CDM
In Cooperation with the
California Department of Water Resources, Northern District

Lake County Watershed Protection District

Lake County Groundwater Management Plan

Final

March 31, 2006

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Contents

List of Tables

List of Figures

Section 1
Introduction

Lake County Watershed Protection District (District) has developed this Groundwater Management Plan (GMP) to provide guidance in managing the groundwater resources of the County. Like many other areas of California, Lake County is facing water supply reliability and water quality challenges. In recent years, the District has initiated a number of efforts to proactively address water resource issues, including documenting the current status of water use and supply, identifying areas of need, and developing recommendations to ensure a supply of high quality water into the future. To promote a collaborative, county-wide approach, the District has included local stakeholders in each of these efforts.

This GMP, together with the *Lake County Water Inventory and Analysis* (CDM 2006) and the *Lake County Water Demand Forecast* (CDM 2006), will serve to improve the understanding of the water resources in Lake County and provide a framework for the County and other water users to implement effective water resource management programs.

1.1 Lake County Watershed Protection District

The District works to protect and maintain water resources within Lake County. The District is part of the County Department of Public Works and reports to the County Board of Supervisors. Because of the District's responsibilities regarding water resources, it is an authorized groundwater management agency as defined by the California Water Code (CWC) §10753 (a) and (b). District responsibilities include:

- Water Resources Planning: plan for groundwater and watershed management;
- Flood Control: administer the National Flood Insurance Program for Lake County, plan and implement flood control projects, and maintain levees and creeks;
- Operations and Maintenance: operate and maintain the Kelsey Creek Detention Structure, Adobe Creek Reservoir, Highland Springs Reservoir, Highland Springs Park; and the Middle Creek Flood Control Project; and
- Prevent other environmental damage.

1.2 Plan Development Process and Public Outreach

The District is following the CWC guidance on GMP development, which follows 5 steps.

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 District provided notification in the Lake County Record Bee on September 14th, 2005 and September

21st 2005, and held a hearing on whether or not to adopt a resolution of intention on October 4th, 2005.

Step 2 – Adopt a resolution of intention to draft a GMP and publish the resolution of intention in accordance with public notification. The Lake County Board of Supervisors adopted the resolution of intention to develop a GMP on October 4th, 2005. The resolution is included as Appendix A.

Step 3 – Prepare a draft GMP within 2 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, discussed in Section 1.3 below. The District provided notification and held a public meeting on the GMP on September 28th, where meeting attendees gave input on management objectives for the GMP.

Groundwater Management Plan Meeting Attendees

Step 4 – Provide public notification of a hearing on whether or not to adopt the GMP, followed by a hearing on whether or not to adopt the GMP. The District anticipates holding this hearing in 2006.

Step 5 - If protests are received for less than 50 percent of the assessed value of property in the plan area, the plan may be adopted within 35 days after completion of Step 4 above. 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.

In addition to following the statutory requirements of the CWC, the District has also made additional efforts to involve the public in the development of the GMP and related documents. The District supplied a pamphlet describing Inventory and Analysis related information to interested stakeholders. The District also held a public meeting on May 25th, 2005 to solicit input from stakeholders on the Inventory and Analysis. Additionally, the District held six additional meetings to involve local stakeholders during the development of Basin Management Objectives (BMOs) for individual groundwater basins. Appendix B includes summaries for these meetings.

1.3 Management Objectives

The GMP supports the long-term maintenance of high quality groundwater resources within the 13 groundwater basins of the county. Specifically, the objectives of Lake County's GMP are:

- Improve the understanding of groundwater hydrology and quality in Lake County;
- Maintain a sustainable, high quality water supply for agricultural, environmental, and urban uses;
- Minimize the long-term drawdown of groundwater levels;
- Protect groundwater quality;
- Minimize changes to surface water flows and quality that directly affect groundwater levels or quality;
- Minimize the effect of groundwater pumping on surface water flows and quality;
- Facilitate groundwater replenishment and cooperative management projects; and
- Prevent inelastic land surface subsidence from occurring as a result of groundwater pumping.

