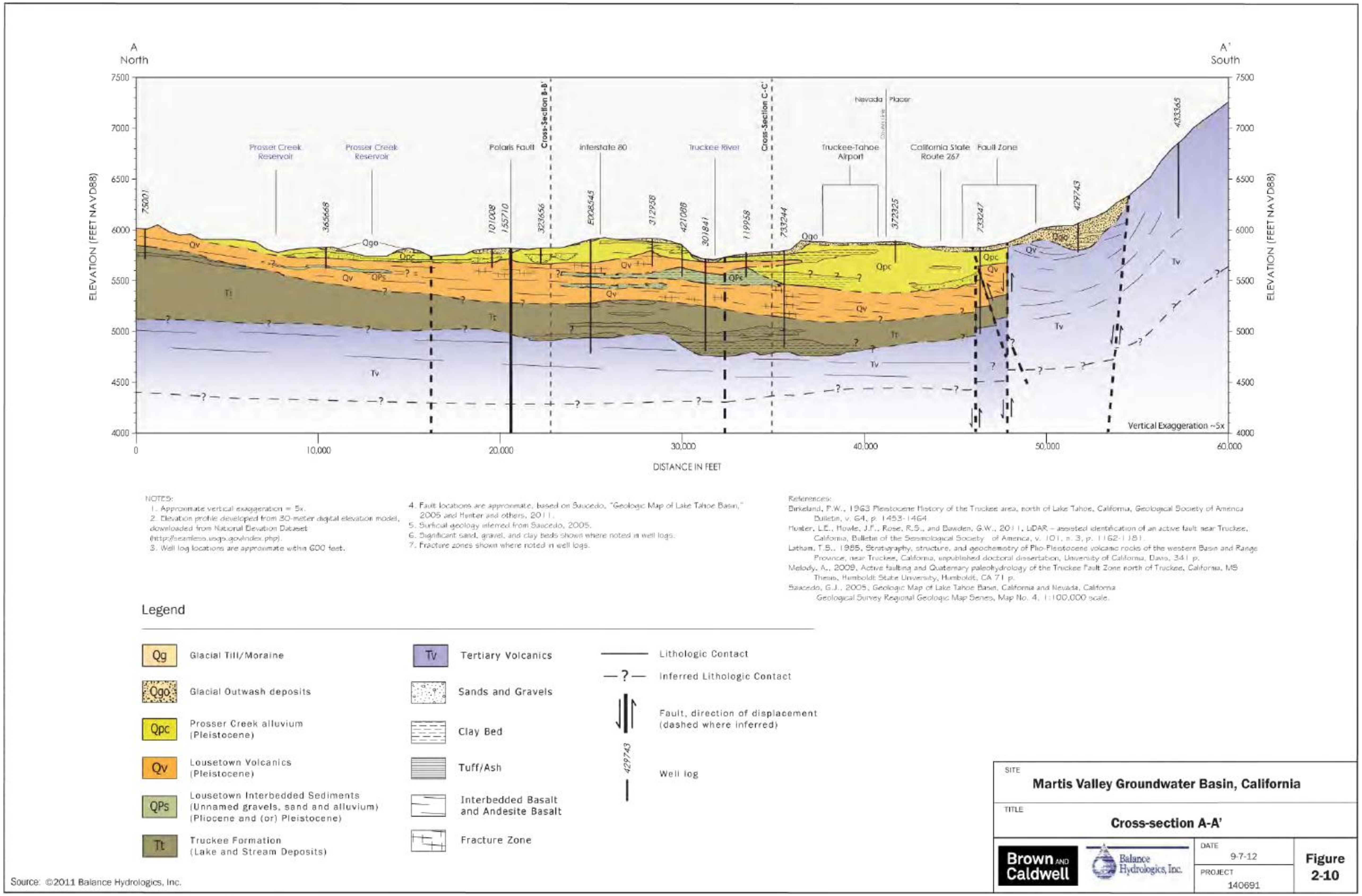


Figure 2-11. Cross-section B-B'

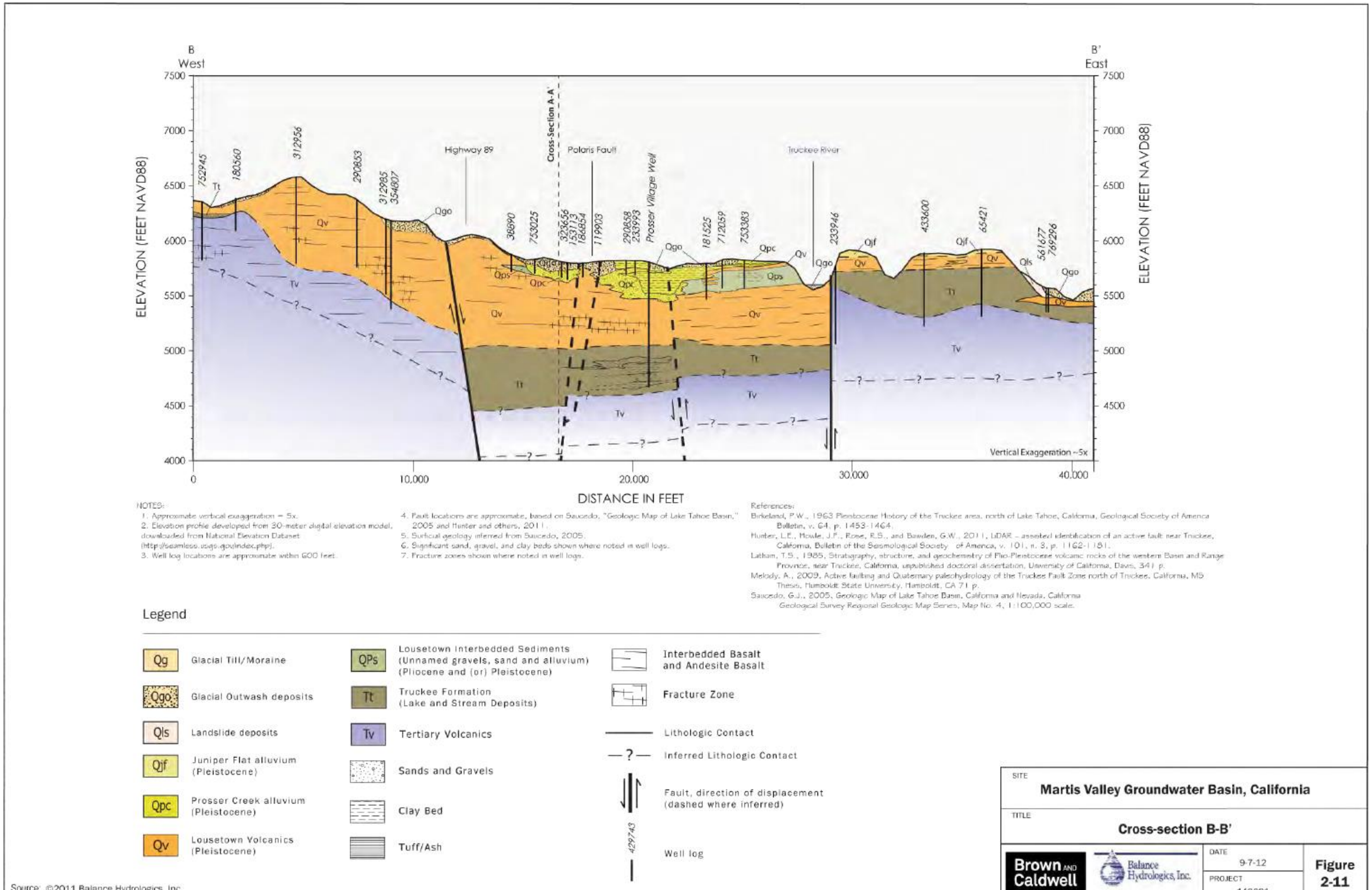
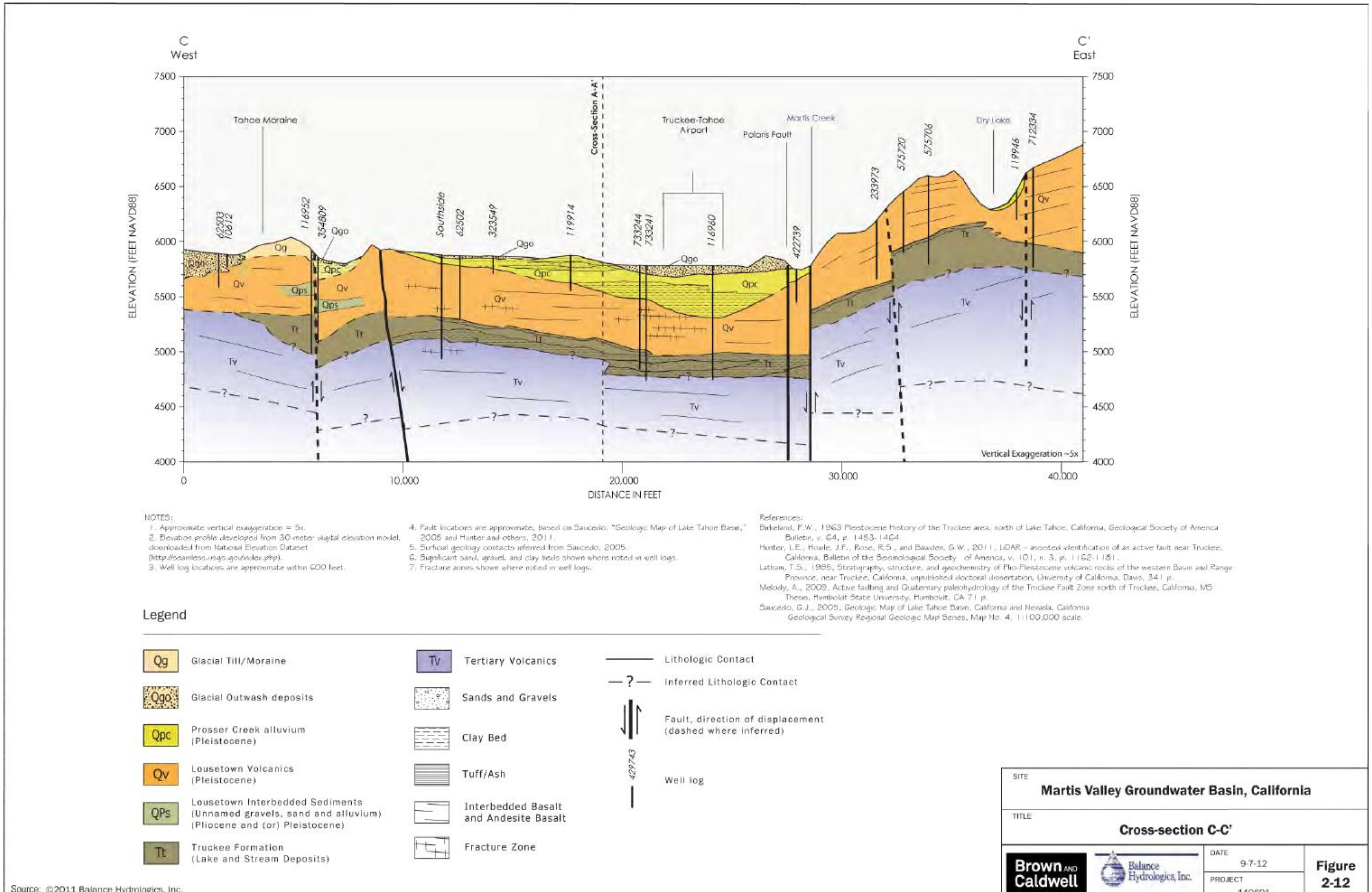


Figure 2-12. Cross-section C-C'



2.4.2. Stratigraphy

The uplift along the faults that created the MVGB probably began during the late Pliocene and into the early Pleistocene, with relatively low-permeability Tertiary volcanics forming the bottom of the basin (considered basement rocks in this report). Prior to and throughout the middle Pliocene, the sedimentary material of the Truckee Formation was deposited in the MVGB, directly overlying andesite tuff breccias, andesite flows, and intrusive rocks of Tertiary age. Following deformation, the general topography of the Martis Valley was probably somewhat similar to today's topography (Birkeland, 1963), with the Truckee River flowing out of the MVGB near where it does today, cutting a canyon through the pre-Pleistocene rocks of the Carson Range.

During the Pleistocene, a series of volcanic flows occurred in the regional Truckee area. At least 20 distinct flows have been recognized (Birkeland, 1961), mostly (but not exclusively) consisting of fine-grained latites and basalts, and are noted as being fairly local in extent. Flows found in the MVGB include the Dry Lake Flows (QPvd), the Bald Mountain olivine latite (Qvbm), Alder Hill Basalt, Polaris olivine latite, and Hirschdale olivine latite. Collectively, these units are referred to as Lousetown volcanics (Qv) based on Birkeland's (1963) correlation to other Lousetown flows in the Carson Range. Also included within the in the Lousetown Formation are interbedded Lousetown sediments (Qps); fluvial (stream) and lacustrine (lake) deposits accumulating, and thereby raising land surface elevation, in the valley between flow events.

As volcanic activity waned, one of the last flows, the Hirschdale Olivine Latite, flowed across the Truckee River Canyon, damming the basin and causing widespread sediment accumulation and deposition of the Prosser Creek Alluvium (Qpc), a partly-lacustrine and partly fluvial sedimentary unit (Birkeland, 1963). Brown (2010) has subdivided the Prosser Formation into Upper, Middle, and Lower Members. For geodatabase development purposes, interbedded Lousetown sediments are defined as being capped by volcanics, while the Prosser Formation is not. It is recognized however, that the lower Prosser Formation may have been deposited concurrently with the interbedded Lousetown sediments, and in some cases, may be correlated to these upper sediments where capping volcanics pinch out laterally.

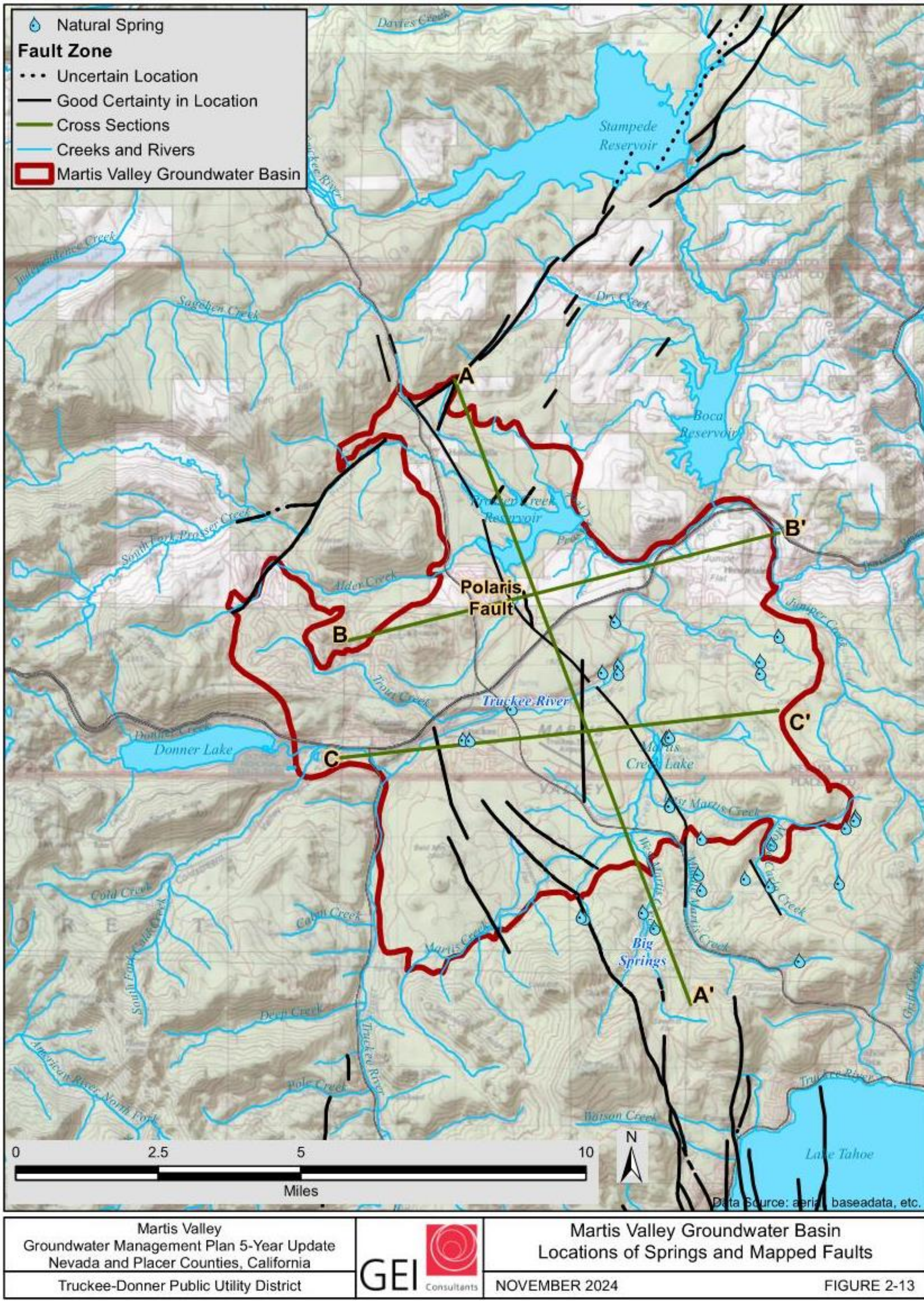
During this same period, Juniper Flat alluvium was being deposited in the Glenshire area with sediment derived from the paleo-Juniper Creek watershed and alluvium derived from the west.

The Prosser Formation and volcanics in other areas are capped by glacial deposits, derived from glacial advances and retreats during a number of glacial episodes (Birkeland, 1961). In the MVGB, most of the deposits consist of glacial outwash deposits of varying age (Qgo). The outwash deposits consist of loose and unconsolidated boulder, cobble, gravel, and sand. In the vicinity of the Truckee River, three distinct outwash deposits (Qogo, Qtao, and Qti) are apparent and form terraces along the course of the river (Birkeland, 1961). A number of glacial moraines were also deposited, and are visible today in the vicinity of Donner Lake, the Tahoe-Donner residential neighborhood, and the Gateway Neighborhood of Truckee.

2.4.3. Structure

The MVGB lies within the Truckee Basin, a structural trough formed at the boundary of the Sierra Nevada and Basin and Range Geomorphic Provinces. Tectonics in this zone are complex and include active right-lateral (strike-slip) shear associated with the Pacific-North American Plate boundary and North Walker Lane Belt, as well as extensional (normal) faulting associated with the Basin and Range Province. The uplift along the faults that created the basin probably began during the late Pliocene and into the early Pleistocene (Birkeland, 1963), while right-lateral faulting is inferred to have occurred into the Holocene (Melody, 2009; Brown, 2010; Hunter and others, 2011). Most recently, the Polaris Fault has been mapped as an active North-South Holocene fault across the center of the MVGB. It is unknown if all of the faults in the MVGB are acting as a barrier to groundwater flow. A subsidiary fault associated with and parallel to the Polaris Fault has been demonstrated by groundwater elevation differences (30-40 feet) to be at least a partial barrier to groundwater flow in the valley (InterFlow Hydrology, 2014). Identified faults are shown in Figure 2-13.

Figure 2-13. Locations of Springs and Mapped Faults



2.5. Groundwater Occurrence and Movement

The geologic units described above are interlayered, with complex spatial relationships, and as such, the occurrence and movement of groundwater within and between these units is variable. For this report, the low-permeability Miocene (Tertiary) volcanic rocks are considered the bottom of the MVGB. This section discusses where groundwater occurs, groundwater and surface water interaction, and water levels over time.

2.5.1. Water-bearing Units and Properties

The Truckee Formation (Tt) is composed of interlayered silts, sands, and clays, and therefore has variable groundwater availability. Well driller's logs document sands and gravels within the Truckee Formation in the center of the basin, near the Truckee Tahoe Airport, at depths of approximately 900 to 1,000 feet, and from 200 to 700 feet in the southern portion of the basin near Shaffer's Mill and Lahontan Golf Clubs. Well yields in the Truckee Formation range from 280 gallons per minute (gpm) in the eastern portion of the basin (Hydro-Search, 1995) to more than 1,000 gpm in faulted areas underlying the Bald Mountain volcanics in the southwestern portions of the MVGB (Herzog, 2001).

Water is found along faults and fractures within the Lousetown volcanics (Qv), though portions of the volcanic flows are massive and unfractured. Figure 2-14a is a photo of a Lousetown volcanic outcrop and illustrates the range of fracture concentrations that can occur in this unit. In most cases, water encountered in this fractured system is pressurized, rising to a static level several hundred feet higher than where initially encountered, suggesting the presence of confining units above these fracture zones. The higher initial groundwater levels are indicative of groundwater recharge entering the fractures at much higher elevations than where a boring has intersected them. The confining unit(s) are not well defined or apparently continuous across the Basin. The confining unit(s) maybe unfractured Lousetown volcanic layers, Lousetown Interbedded Sediments (clay or ash layers) or Prosser Creek alluvium. The cross-sections, shown on Figures 2-9 through 2-11 do not show this confining unit to be continuous across the entire Basin.

Wells located in the southern portion of the groundwater basin have been found to be artesian, or flowing, along fractures interpreted as faults (Herzog and Whitford, 2001), with yields ranging from approximately 250 to 1,000 gpm. A number of distinct fault blocks are present in this area, with unique and heterogeneous aquifer properties where faults serve as barriers to groundwater flow (ECO:LOGIC, 2006; ECO:LOGIC, 2007; Bugenig, 2007; 2006; Peck and Herzog, 2008). Groundwater discharge areas in the form of seeps and springs are also found within these areas and along the periphery of the MVGB (Figure 2-13), including thermal springs in the vicinity of the recently-mapped Polaris Fault (Hunter and others, 2011).

The Prosser Formation overlies the Lousetown volcanics. The Prosser Formation (Qpc) includes interlayered silts, sands, and clays and has variable water bearing capacity. Figure 2-14b shows an outcrop of the Prosser Formation, where coarser materials such as sand and gravel are present, and moderate groundwater yields may be encountered. Water-bearing portions of the Prosser Formation may also be hydrologically connected to overlying glacial outwash and potentially surface water bodies as well. Fine grained materials such as silts and clays may locally produce confining conditions in the underlying Lousetown volcanics. Well yields in these coarse grained alluvial sediments typically range from 12 to 100 gpm, though larger-diameter production wells have estimated yields as high as 500 gpm according to State well driller's logs (DWR).

Hydraulic properties of the glacial moraines contrast sharply with those of the glacial outwash deposits; the moraines consist of poorly-sorted clay to boulder-size materials, while the glacial outwash deposits are primarily well-sorted sands and gravels. As a result, the glacial outwash tends to transmit water relatively easily, while moraines are typically water-limited.

Figure 2-14a. Lousetown Volcanic Outcrop

Figure 2-15. Prosser Formation Outcrop Underlying Glacial Outwash

2.5.2. Surface-Groundwater Interaction

Generalized groundwater flow directions were inferred by Hydro-Search (1995) and were based on static water levels reported in State well drillers reports and DWR's long-term well monitoring data and indicated groundwater flow directions are toward the Truckee River. The Truckee River is the topographic low in the Basin and as long as groundwater elevations are above the riverbed, groundwater would discharge to the river.

A more detailed surface water and groundwater interaction study (Interflow Hydrology, 2003) was completed for the TDPUD for tributaries to the Truckee River. The Interflow Hydrology study provides estimates of the magnitude of stream losses and gains to and from groundwater across the Martis Valley during summer 2002, in the middle of a multi-year dry period. Observations made during the course of the study showed Martis Creek to be a 'gaining stream' (receiving groundwater discharge) across the Lahontan Golf Club, upstream of Martis Valley; West Martis Creek was found to be a 'losing stream' as it enters Martis Valley, recharging groundwater between the Northstar Golf Course and its confluence with Martis Creek; and Middle Martis Creek showed no loss or gain across the valley floor. Groundwater discharge in the form of springs generally support perennial flows in Lower East Martis and Dry Lake Creeks, as well as from the hillside adjacent to Martis Reservoir.

Interflow Hydrology (2003) computed a basic water balance based on late season low flow measurements in the watershed and found that in October 2002, total streamflow losses across the Martis Valley floor were on the order of 0.65 cfs (approximately 9% of the total baseflow into the MVGB from Martis Creek), while losses at Martis Creek Lake were on the order of 1.55 cfs (approximately 29% of the total flow at that point). Evaporation and evapotranspiration by plants were not measured as part of the study; however, these data suggest that the Martis Valley floor potentially serves as a groundwater recharge area during the late summer and fall months.

Beginning in 2023, NCSD began working with the Truckee River Watershed Council to evaluate surface water and groundwater interaction in southern portions of the MVGB, with a goal of detailing the spatial and temporal variation in surface and groundwater interaction in the vicinity of NCSD production wells. This work is in progress and uses the best available science (implementing BMO #5) including multiple lines of evidence to evaluate these interactions, including: comparison of general chemistry and isotopes in surface and groundwater, depth-to-water interpolation and mapping of surface water that is interconnected with groundwater, and synoptic streamflow measurements along Prosser, West Martis, Middle Martis, and East Martis Creeks to identify losing and gaining reaches.

In addition, Interflow Hydrology (2003) identified groundwater recharge occurring where Prosser Creek enters the MVGB, just upstream of Prosser Reservoir. All other tributaries, including Cold, Donner, and Trout Creeks were concluded to be supported by groundwater discharge.

2.5.3. Groundwater Levels

Groundwater levels have been generally stable in the Martis Valley with some declines occurring in specific regions. Figure 2-15 presents groundwater level monitoring data throughout much of the MVGB since 1990 in a single set of hydrographs. This graph shows that overall groundwater levels have been stable in the MVGB, including during the drought of the early 1990s, and the wet years of the late 1990s.

Groundwater levels are measured by the partner agencies and DWR and are reported to the California Statewide Groundwater Elevation Monitoring (CASGEM) program. Historically, groundwater level measurements were taken in the spring and fall. In 2017, the MVGB Agencies voluntarily implemented monthly monitoring of groundwater levels for all wells in the CASGEM program, implementing BMO #5. This proactive move to monthly monitoring was, in part, to investigate and address uncertainties in seasonal variations. Monthly groundwater measurements illustrated that peak summer-time groundwater pumping temporarily lowers groundwater levels below the previous fall measurements, as would be expected, but are not depleting reserves, even with decreased precipitation within the last 20 years.