1.4 Plan Area

The Lake County GMP includes those areas in Lake County overlying a groundwater basin or groundwater source area not within the service area of another local agency, water corporation regulated by the Public Utilities Commission, or mutual water company without the agreement of the overlying agency (CWC § 10750.7 (a)). Figure 1-1 shows the Lake County GMP plan area. Areas within Lake County not overlying a groundwater basin as defined in Bulletin 118-2003 nor designated a groundwater source area are not explicitly included in the GMP. The groundwater basins and source areas in the Lake County GMP are:

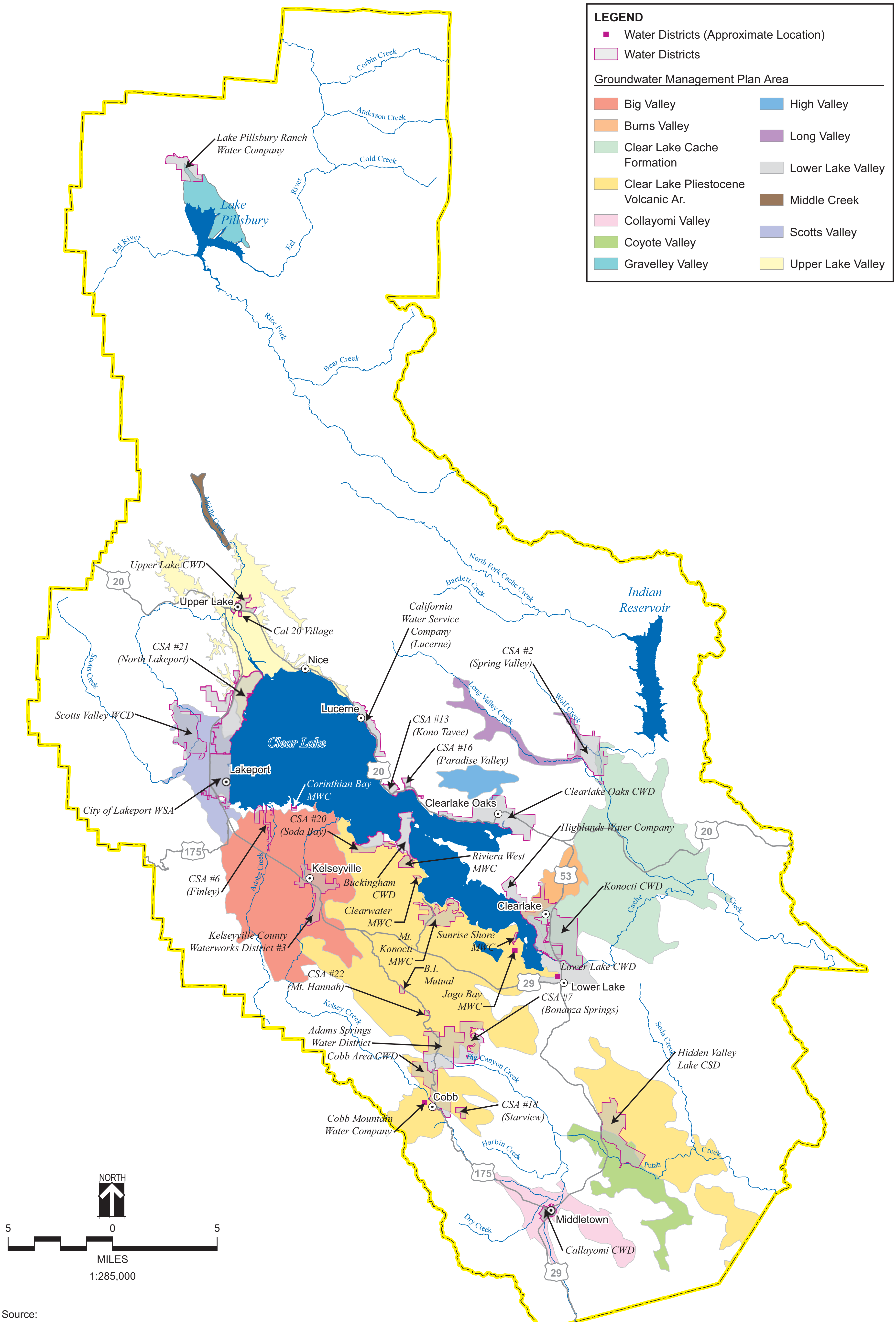
- Gravelly Valley
- Upper Lake
- Scotts Valley
- Big Valley
- High Valley
- Burns Valley
- Coyote Valley
- Collayomi Valley