Figure 2-16 shows the locations of the 13 monitoring wells and selected respective hydrographs. The hydrographs indicate that groundwater is locally variable in the MVGB, as levels may decline in some wells and rise in other wells over the same period of time. These data suggest that there may be several water-bearing zones in the MVGB that may or not be hydraulically connected. The hydrographs also provides the following well specific information:

- Well 17N16E11F001M (northeast of downtown Truckee) experienced a nearly 50-foot rise in water level in the late 1990s, and then declined steadily over the following decade before rising again in 2011 and continuing until winter of 2022 when water levels reached record heights. This rise coincides with above-average precipitation and streamflow (Figure 2-4).
- Levels in Well 17N17E29B001M (Northstar) was relatively steady throughout the early monitoring period until summer 2007, when seasonal fluctuations began to occur due to

development and groundwater production. Water levels had declined between 2007 and 2012 but recovered close to pre-development levels in 2017 and has remained consistent in recovery and use since then.

- Groundwater levels in well 17N17E05D001M (Truckee River east of Truckee) have increased steadily over the period of record, rising over 10 feet from 1990 to 2012, and has remained consistent to present at these levels with wet and dry periods showing temporary rises and declines.
- In well 17N1E17F002M (Donner Creek area), groundwater levels fluctuated seasonally but generally remained constant year to year) and have increased slightly over time to present.
- In the nested wells 17N16E13K001M (deep) and 17N16E13K003M (shallow), water levels in both wells were matching until late 2003, at which time a divergence occurred causing water levels in the deep well to rise significantly, while water levels in the shallow dropped slightly. This divergence and slow increase of groundwater levels continued until December 2022 when the water levels within the deeper well dropped to pre-2003 levels and shallow well rose simultaneously to match with identical groundwater measurements. These water levels will be tracked and acted upon if needed.
- TH-Fibreboard and TH-Martis Valley wells have seen fluctuations based on the type of water year and has risen slightly overall. TH-Prosser Village has seen these same fluctuations, but groundwater levels have declined on average over the same period, likely due to complications with the nearby Polaris fault to the west.
- Groundwater levels in well 18N17E33L001M had been consistent up until 2019 when levels started to decline slowly during the 2020 and 2021 drought period and has not recovered to pre-2019 levels.

Figure 2-16. Water Levels in Long-term Groundwater Monitoring Wells

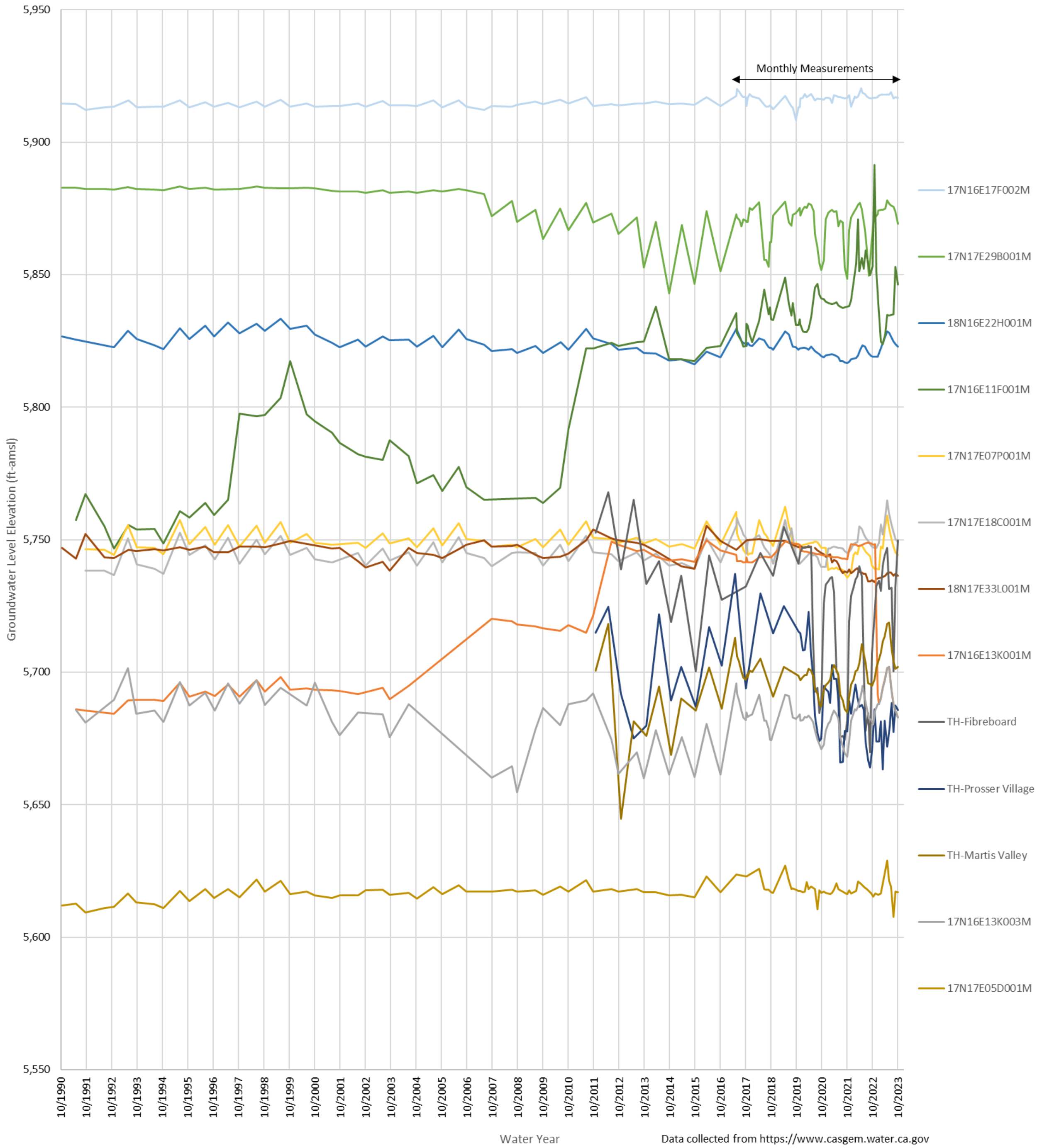
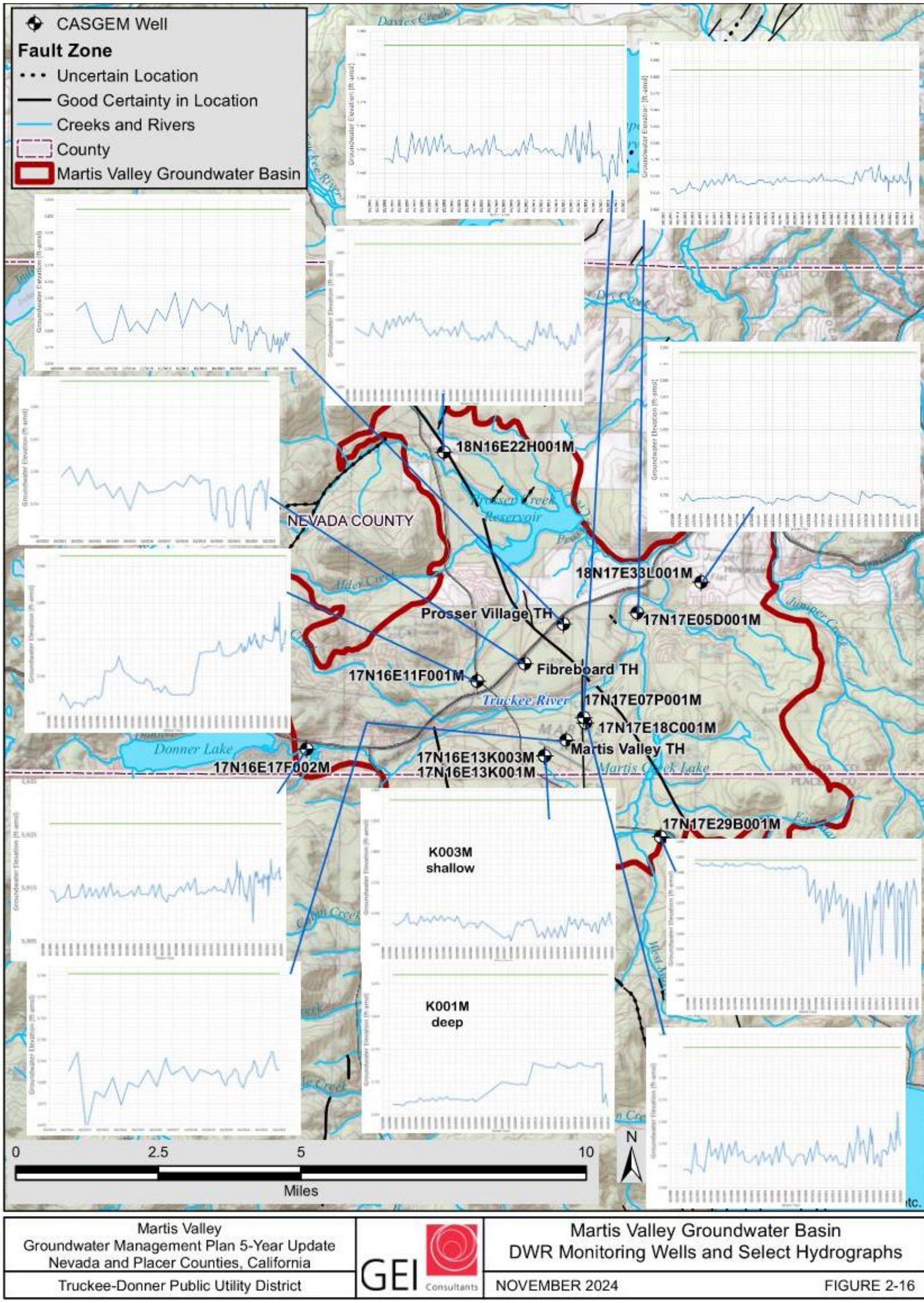


Figure 2-16. Monitoring Wells and Select Hydrographs



Source: DWR 2024

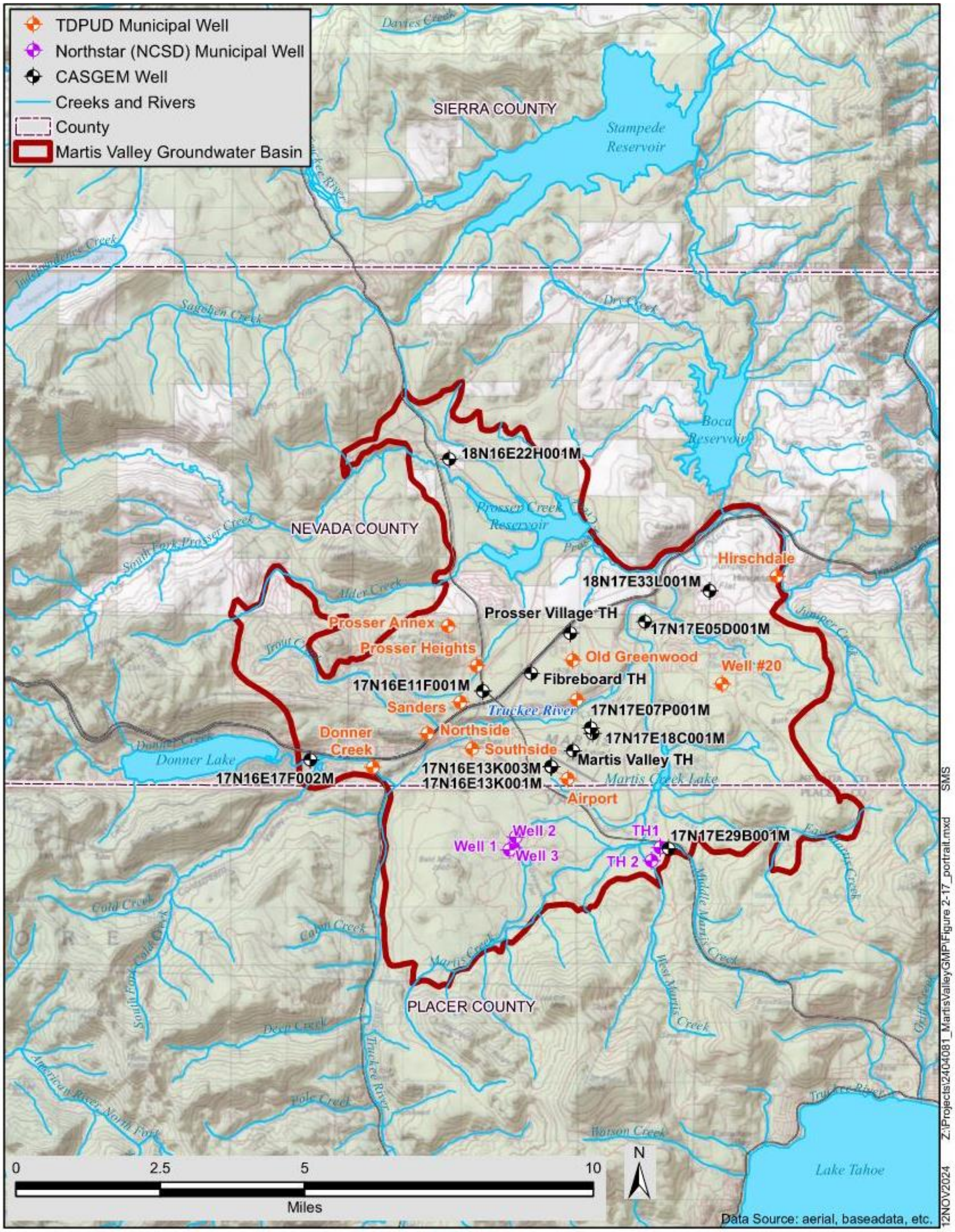
2.5.4. Land Subsidence

Permanent land subsidence can occur when groundwater is removed by pumpage or drainage due to irreversible compression of aquitard materials. The potential for subsidence is low because there are no regionally continuous clay units which act as aquitards and the groundwater levels, for the most part have remained stable. No indications of land subsidence have been reported in the documents reviewed as part of this evaluation.

2.6. Groundwater Well Infrastructure

TDPUD, NCSD, hundreds of domestic pumpers, and a number of golf courses rely on groundwater in the MVGB for drinking water and irrigation supplies. The TDPUD provides water service to portions of the Town of Truckee and adjacent unincorporated areas of Nevada and Placer Counties. The TDPUD currently has 13 active production wells for potable water service, plus three wells to serve non-potable water demands. PCWA's former Eastern Water System (Zone 4) currently includes three production wells, Wells #1, #2, and #3, to serve the Lahontan Golf Club, Shaffer's Mill Golf Club, Hopkins Ranch, and Martis Camp Residences. PCWA transferred ownership and operating responsibilities to NCSD in 2015. NCSD supplies water to residents and guests in the Northstar community, producing water from two production wells (TH-1 and TH-2). Figure 2-17 shows the general location of the well infrastructure and the groundwater level monitoring network. Table 2-2 summarizes the estimated yields and production rates associated with these wells.

Figure 2-17. Groundwater Well Infrastructure and Level Monitoring Network



Martis Valley Groundwater Management Plan 5-Year Update Nevada and Placer Counties, California	GEI Consultants	Martis Valley Groundwater Basin Groundwater Well Infrastructure and Level Monitoring Network	
Truckee-Donner Public Utility District		NOVEMBER 2024	FIGURE 2-17

Table 2-2. Estimated Yield of Public Agency Production Wells

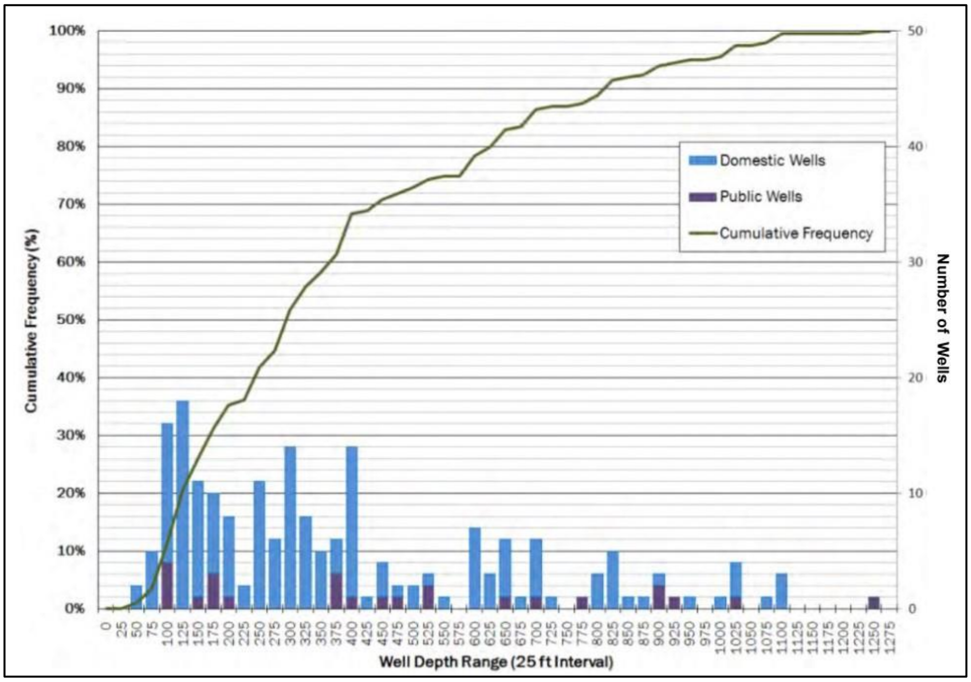
Well Name	Estimated Maximum Yield (gpm)
NCSD	
TH-2	850
TH-1	850
Well 1	1,250
Well 2	1,250
Well 3	250
TDPUD	
A Well	N/A
Airport	2,600
Glenshire Drive	1,685
Martis Valley No. 1	1,640
Northside	540
Southside No. 2	N/A
Southside No. 1 (non-potable)	258
Sanders	290
Old Greenwood	1,045
Hirschdale	35
Prosser Annex	510
Prosser Heights	430
Prosser Village	860
Well No. 20	600
Fibreboard (non-potable)	1,430
Donner Creek (non-potable)	569
Tahoe Donner GC (non-potable)	N/A

*Well Yield information from TDPUD, 2021) and provided by NCSD, N/A = No pump installed

A number of private wells are distributed across the basin, and a number of residential neighborhoods or tracts have relatively higher concentrations of wells. Martis Camp operates three irrigation wells for their own use and provides Northstar Ski Resort with water from these wells for snowmaking and irrigation purposes as well (Josh Detwiler, NCSD, pers. comm.). At higher elevations in the eastern portion of the basin, the Juniper Hills area (near Well No. 20) includes a number of estates, most of which rely on private wells drilled deep (typically 500-800 feet) into uplifted Lousetown volcanics and/or deeper volcanics. In the center of the MVGB, a high density of relatively shallow (200-300 feet deep) private wells have been drilled and are in use along Prosser Dam Road. Many of these are drilled into shallow Lousetown volcanics, while others are drilled into glacial outwash and the Prosser Formation. In the northwestern portion of the MVGB a number of homes located on Alder Hill have domestic wells drilled primarily into uplifted Lousetown volcanics and range in depth from 300 to 800 feet.

Figure 2-18 is a cumulative frequency plot derived from DWR data and shows the number of public and domestic wells drilled at various depths in the MVGB through 2013. These data show that the vast majority of domestic wells drilled in the area are relatively shallow, with 50 percent of domestic wells being installed at depths of 400 feet below ground surface or less, while the public production wells range widely in depth. About 330 wells (Domestic, Public Water Supply, Irrigation, and Agricultural) have been constructed in the Basin through 2012. Since 2012, an additional 19 domestic, and 2 public supply wells, have been constructed in the Basin.

Figure 2-17. Depth Distribution of Wells in the Martis Valley Groundwater Basin



2.7. Groundwater Quality

Groundwater quality in the MVGB is generally of good quality and is currently monitored as part of the agencies' agreements with the State Water Resources Control Board (SWRCB), Division of Drinking Water (DDW). Each agency releases an annual water quality report for their service areas in the MVGB; the 2022 and 2023 annual reports are included in Appendix E. The USGS carried out groundwater monitoring activities in the MVGB in cooperation with the SWRCB as part of the California Groundwater Ambient Monitoring and Assessment (GAMA) Program (Fram and others, 2007) and sampled 14 wells in the MVGB for a wide range of constituents during summer 2007. The concentrations of most constituents detected in these samples were below drinking-water thresholds, with some exceptions: a) concentrations of arsenic were above the Maximum Contaminant Level (MCL) in four of the 14 wells sampled, and b) manganese concentrations were elevated above the MCL in one well. Arsenic levels above the MCL have also been reported by the TDPUD.

Singleton and others (2013) used dissolved gas and isotopic tracers to estimate the age, flow pathways, and interactions between groundwater and surface water in the MVGB. Isotopic sampling results from June and September revealed that Summer samples more closely matched the signature of meteoric waters while Fall samples matched more regional, mixed-water signals indicating a shift in groundwater source between Summer and Fall in the MVGB. Results were variable but generally indicated that recharge to production wells, springs, and surface water baseflow is sustained by snowmelt of mixed or young age that recharges at lower elevations and through alluvium (rather than fractured bedrock), with minimal contributions from very recent snowmelt. Water pumped from wells tends to increase in age as wells are pumped over the course of a season. In contrast to many of the other production wells in the MVGB, NCSD's deep production well TH-2 (Well "K" in the study) consistently draws very old water, apparently from the predominately deeper aquifer. Finally, the authors pointed to the Polaris Fault as a potential source of very deep water, as indicated by the presence of mantle helium in samples from wells near the fault.

The T-TSA operates a water reclamation plant which includes the discharge of tertiary-treated effluent into glacial outwash and Prosser Formation alluvium downstream of the Town of Truckee on the south side of the Truckee River. Hydrogeologic investigations in the vicinity of the plant indicate that effluent flows laterally toward the Truckee River and Martis Creek, discharging to these water bodies after a minimum 50-day travel time (CH2MHill, 1974). DWR (2003) noted that a water quality monitoring program is in place to evaluate potential changes to ground- and surface-water quality.

Seventy-three leaking underground storage tank (LUST) cleanup sites have been identified by the SWRCB's GeoTracker database in the MVGB. Of these 73 sites, cleanup actions for 71 are documented as "completed", while two are listed as "open" with one of those considered "inactive" and the other in an "assessment & interim remedial action" status. All the sites are located in the Town of Truckee.

2.8. Land Use

Prior to the 1950s, land use in Martis Valley and the Truckee area was primarily ranching and timber related (Shaw and others, 2012). During the 1950s, 60s, and 70s, the rural ranching- and timber-based economy began shifting to more recreational and community development. Today, the primary land uses in the MVGB are residential and ski and/or golf resort related communities with commercial centers in and near downtown Truckee and at the Truckee Airport. Timber and sand and gravel mining operations still continue to operate on a seasonal basis (GEI, 2023, Shaw and others, 2012).

The Truckee population has and will rely on groundwater as its source of supply.

The Town of Truckee, in Nevada County, developed its 2040 General Plan which includes project land use changes (Town of Truckee, 2019). It includes:

- Coldstream Specific Plan – is located between Donner Lake and State Route 89, south of Interstate 80. The plan was adopted by the Town of Truckee in 2014 with mixed-use development.
- Joerger Ranch Specific Plan – is located at the intersection of State Route 267 and Brockway Road and Soaring Way near the Truckee Tahoe Airport. The Specific Plan was adopted in 2015 and amended in 2021.
- Railyard Master Plan – encompasses the eastern end of downtown Truckee. The plan was updated in 2016 and includes mixed residential and commercial land use.
- Hilltop Master Plan – was adopted in 2008 and guides mixed-use residential and commercial land use development.

Projections of population growth for the Town of Truckee from 2020 to 2040 with a projected population of about 18,500 (TDPUD UWMP, 2021). Projected build-out for the Town of Truckee would be reached sometime after year 2100 with a conservative permanent population estimate of about 28,800.

Placer County developed a Housing Element for the period of 2021 to 2029 for its General Plan. The plan showed limited residential growth. Planned/Approved infill projects will continue in the Schaffer's Mill (134 units) and Hopkins Village (40 units) (Placer County, 2021).

2.9. Groundwater Recharge

Several previous studies estimated groundwater recharge within the MVGB using water balance and empirical data, resulting in a range from 18,000 to 34,560 acre-feet per year (ac-ft/yr). Recently, DRI has developed annual groundwater recharge estimates using the physically-based PRMS. Table 2-3 summarizes previous and current studies including the study's author, year, and average annual groundwater recharge estimates.

Table 2-3. Summary of Average Annual Groundwater Recharge Estimates for the MVGB

Author	Year	Recharge (ac-ft/yr)
Hydro-Search	1974, 1980, 1995	18,000
Nimbus Engineers	2001	24,700
Kennedy/Jenks Consultants	2001	none
Interflow Hydrology, Inc. and Cordilleran Hydrology, Inc	2003	34,560
DRI, PRMS estimate	2012	32,745
DRI, modified Maxey-Eakin method	2012	35,168

DRI outlines its scientific and technical methods, including the climate data used, the PRMS method, and total recharge estimates in a Technical Note, which is included in Appendix F. PRMS simulates land surface hydrologic processes of evapotranspiration, runoff, infiltration, and interflow by balancing energy and mass budgets of the plant canopy, snowpack, and soil zone on the basis of distributed climate information. The PRMS computed recharge consists of the sum of shallow infiltrated water that discharges into the Truckee River and its tributaries as well as deep percolation of ground water to deeper aquifers with water supply wells (Rajagopal and others, 2012). DRI's study "…also applied a modified Maxey-Eakin (1949) method to estimate recharge which relates mean annual precipitation to recharge using recharge coefficients applied to precipitation amounts."

The PRMS is modeled for the years 1983 to 2011 with annual recharge estimates ranging from 12,143 ac-ft/yr (dry year) to 56,792 ac-ft/yr (wet year), with an average annual recharge estimate of 32,745 ac-ft/yr. Because annual precipitation drives recharge, the PRMS simulated recharge varies from year to year. DRI included in its Technical Note annual recharge efficiency, or the ratio of annual recharge to annual precipitation. For the MVGB, the calculated annual recharge efficiency is 18 to 26 percent.