- Lower Lake
- Long Valley
- Clear Lake Cache Formation
- Middle Creek
- Clear Lake Volcanics Groundwater Source Area

The District attempted to include as many overlying agencies as possible in the Lake County GMP to provide the most comprehensive and inclusive planning framework. To this end, the District sent letters to local water agencies requesting that they enter into an agreement with the District to be included in the GMP. Overlying agencies, after consulting with their boards of directors may agree to be a part of the GMP by signing a Memorandum of Understanding (MOU) with the District. Figure 1-1 also shows water agencies overlying groundwater basins in Lake County. Table 1-1 provides a listing of overlying agencies, the groundwater basins overlain, and the status of their agreement to be a part of the GMP.

Table 1-1
Overlying Agencies and Agreement to Join GMP

System Name	***Groundwater Basin***	***Agreement Status***
Adams Springs Water District - part of Cobb ACWD	Clear Lake Volcanics	
B.I. Mutual Water Company	Clear Lake Volcanics	
Cal 20 Village	Upper Lake Valley	
Callayomi County Water District	Collayomi Valley	
Clearwater Mutual Water Company	Clear Lake Volcanics	
Cobb Area County Water District	Clear Lake Volcanics	
Cobb Mountain Water Company	Clear Lake Volcanics	
Corinthian Bay Mutual Water Company	Big Valley	
Hidden Valley Lake CSD	Clear Lake Volcanics	
	Coyote Valley	
Highlands Mutual Water Company	Burns Valley,	
	Clear Lake Cache Formation,	
	Lower Lake Valley	
Jago Bay Mutual Water Company	Clear Lake Volcanics	
Kelseyville Co Waterworks District 3	Big Valley	
Konocti County Water District	Clear Lake Cache Formation	
Lake County CSA 18 - Starview	Clear Lake Volcanics	
Lake County CSA 2 - Spring Valley	Clear Lake Cache Formation	
	Long Valley	
Lake County CSA 20 - Soda Bay	Clear Lake Volcanics	
Lake County CSA 21 - North Lakeport	Upper Lake Valley	
	Scotts Valley	
Lake County CSA 22 - Mt. Hannah	Clear Lake Volcanics	
Lake County CSA 6 - Finley	Big Valley	
Lake County CSA 7 - Bonanza Springs	Clear Lake Volcanics	
Lake Pillsbury Ranch Water Company	Gravelly Valley	



Source:
Lake County Department of Public Works
California Spatial Information Library

CDM

Figure 1-1
Groundwater Management Plan Area
and Overlying Agencies

Table 1-1 ***Overlying Agencies and Agreement to Join GMP***		
System Name	***Groundwater Basin***	***Agreement Status***
Lakeport, City of	Scotts Valley	
Loch Lomond Mutual Water Co - part of Cobb ACWD	Clear Lake Volcanics	
Lower Lake County Water District	Lower Lake Valley	
Mt. Konocti Mutual Water Company	Clear Lake Volcanics	
Pine Grove Water System - part of Cobb ACWD	Clear Lake Volcanics	
Riviera West Mutual Water Co.	Clear Lake Volcanics	
Sunrise Shore Mutual Water Company	Clear Lake Volcanics	
Upper Lake County Water District	Upper Lake Valley	

1.5 Plan Implementation

In 2004, to further its objective to improve water resource planning in the County, the District applied for an AB 303 grant to inventory existing groundwater conditions and uses and to develop a GMP.