Groundwater recharge to the MVGB occurs throughout most of the valley to some extent. Figure 2-19 shows the average annual groundwater recharge as simulated by the PRMS model, for a period of record from 1983 to 2011. Figure 2-20 shows the annual recharge for the year 1988, a dry year. Figure 2-21 shows the annual recharge for the year 1995, a wet year. The figures indirectly show where the most permeable soils occur by the amount of recharge. The figures show consistently that there is very little recharge in the eastern portion of the MVGB (orange color). The most permeable areas (green color) appear to be near Shaffer's Mill, north of Interstate 80 near the western edge of the MVGB and south of Truckee along State Route 267 corridor.

The models were also used to predict the effects of precipitation and the availability of surface water and groundwater supplies. Four simulations were run (Warmer-Drier, Hotter-Drier, Hotter-Wetter, Warmer-Wetter) were run and compared to Reference conditions. The Central Tendency is the average of these four simulations. Average annual groundwater recharge would change with changes in precipitation, however a direct comparison between Historical and Reference supply conditions cannot be made because a record of historical recharge data does not exist for the Truckee Basin. Recharge decreases in the Martis Valley under drier climates (up to 23 %) and increases under wetter climates (up to 9 %) would occur compared to the Reference supply condition. Hotter climates would also affect groundwater recharge, although to a lesser extent than precipitation changes. The Hotter-Drier climate would decrease Martis Valley groundwater recharge an additional 10 percent beyond the Warmer-Drier climate due to decreases in the extent of snowpack and a faster snowmelt season. The Central Tendency predicts about a 5 percent reduction in the average annual recharge in the Martis Valley, or about 800 acre-feet, with the Hotter-Drier conditions reducing recharge by about 2,000 acre-feet per year.

A more detailed study was developed for just the Martis Valley (Rajagopal, et al, 2015). Despite differences in the reported absolute values for recharge between the two studies, the trends identified in the Truckee Basin Study are considered valid and appropriate for describing the sensitivities of recharge to changes in climate. This additional detailed study predicted a decline in groundwater recharge likely due to the shift from snow melt to precipitation which increases runoff and decreases recharge. One of the most significant findings from this study is the potential reduction of groundwater recharge and discharge to streams, not including the capture of groundwater discharge to streams due to pumping. Even with lower precipitation recorded within the last 20 years, groundwater levels are remaining stable.

In addition to natural recharge, treated water from the T-TSA is recharged into the MVGB groundwater system through subsurface leach fields located on the south side of the Truckee River. Hydrogeologic investigations in the vicinity of the plant indicate that effluent flows laterally toward the Truckee River and Martis Creek, discharging to these water bodies after a minimum 50-day travel time. Wastewater treated by T-TSA is from the Truckee Sanitary District and North Lake Tahoe area. About 30 percent of the potable water served by TDPUD and NCSD is treated and recharged into MVGB (GEI, 2024).

Figure 2-18. Average Annual Groundwater Recharge 1983-2011

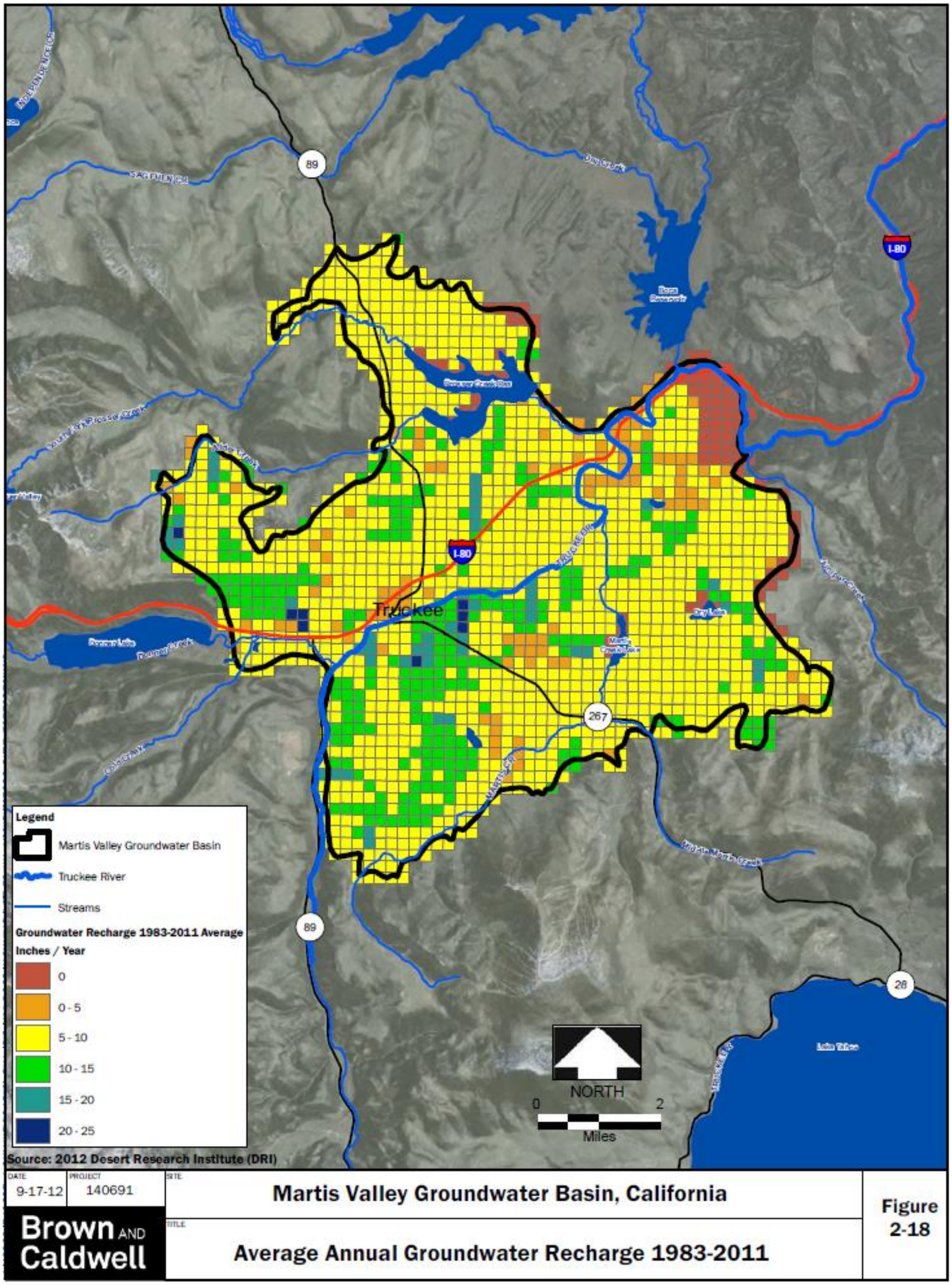


Figure 2-19. Annual Groundwater Recharge 1988

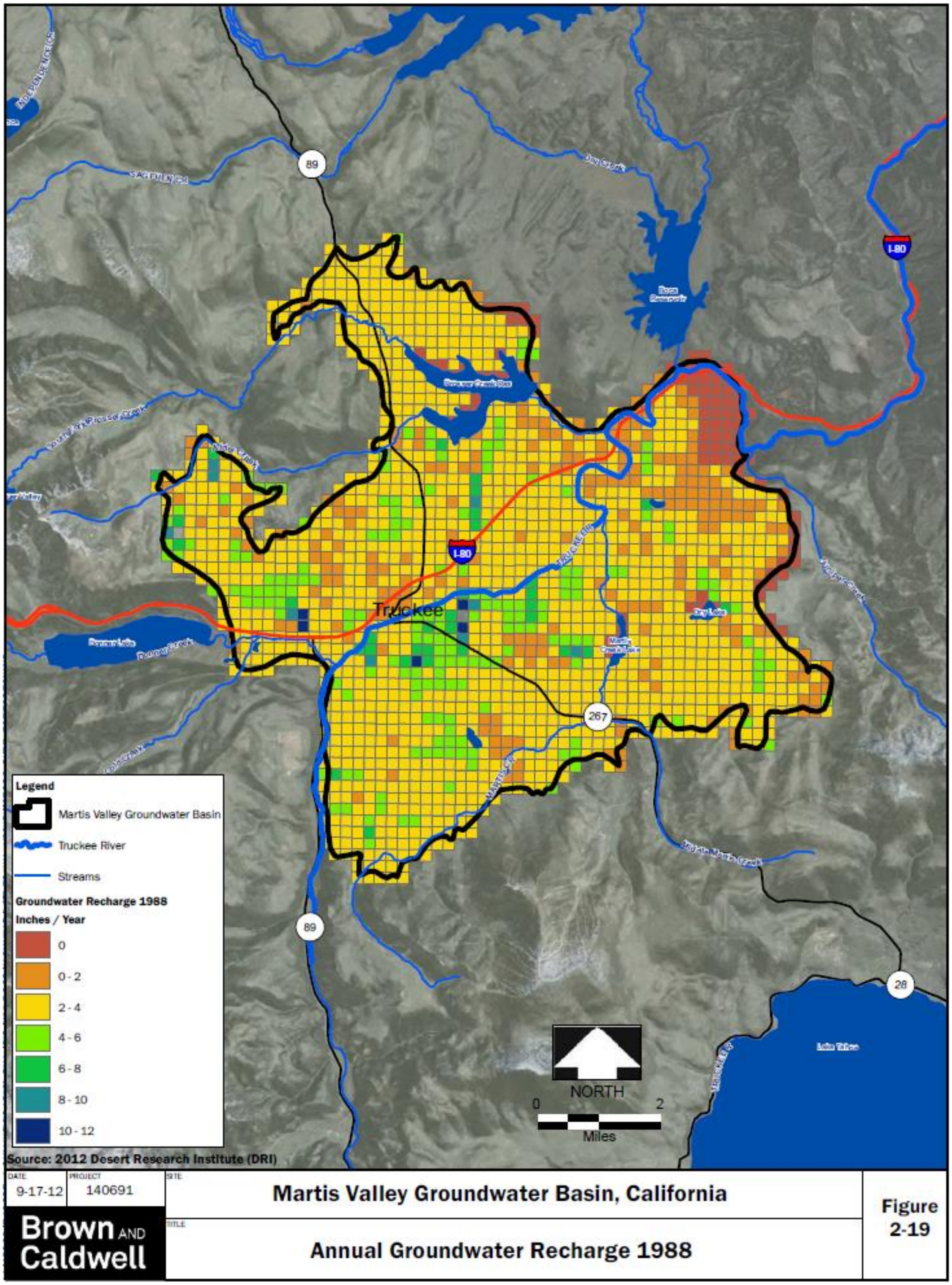
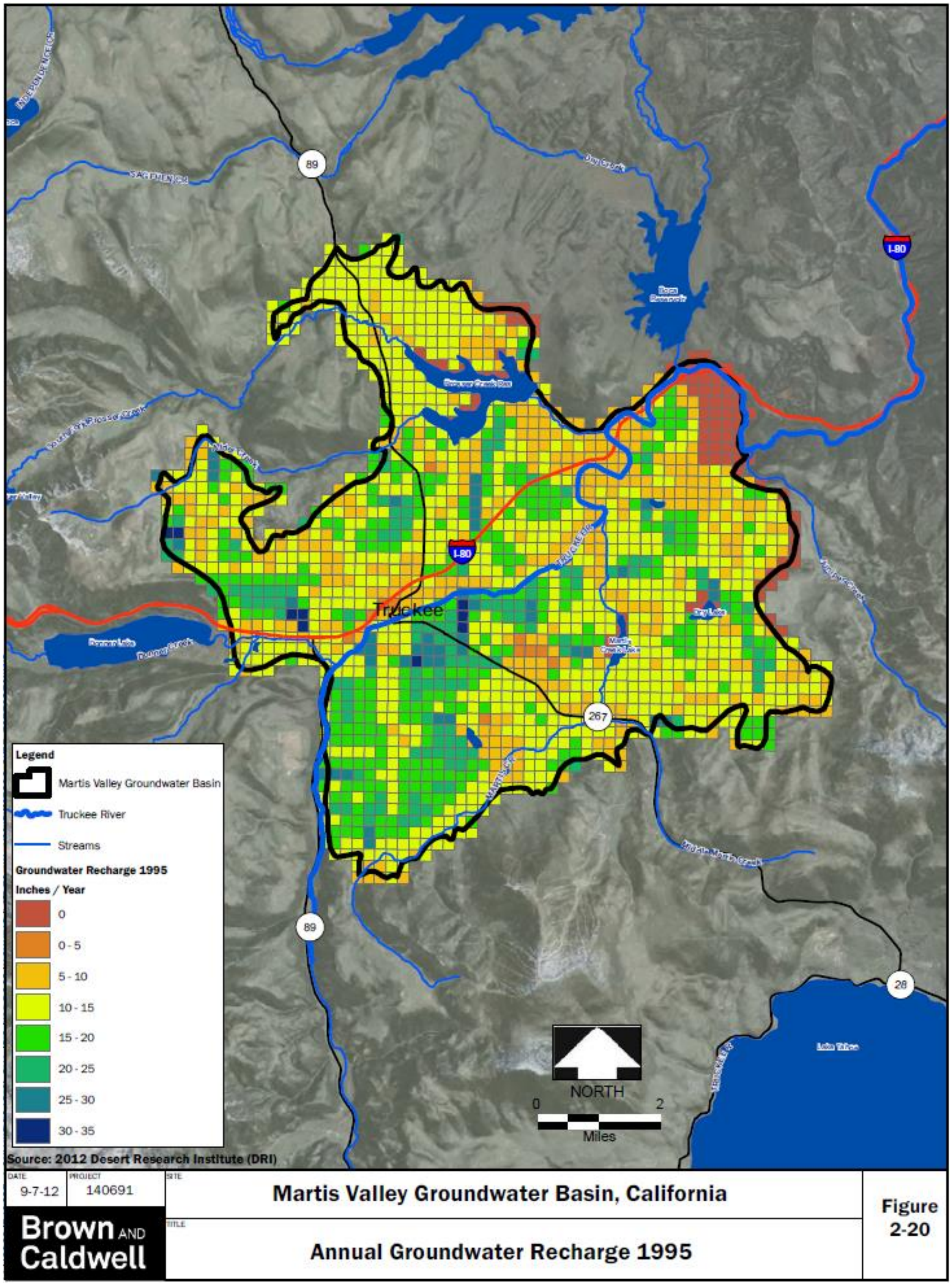


Figure 2-20. Annual Groundwater Recharge 1995



2.10. Water Use

Groundwater use in the MVGB is primarily for municipal, domestic, and recreational uses. The TDPUD summarized their water supply and demand as part of 2020 Urban Water Management Plan. Average potable day demand served by the TDPUD in 2020 was reported to be 4.53 million gallons per day (mgd); 5,073 ac-ft/yr).

NCSD meets demand primarily from its Big Springs collection system, outside of the MVGB, and uses water pumped from wells TH-1 and TH-2 in the MVGB to augment this supply. Demand on the MVGB imposed by NCSD varies by year due to climatic conditions and during the 2012 through 2016 drought, the average volumes pumped by NCSD ranged from 0.11 to 0.19 mgd or 193 to 340 ac-ft/yr. In wet year 2023, the wells produced 154 ac-ft. From 2009 to 2023, production from Wells 1 through 3 (formerly PCWA owned wells and now reported by NCSD as Martis Valley wells) have increased from an average daily demand of 0.13 to 1.13 mgd (141-412 ac-ft/yr) due to development of the Schaffer's Mill and Hopkins Village developments which began construction in 2005.

Nine golf courses depend on the MVGB for irrigation supply; five are supplied by TDPUD (one uses a potable supply counted in the TDPUD production totals, as well as non-potable supply and the other three are non-potable), one is supplied by NCSD (potable), and three are supplied privately and assumed to be all non-potable. Using the partner agencies records of non-potable water pumped and supplied to the majority of the courses, the average non-potable demands range from 0.02 to 0.28 mgd (21-314 ac-ft/yr), with an average of 0.19 mgd (208 ac-ft/yr). This average demand rate of 0.19 mgd is applied to the four privately-supplied courses for an estimated production of 1,876 ac-ft/yr.

Based on the available data and summarized in Table 2-4, current annual average production from the MVGB is estimated to be approximately 7,455 ac-ft/yr. TDPUD UWMP estimates that the total withdrawals at buildout conditions including other water users in the Basin, is estimated to be 13,300 ac-ft/yr but this will not likely occur until after year 2100 (TDPUD UWMP, 2021). The sustainable yield of the Basin was estimated to be about 24,000 AF (GEI, 2016). As discussed in Section 2.9 recharge to the Basin might decrease about 800 acre-feet with the Central Tendency projections and up to 2,000 ac-ft/yr with the Hotter-Drier conditions. This could reduce the sustainable yield to 20,000 to 21,200 ac-ft/yr. At build-out the Basin would still be within its estimated sustainable yield.

Table 2-4. Five-year Average Groundwater Production

	mgd	ac-ft/yr
TDPUD		
Potable - Average (WY2019-2023)	3.79	4,950
Golf Course (non-potable) – Average (WY2019-2023)	0.02	26
NCSD		
Potable - Average (WY2019-2023)	0.48	628
Privately Supplied Golf Courses		
Total estimated non-potable production	1.43	1,876
Estimated Total Demand	**5.719**	**7,455**

3. Plan Implementation

The partner agencies are already performing many of the groundwater management activities associated with an AB 3030 GMP. Through GMP implementation, the partner agencies formalize their groundwater management goal, BMOs, and implementation actions that elaborate on both current actions and planned future actions under the GMP. As discussed in Section 1.6 and shown on Tables 1-2, 1-3, and 1-4, a number of required, voluntary, and suggested components constitute a GMP.

This chapter discusses implementation actions that are grouped under each BMO. The BMOs are fully described in Section 1.5, and are listed below:

1. Manage groundwater to maintain established and planned uses.
2. Manage groundwater use within the provisions of the Truckee River Operating Agreement.
3. Collaborate and cooperate with groundwater users and stakeholders in the Martis Groundwater Basin.
4. Protect groundwater quantity and quality.
5. Pursue and use the best available science and technology to inform the decision-making process.
6. Consider the environment and participate in the stewardship of groundwater resources.

3.1. Implementation Actions that Support BMO #1 - Manage Groundwater to Maintain Established and Planned Uses

The MVGB is the primary source of water to multiple users under separate jurisdictions. BMO #1 encourages the partner agencies to pursue management of groundwater that is within their jurisdiction in order to protect existing uses.

Implementation actions identified as falling under BMO #1 facilitate the management of groundwater in the MVGB. These implementation actions are focused on regular communication and consideration of future programs intended to protect the groundwater resource from degradation and depletion.

3.1.1. Develop and implement a summary report every five years

This action is intended to concentrate and document GMP activity, data, and management decisions into periodic reports for use by partner agencies, Stakeholders, and local planning agencies for continual groundwater management decisions and maintenance.

This implementation action provides a report every five years that summarizes groundwater conditions and management activities and presents an opportunity to update and improve the GMP as needed. The 5-year summary report will also replace the annual report for the final year of the summary period. The summary report will include:

- A summary of monitoring results with a discussion of historical trends.

- A summary of management actions during the period covered by the report.
- A discussion of whether actions are achieving progress towards meeting BMOs.
- A summary of proposed management actions for the future.
- A summary of any GMP changes that occurred during the period covered by the report.
- A summary of actions taken to coordinate with other water and land agencies and other government agencies.
- Recommendation of updates and changes to the GMP.

3.1.2. Compile an annual summary of groundwater monitoring data

This action will compile, organize and evaluate groundwater level elevation and groundwater quality monitoring data collected during the previous year. The annual summary of monitoring data will include groundwater level monitoring information from the partner agencies water level monitoring efforts, and water quality data collected by the partner agencies from production wells. The annual summary of groundwater monitoring data will be used by the agencies at the annual GMP implementation meeting described in Section 3.1.3 to evaluate the need to implement other portions of the GMP that are contingent on monitoring data. The annual summary of groundwater monitoring data for the fifth year of the summary period will be included in the 5-year summary report and will replace the annual report for that year.

3.1.3. Partner agencies to meet annually to discuss GMP implementation

This action will require the partnership agencies to meet at least once annually to discuss GMP implementation. Currently, the partner agencies meet in the Truckee area annually and GMP implementation will be added as an agenda item during this annual meeting.

3.1.4. Support TROA provisions associated with well construction, repair, modification, and destruction

The Settlement Act may eventually establish additional requirements for the siting and construction of wells drilled in the Truckee River Basin, which includes the MVGB. Section 6.E of TROA outlines Truckee River basin allocation procedures including well construction, repair, modification and destruction to address groundwater-surface water interactions within the Truckee River Basin including areas of Martis Valley. Section 204(c)(1)(B) of the Settlement Act provides that, "...all new wells drilled after the date of enactment of this title shall be designed to minimize any short-term reductions of surface streamflows to the maximum extent feasible." This implementation action supports the implementation of TROA's well construction guidelines. Coordinate with Placer and Nevada counties Environmental Health Department to be notified of permit applications in MVGB.

3.1.5. Evaluate and consider taking a position on relevant water resources-related policies, programs, and projects under consideration by local, State, and Federal agencies

Throughout the state, surface water and groundwater resource management are becoming critical components of meeting growing water supply demands. As part of this implementation action, the partner agencies will actively evaluate and consider policies, programs and projects that may impact water resources quality and/or quantity within the Martis Valley.

3.1.6. Pursue opportunities for improved groundwater basin monitoring and reporting with local, State, and Federal agencies

This implementation action prompts the partner agencies to continuously pursue opportunities and funding that may provide additional groundwater data collection and/or reporting. Groundwater monitoring is a critical component in understanding the physical condition of the groundwater basin and is further described in Section 3.3.1.

3.1.7. Evaluate the need for programs to facilitate saline intrusion control, mitigate the migration of contaminated groundwater, facilitate conjunctive use, and to mitigate overdraft

This implementation action includes evaluation of a variety of potential programs to manage groundwater within the jurisdiction of the partner agencies. As part of this action, the agencies will evaluate the need for saline intrusion controls, mitigation of the migration of contaminated groundwater, conjunctive use programs, and overdraft mitigation.

Currently, the groundwater supply in Martis Valley is not threatened by saline intrusion, contaminant plumes, or in a state of overdraft that would warrant immediate steps for mitigation. Saline intrusion is a primary concern along coastal areas with intruding sea water, which is high in Total Dissolved Solids (TDS) that may threaten fresh groundwater supplies. Saline conditions may also occur in interior basins due to industrial, agricultural or wastewater disposal activities. In the Martis Valley, groundwater monitoring (discussed under Section 3.4), will assist in identifying saline issues. Should future monitoring indicate that saline intrusion is a potential problem in the MVGB, the partner agencies will evaluate development of a saline intrusion control program.

Groundwater contamination in the MVGB falls under the jurisdiction of the Lahontan Regional Water Quality Control Board (LRWQCB). Should monitoring indicate a large scale groundwater contamination issue, the partner agencies will share knowledge of the issue and collaborate with the LRWQCB. If monitoring indicates that contaminated groundwater is migrating, the partner agencies will further collaborate with the LRWQCB to mitigate the migration, if possible, without interrupting water supply deliveries.

Conjunctive use is the management of surface water and groundwater to optimize the yield of the overall water resource. One method would be to rely primarily on surface water in wet years and groundwater in dry years. Other methods employ artificial recharge, where surface water is intentionally stored into aquifers for later use. NCSD currently manages both its spring water and groundwater supply and TDPUD currently relies solely on groundwater but maintains water rights to several springs. The partner agencies will evaluate opportunities to increase the use of conjunctive management as they arise within the MVGB.

Groundwater overdraft occurs when pumping exceeds recharge to a groundwater basin. If monitoring indicates through declining groundwater levels that groundwater overdraft is occurring, the partner agencies will consider development of programs to mitigate the groundwater overdraft.

3.1.8. Consider development of contamination cleanup, recharge, storage, conservation and water recycling projects

This implementation action includes evaluation of a variety of potential programs to manage groundwater within the jurisdiction of the partner agencies. As part of this action, the partner agencies will consider development of projects that cleanup contamination, increase groundwater recharge and storage, or increase conservation and water recycling.

The LRWQCB is responsible for developing and enforcing water quality objectives and plans that best protect the State's waters within its hydrologic area. Should monitoring indicate that contaminated groundwater is a threat to groundwater supplies, the partner agencies will consider collaborating with the LRWQCB.

During GMP implementation, opportunities may arise for the partner agencies to engage in activities related to groundwater recharge, storage, conservation and recycling. As those opportunities arise, the agencies will consider participating in projects to improve groundwater recharge, storage, conservation and recycling efforts.

3.1.9. Pursue funding sources for implementation of plan policies, programs, reporting and projects

This implementation action directs the partner agencies to pursue funds from Federal, State and other sources as they become available and are beneficial to pursue. Funding sources may include Local Groundwater Assistance (LGA) grants and Integrated Regional Water Management Planning (IRWMP) grants from DWR, grants from the California State Water Resources Control Board, various funds available through collaboration with the U.S. Bureau of the Interior, Truckee River Watershed Council, and other agencies.

3.1.10. Participate in the evaluation of relevant local projects to maintain groundwater quantity and quality

Local groups and local, State or Federal agencies may develop opportunities that seek support or assistance for projects that affect groundwater quantity and/or quality in the Martis Valley. This action directs the partner agencies to participate in relevant local projects as appropriate and reasonable.

3.1.11. Summary of BMO #1 Actions

Table 3-1 presents a summary of implementation actions to be undertaken by the partner agencies that support BMO #1 including the anticipated schedule of implementation.

Table 3-1. Summary BMO#1 Supporting Implementation Actions

	Description of Action	Implementation Schedule
1-1	Develop and implement a summary report every ten years that includes: A summary of monitoring results, with a discussion of historical trends A summary of management actions during the period covered by the report A discussion of whether actions are achieving progress towards meeting BMOs A summary of proposed management actions for the future A summary of any GMP changes that occurred during the period covered by the report A summary of actions taken to coordinate with other water and land agencies and other government agencies Review of the GMP and consider updates to the GMP	Once every ten years
1-2	Compile an annual summary of groundwater monitoring data	Annually
1-3	Partner agencies to meet annually to discuss GMP implementation	Annually
1-4	Support TROA provisions associated with well construction, repair, modification, and destruction	As Needed
1-5	Evaluate and consider taking a position on relevant water resource-related policies, programs, and projects under consideration by local, State and Federal agencies	As Needed
1-6	Pursue opportunities for improved groundwater basin monitoring and reporting with local, State, and Federal agencies	As Needed
1-7	Evaluate the need for programs to facilitate saline intrusion control, mitigate the migration of contaminated groundwater, facilitate conjunctive use, and to mitigate overdraft	As Needed
1-8	Consider development of contamination cleanup, recharge, storage, conservation and water recycling projects	As Needed
1-9	Pursue funding sources for implementation of plan policies, programs, reporting and projects	Ongoing
1-10	Participate in the evaluation of relevant local projects to maintain groundwater quantity and quality	As Needed

3.2. Implementation Actions that Support BMO #2 – Manage Groundwater within the Provisions of TROA

The Settlement Act, Public Law 101-618 (1990), established entitlements to the waters of Lake Tahoe, the Truckee River and its tributaries, and how the storage reservoirs of the Truckee River are operated. Section 205 of the Settlement Act directs the Secretary of the Department of the Interior to negotiate an operating agreement for the operation of Truckee River reservoirs, between DWR, Nevada, Truckee Meadows Water Authority (formerly Sierra Pacific Power Company and Nevada Energy), Pyramid Tribe, and the United States Bureau of Reclamation. The operating agreement is known as TROA.

Section 204(c)(1) of the Settlement Act outlines the allocation of 32,000 acre-feet of water (both surface and groundwater) to the State of California from within the Truckee River Basin. The Settlement Act may eventually establish additional requirements for the siting and construction of wells drilled in the Truckee River Basin, which includes the MVGB. Section 6.E of TROA outlines Truckee River Basin allocation procedures including surface water diversions and water accounting procedures. Article 10 of TROA identifies well construction, repair, modification and destruction to address groundwater-surface water interactions within the Truckee River Basin including areas of Martis Valley. Section 204(c)(1)(B) of the Settlement Act provides that, "...all new wells drilled after the date of enactment of this title shall be designed to minimize any short-term reductions of surface streamflows to the maximum extent feasible." Article 10 of TROA requires that new water supply wells be designed to minimize impacts to surface water and outlines siting and design processes. Wells drilled or under construction before May 1, 1996 are presumed to comply with the Settlement Act.

This BMO documents the partner agencies' commitment to continue to comply with provisions of TROA. There are provisions in TROA that apply to groundwater and water wells within the Truckee River Basin (which includes the Martis Valley) to address potential adverse impacts to surface water.

3.2.1. Continue coordination and collaboration with TROA agencies on groundwater management issues and source well development

This implementation action directs the partner agencies to coordinate and collaborate with TROA agencies as necessary to be compliant with the Settlement Act. To meet this implementation action, the agencies will continue regular contact with TROA agencies as appropriate.

3.2.2. Summary of BMO #2 Actions

Table 3-2 presents a summary of implementation actions to be undertaken by the partner agencies that support BMO #2 including the anticipated schedule of implementation.

Table 3-2. Summary BMO#2 Supporting Implementation Actions

	Description of Action	Implementation Schedule
2-1	Continue coordination and collaboration with TROA agencies on groundwater management issues and source well development	Ongoing

3.3. Implementation Actions that Support BMO #3 - Collaborate and Cooperate with Groundwater Users and Stakeholders in the Martis Valley Groundwater Basin

With one common groundwater supply it makes sense to share information and resources toward similar goals. This objective encourages the partner agencies to reach out to other agencies and groundwater users within the MVGB.

3.3.1. Formalize and institute a Stakeholder Working Group to meet at least annually or as needed on GMP implementation activities and updates

The SWG has been a key component of the GMP development process and will be continued into the implementation phase. This implementation action directs the partner agencies to continue using working groups during implementation of the GMP. The SWG will continue to work cooperatively with the partner agencies and will meet at least once a year to discuss GMP implementation.

3.3.2. Collaborate with the LRWQCB to limit the migration of contaminated groundwater and in development of large scale contamination clean up programs

This implementation action directs the partner agencies to communicate, collaborate, and coordinate with the LRWQCB on groundwater contamination issues. There are no currently identified large scale groundwater contamination issues in the Martis Valley at this time. Communication with the LRWQCB allows for collaboration in the event of the identification of groundwater contamination and collaboration with the LRWQCB on the prevention of contaminant migration.

3.3.3. Work cooperatively with local stakeholders and local, State and Federal agencies on groundwater management activities, projects, and studies

Strong relationships with Federal, State, and local agencies and stakeholders are critical in developing and implementing many of the GMP's implementation actions. The partner agencies are already working cooperatively with local stakeholders and agencies on groundwater management, as evidenced by the use of the SWG during GMP development. This implementation action directs the partner agencies to communicate and work cooperatively with local groundwater interests, and includes outreach activities aimed to educate agencies and stakeholders on groundwater management opportunities and activities in the MVGB.

3.3.4. Identify opportunities for public involvement during GMP implementation

Informing the public of GMP implementation activities increases local understanding and support of GMP activities. This implementation action encourages the partner agencies to inform and invite the public to participate in GMP implementation activities. Public information and involvement may take place in the form of a specific webpage designed to communicate GMP implementation actions, public meetings, and at agency board meetings, as well as other activities.

3.3.5. Summary of BMO #3 Actions

Table 3-3 presents a summary of implementation actions to be undertaken by the partner agencies that support BMO #3 including the anticipated schedule of implementation.

Table 3-3. Summary BMO#3 Supporting Implementation Actions

	Description of Action	Implementation Schedule
3-1	Formalize and institute a Stakeholder Working Group to meet at least annually or as needed on GMP implementation activities and updates.	Annually
3-2	Collaborate with the LRWQCB to limit the migration of contaminated groundwater and in development of large scale contamination clean up programs	As Needed
3-3	Work cooperatively with local stakeholders and local, State and Federal agencies on groundwater management activities, projects and studies	Ongoing
3-4	Identify opportunities for public involvement during plan implementation	Ongoing

3.4. Implementation Actions that Support BMO #4 – Protect Groundwater Quantity and Quality

Groundwater performs an integral function in a watershed, one of which is satisfying water supply needs. Improving the understanding of the regional supplies is a critical step in protecting and sustaining the Martis Valley groundwater supply.

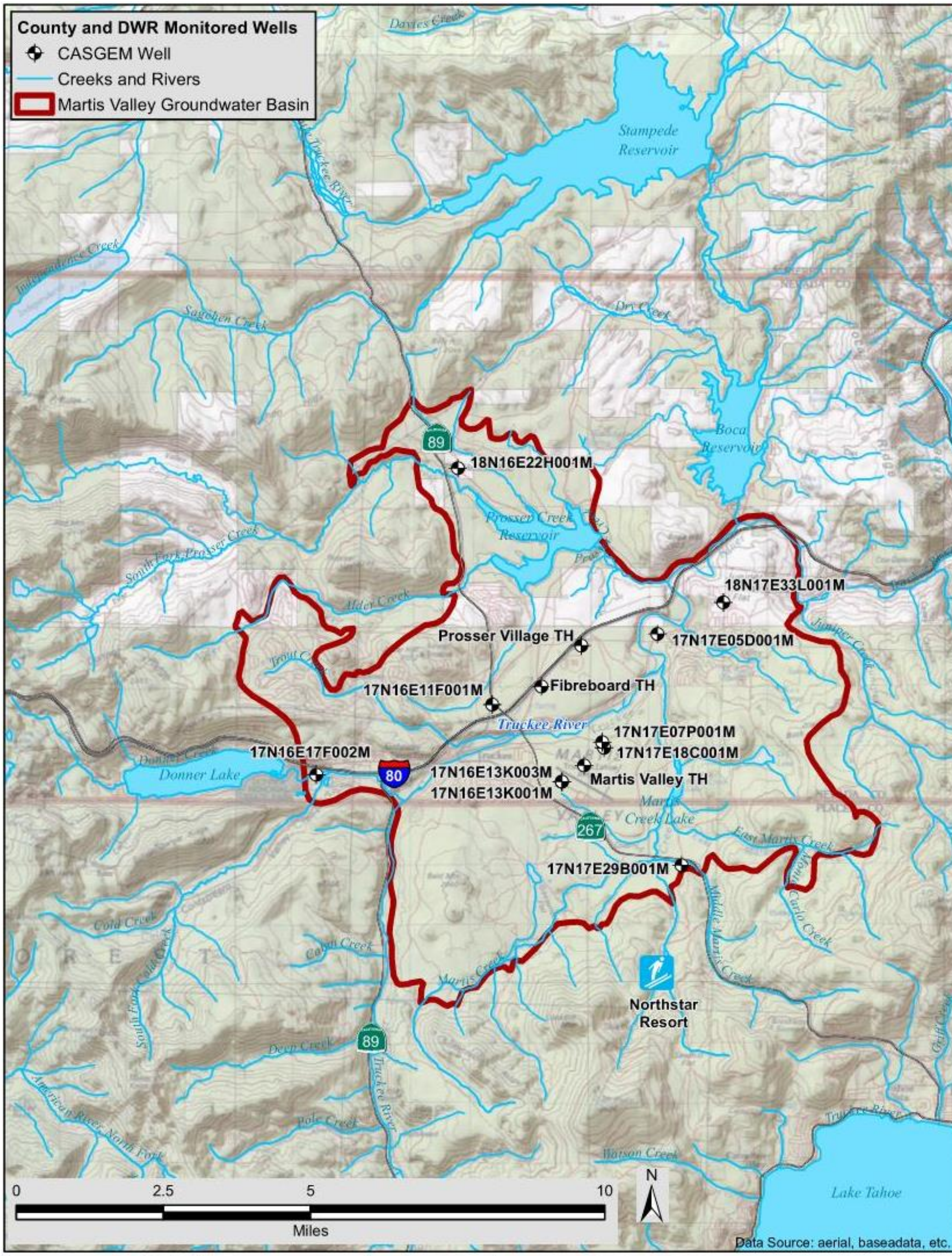
The collection, evaluation and analysis of groundwater monitoring data including water quality and water levels on a regular basis is the cornerstone in understanding the MVGB's groundwater resources and provides critical information for management decisions. Groundwater level monitoring can identify areas of overdraft, enabling appropriate management decisions and responses. Groundwater quality monitoring can help identify areas of degrading water quality, potentially identifying specific water quality issues. Ongoing groundwater monitoring provides information needed to document current conditions, assess long-term trends, and to support development and implementation of GMP components.

Groundwater data is collected by both DWR and the partner agencies on a regular basis; and by the USGS on a less regular basis. Accumulating, processing, evaluating, summarizing and reporting the available data for discussion and distribution will be required to make informed decisions regarding continued groundwater supply and demand. Additionally, surface water data is collected by local, State, and Federal agencies and is evaluated by the appropriate agency for their own purpose. These data are critical and can be used in conjunction with the accumulated groundwater data to help improve the understanding of surface water-groundwater relationships.

3.4.1. Establish and maintain a California Statewide Groundwater Elevation Monitoring compliant monitoring program

This implementation action directs the partner agencies to continue their California Statewide Groundwater Elevation Monitoring (CASGEM) compliant monitoring program (included as Appendix D). Figure 3-1 shows the locations of CASGEM monitoring wells in the MVGB. CASGEM monitoring results will be used in the annual groundwater monitoring summary prepared under implementation action 1-2.

Figure 3-1. CASGEM and DWR Groundwater Monitoring Wells



Martis Valley Groundwater Management Plan 5-Year Update Nevada and Placer Counties, California	GEI Consultants	Martis Valley Groundwater Basin CASGEM and DWR Groundwater Monitoring Wells
Truckee-Donner Public Utility District		NOVEMBER 2024 FIGURE 3-1

3.4.2. Continue and Encourage Water Conservation Activities and Public Education

The partner agencies currently implement significant water conservation and public outreach programs per State requirements. All three agencies hold public board meetings and maintain informative websites for public outreach purposes at the following web addresses:

- www.tdpud.org
- www.pcwa.net
- www.northstarcsd.org

This implementation action encourages the partner agencies to continue to implement conservation activities and continue public outreach activities as opportunities become available.

3.4.3. Work with local stakeholders and DWR to identify areas that may need additional groundwater level and groundwater quality monitoring based on identified data gaps or negative performance trends

Currently, groundwater is monitored by the partner agencies under CASGEM, and by DWR, who monitors a number of wells in the MVGB. DWR monitoring wells are shown in Figure 3-1. This implementation action requires the partner agencies to work with local stakeholders and DWR to identify areas in need of additional monitoring. The SWG includes representatives from DWR and California Department of Fish and Wildlife. Through the SWG, the partner agencies will be working with local stakeholders and DWR and will discuss identification of additional monitoring areas at the SWG annual meetings.

3.4.4. Coordinate with other agencies, including DWR and the USGS to identify opportunities for land subsidence monitoring

Inelastic land subsidence is caused by dewatering of aquifers and the compressing of clays. As water is removed from the aquifer, it is transported through interconnected pore spaces between grains of sand and gravel. If an aquifer has intervals of clay or silt within it, the lowered water pressure in the sand and gravel results in the slow drainage of water from the clay and silt beds. The decreased water pressure reduces the support for the clay and silt beds. Because these beds are compressible, they compact (become thinner) and the effects are seen as a lowering of the land surface. The lowering of the land surface elevation from this process is often permanent (inelastic). Recharge of the aquifer will not result in an appreciable recovery of the land-surface elevation.

The partner agencies have not developed a network of extensometers to measure inelastic land subsidence. Groundwater level monitoring indicates that groundwater levels have not been significantly lowered, a condition required for land subsidence due to groundwater extraction to occur. Additionally, the geology (Section 2.4) in the MVGB does not consist of large layers of clay to be compressed and is unlikely to experience inelastic land subsidence even if groundwater levels begin to decline. Based on a review of groundwater elevation trends over time, it can reasonably be assumed that significant land subsidence has not occurred on a regional scale due to groundwater extraction within the MVGB.

Under this implementation action, the partner agencies will coordinate with DWR and the USGS to identify opportunities for collaboration to detect land subsidence. Because inelastic land subsidence is tied to groundwater levels, the primary means for early detection include:

- Monitor and analyze groundwater levels, watching for significant declines
- Inspect wells for anecdotal evidence of subsidence during groundwater level monitoring

Monitoring groundwater levels with concurrent inspections for anecdotal evidence of subsidence is the least expensive, and least reliable, method to monitor for land subsidence. Declines in groundwater levels can be a precursor to land subsidence. Staff performing water level monitoring can inspect the monitoring well for indicators of subsidence. Anecdotal subsidence indicators include cracks in the well pad, elevation of the well casing in comparison to the ground surface, and cracks in the ground surface.

3.4.5. Evaluate the need for, and advocate for, as necessary, a wellhead protection, groundwater recharge area protection, and other programs as necessary in MVGB

Wellhead protection is a component of the Drinking Water Source Assessment and Protection (DWSAP) program administered by the DDW. The purpose of the DWSAP program is to protect groundwater sources of public drinking water supplies from contamination, thereby eliminating the need for costly treatment to meet drinking water standards. There are three major components to the DWSAP program, including: Delineation of capture zones around source wells, inventory of potential contaminating activities within protection areas, and analysis of vulnerabilities.

The partner agencies are in compliance with the DWSAP program, will work to comply with the DWSAP program into the future, and will consider supporting programs that will protect groundwater quality in the MVGB.

3.4.6. Map and share groundwater recharge zones

This GMP identifies preliminary areas of groundwater recharge in the MVGB in Section 2.9. This implementation action encourages the partner agencies to share the recharge zone maps in this GMP with local land use agencies to consider in land use decisions.

3.4.7. Provide relevant information to land use agencies regarding groundwater availability

Through GMP implementation activities, such as CASGEM monitoring, groundwater monitoring summary reports and annual meetings of the SWG, the partner agencies will develop water resources information about the MVGB. As development increases in the MVGB, local land use agencies will be faced with decisions regarding zoning and permitting. In Placer County, the Community Development Resource Agency leads development of the County's general plan and land development activities. The

Nevada County Community Development Agency is responsible for the Nevada County General Plan and zoning, and the Town of Truckee has developed its own general plan and zoning. This implementation action directs the partner agencies to communicate relevant groundwater information to the appropriate planning agencies to assist them in making informed land use decisions.

3.4.8. Summary of BMO #4 Actions

Table 3-4 presents a summary of implementation actions to be undertaken by the partner agencies that support BMO #3 including the anticipated schedule of implementation.

Table 3-4. Summary BMO#4 Supporting Implementation Actions

	Description of Action	Implementation Schedule
4-1	Establish and maintain a CASGEM compliant monitoring program	Ongoing
4-2	Continue and encourage water conservation activities and public education	Ongoing
4-3	Work with local stakeholders and DWR to identify areas that may need additional groundwater level and groundwater quality monitoring based on identified data gaps or negative performance trends	Annually
4-4	Coordinate with other agencies, including DWR, USGS and the Federal Aviation Administration to identify opportunities for land subsidence monitoring	As Needed
4-5	Evaluate the need for, and advocate for, as necessary, a wellhead protection, groundwater recharge area protection, and other programs as necessary in MVGB	As Needed
4-6	Map and share groundwater recharge zones	Ongoing
4-6	Provide relevant information to land use agencies regarding groundwater availability	As Needed

3.5. BMO #5 - Pursue and use the best available science and technology to inform the decision making process.

Science and technology continue to develop new tools that may improve our understanding of the MVGB. This objective encourages the partner agencies to take actions that work with the best available science to help make informed agency decisions.

The partner agencies have worked to develop the best groundwater science available by collaborating with the Bureau of Reclamation (Reclamation) and DRI to develop an integrated watershed-groundwater model in conjunction with the Martis Valley GMP. The geologic investigation conducted and documented in Section 2 of this report has been used to shape a bi-modal geologic framework which was used to develop the conceptual model for the hydrogeology of the subsurface components of the integrated watershed model. The integrated model was developed in parallel with the GMP and has been incorporated into this GMP update.

The integrated watershed model is comprised of a PRMS and MODFLOW coupled together using an UZF package. The PRMS is used to model surface water within the watershed, the MODFLOW is used to model groundwater within the MVGB, and UZF is a kinematic wave vadose zone model used to model the interaction between surface water and groundwater. Each model will be calibrated separately, and then calibrated together over a ten-year period using a coupled GSFLOW. Calibrations will be conducted using multiple GCM projections of precipitation and temperature to investigate the influence of future climate on water resources. Calibration targets for GSFLOW will include head values measured from wells, meadow and spring locations, streamflows, measured snow depth, and remotely sensed snow cover.

The integrated model's model domain covers the entire MVGB, and the watersheds that contribute surface water to the region up to Lake Tahoe. The model grid's cells are 300 by 300 meters in size.

The partner agencies have obtained a copy of the groundwater model component for future use.

3.5.1. Work with State and Federal agencies to attempt to secure funding for expansion of the partner agencies' monitoring grid

Increasing the number of monitoring points and frequency of monitoring provides for better long-term understanding of groundwater trends in the MVGB. Monitoring locations can be added by drilling new, dedicated monitoring wells, and by reaching agreements with well owners that have wells suitable for monitoring activities. Suitable wells will have a driller's log that describes well construction and sediments encountered, a short screened interval, a sanitary seal to prevent surface water from entering the well, and cannot be municipal supply wells.

This implementation action directs the partner agencies to collaborate with State agencies such as DWR, SWRCB, DDW, and others, as well as Federal agencies such as Reclamation, to acquire funding for improvements to the groundwater monitoring grid in the MVGB.

3.5.2. Maintain relationship with DWR for groundwater monitoring and database management activities

The partner agencies are a designated monitoring entity under DWR's CASGEM program. DWR staff have been an integral part of the SWG during GMP development and their contribution in the SWG is anticipated during GMP implementation.

This implementation action directs the partner agencies to continue to maintain a collaborative relationship with DWR for monitoring and database management activities in the MVGB. A continued relationship with DWR benefits the GMP by continuing the monitoring of long-term monitoring wells (especially those with long periods of records) and ensures that DWR groundwater expertise is involved during plan implementation activities through the SWG.

3.5.3. Identify opportunities for collecting water quality monitoring data

The purpose of water quality monitoring as a GMP implementation action is to assess regional trends in water quality that may be caused by changes in groundwater-related activities. For example, groundwater pumping may induce groundwater flow from deeper aquifers or hard rock areas that are less desirable, such as water with a high mineral content or arsenic. Groundwater quality monitoring from a basin-wide perspective is focused on information that is indicative of overall groundwater basin conditions and not focused on individual anthropogenic contaminants. Localized anthropogenic groundwater quality contaminants fall under the jurisdiction of the LRWCQB.

Groundwater quality is currently monitored as part of the agencies' agreements with DDW. Each agency releases an annual water quality report for their service areas in the MVGB and maintains databases of water quality information. Partner agency annual water quality reports are included in Appendix E.

Additional opportunities exist to collect groundwater quality information by collaborating with other State and Federal programs, such as the USGS funded California Groundwater Ambient Monitoring and Assessment Special Studies Program (GAMA). The 2007 GAMA study collected water quality data in the MVGB from 52 groundwater wells. The GAMA fact sheet for the MVGB is included in Appendix E.

Another example of how the partner agencies optimize collaboration opportunities occurred in February, 2012. The partner agencies teamed with Lawrence Livermore National Laboratory (LLNL) to conduct a water aging study to help improve the understanding of how the MVGB functions. The LLNL study is funded by the GAMA Special Studies Program. Results of the LLNL study will supplement and validate the DRI integrated Martis Valley surface-groundwater model.

This implementation action encourages the partner agencies to continue to identify opportunities, both within the agencies' operations and by collaborating with State and Federal agencies to improve groundwater quality data collection in the MVGB. Data collected for GMP implementation will be focused on identifying long-term water quality trends as they are related to groundwater use.

3.5.4. Use and consider updating the hydrologic model to improve understanding of groundwater in the MVGB

The implementation action directs the partner agencies to use the groundwater model component of the integrated watershed model to improve local hydrogeologic understanding within the MVGB. This may be achieved by revising the future regional groundwater model to include the following:

- Development of a focused MVGB hydrogeologic conceptual model;
- Refinement of the numerical groundwater model grid size and model extent;
- Revisions to numerical groundwater model layering and parameterization to reflect updates in the conceptual model; and,
- Establishment of appropriate stress periods and time scales for transient model simulations.

Incorporation of these revisions to the DRI-developed groundwater model will improve the tool so that it can be used to characterize groundwater flow patterns originating from key recharge zones; to quantify potential impacts on groundwater resources resulting from localized extractions; and to evaluate current and future impacts on base flows within the Truckee River as a result of groundwater pumping within the MVGB.

3.5.5. Seek new tools, technology, and information that may improve the understanding of the water resources in the MVGB and watershed

The partner agencies strive to have the best possible understanding of water resources in the MVGB and prepare reports on water resources such as urban water management plans, water shortage contingency plans, water supply analyses, and water master plans in accordance to State requirements.

This implementation action directs the partner agencies to actively seek out tools, technology, and compiled information in order to improve the understanding of water resources in the MVGB. The agencies will share and compare their water resources planning documents to identify similarities and differences. Additionally the agencies will continue to be proactive in looking for methods, approaches, and analysis that improves understanding of water in the MVGB.

3.5.6. Summary of BMO #5 Actions

Table 3-5 presents a summary of implementation actions to be undertaken by the partner agencies that support BMO #5 including the anticipated schedule of implementation.

Table 3-5. Summary BMO#5 Supporting Implementation Actions

	Description of Action	**Implementation Schedule**
5-1	Work with State and Federal agencies to attempt to secure funding for expansion of the Partner Agencies monitoring grid	Ongoing
5-2	Maintain relationship with DWR for groundwater monitoring and database management activities	Ongoing
5-3	Identify opportunities for collecting water quality monitoring data	As Available
5-4	Use and consider updating the hydrologic model to improve understanding of groundwater in the MVGB	Ongoing
5-5	Seek new tools, technology, and information that may improve the understanding of the water resources in the MVGB and watershed	Ongoing
5-6	Use the best available data to inform and link agency interdependent planning documents (i.e. urban water management plans, water shortage contingency plans, water supply analyses, and water master plans)	Ongoing

3.6. Implementation Actions that Support BMO #6 - Consider the environment and participate in the stewardship of groundwater resources

The partner agencies are dedicated stewards of the Martis Valley groundwater resources. The partner agencies' mission statements reflect the importance of managing their respective agencies in an environmentally sound manner, such as minimizing negative impacts of operations on the environment. This BMO directs the partner agencies to continue their leadership in the stewardship of the groundwater, watershed and natural infrastructure.

3.6.1. Consider local, State, or Federal riparian, surface water, or surface water-groundwater interaction investigations, studies or programs in the MVGB

This implementation action directs the partner agencies to consider existing and future studies and investigations of riparian habitat, surface water, and surface-groundwater interaction investigations. Wetlands and riparian areas play an important role in protecting water quality and reducing adverse water quality impacts (EPA, 2005). This implementation action, while not solely focused on pollution prevention, may address issues with such through traditional point sources and non-point sources. Many pollutants are delivered to surface waters and to groundwater from diffuse sources, such as urban runoff, agricultural runoff, and atmospheric deposition of contaminants. Pollution of surface water can impact groundwater quality and conversely pollution of groundwater can impact surface water. The agencies will evaluate the need to consider studies, guidance documents, and programs that investigate the linkages between ground and surface waters.

3.6.2. Continue support and collaboration with local groups that identify, coordinate, or implement projects that support the overall sustainability of the MVGB

This implementation action directs the partner agencies to support and collaborate with local groups that improve sustainability in the MVGB.

The partner agencies will continue support and collaboration with groups and agency members of the SWG, and through public involvement and outreach, identify additional groups to include in GMP implementation.

3.6.3. Summary of BMO #6 Actions

Table 3-6 presents a summary of implementation actions to be undertaken by the partner agencies that support BMO #3 including the anticipated schedule of implementation.

Table 3-6. Summary BMO#6 Supporting Implementation Actions

	Description of Action	Implementation Schedule
6-1	Consider local, State, or Federal riparian, surface water, or surface water/groundwater interaction investigations, studies or programs in the MVGB.	As Needed
6-2	Continue support and collaboration with local groups that identify, coordinate, or implement projects that support the overall sustainability of the MVGB.	Ongoing

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