In order for the County to acquire future state funding for groundwater resources projects, a GMP must be in place. Assembly Bill 3030 (AB3030), passed by the California Legislature in 1992, codified 12 *recommended* components of a GMP. Congress updated GMP requirements with Senate Bill 1938 (SB1938) in 2002. SB1938 added five *required* components of a GMP that must be included in order to acquire funding from the state. The California Department of Water Resources (DWR) added *suggested* components for a GMP in Bulletin 118-2003.

Table 1-2 lists the mandatory, voluntary, and suggested components included in the Lake County GMP. Table 1-2 also lists the section, figure, or table number within the Lake County GMP where each item is addressed.

Table 1-2 ***Groundwater Management Plan Components***	
GMP Components	***Lake County GMP Section***
Required Components: (10753.7.)	
Establish Basin Management Objectives (BMOs)	3
Include components relating to the monitoring and management of: 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	4.1
Prepare a plan that enables the district to work cooperatively with other public entities whose service area falls within the plan area and overlies the groundwater basin	1.3
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	1.3
Adopt monitoring protocols that detect changes in: 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	4.1

Table 1-2
Groundwater Management Plan Components

GMP Components		Lake County GMP Section
Suggested Components (From bulletin 118-2003 Appendix C)		
If the GMP area includes areas outside a groundwater basin as defined in Bulletin 118, the district will use the required components, and geologic and hydrologic principles appropriate for the area		Throughout Plan
Voluntary Components (10753.8.)		
Control of saline intrusion		4.1.2.1
Identification and management of wellhead protection areas and recharge areas		4.3.2
Regulation of the migration of contaminated groundwater		4.1.2.1
Administration of a well abandonment and well destruction program		4.3.1
Mitigation of conditions of overdraft		4.4
Replenishment of groundwater extracted by water producers		4.4
Monitoring of groundwater levels and storage		4.1.1
Facilitating conjunctive use operations		4.4
Identification of well construction policies		4.3.1
Construction and operation by the district of GW contamination cleanup, recharge, storage, conservation, water recycling, and extraction projects		4.4
Development of relationships with state and federal regulatory agencies		4.2
Review of land use plans and coordination with land use planning agencies to assess activities that create a reasonable risk of groundwater contamination		4.2
Document public involvement and ability of the public to participate in development of the GMP, this may include a Technical Advisory Committee (TAC)		1.2
Establish an advisory committee of stakeholders within the plan area that will help guide the development and implementation of the plan and provide a forum for the resolution of controversial issues		5.3
Describe the area to be managed under the GMP including		2
	The physical structure of the aquifer system	
	A summary of available historical data 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 summary of 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	
Establish management objectives (MOs) for the groundwater basin subject to the GMP		1.4
Describe how meeting each MO will contribute to a more reliable water supply, and describe existing or planned actions to achieve MOs		5.1
Describe the GMP's monitoring program		4.1
Describe efforts to coordinate with land use, zoning, or water management planning agencies or activities		4.2
Create a summary of monitoring locations with frequency of wells monitored		4.1
Provide periodic reports summarizing groundwater conditions and management activities including:		5.1
	A summary of monitoring results, with a discussion of historical trends	5.1
	A summary of management actions during the period covered by the report	5.1
	A discussion of whether actions are achieving progress towards meeting MOs	5.1
	A summary of proposed management actions for the future	5.1
	A summary of any GMP changes that occurred during the period covered by the report	5.1
	A summary of actions taken to coordinate with other water and land agencies and other government agencies	5.1
Provide for the periodic re-evaluation of the entire plan by the managing entity		5.2

1.6 Document Organization

The Lake County GMP is organized into the following sections:

- Section 2 Plan Area Setting - describes the physical setting of Lake County including items such as geologic setting, land use, water sources, and physical hydrogeologic infrastructure;
- Section 3 Basin Management Objectives - discusses the development and implementation of Basin Management Objectives (BMOs);
- Section 4 Plan Components - discusses the individual components of the Lake County GMP as listed in Table 1-2;
- Section 5 Recommendations and Conclusion - summarizes the results of this document and presents recommendations for management of the County's groundwater resources; and
- Section 6 References.
- Appendices

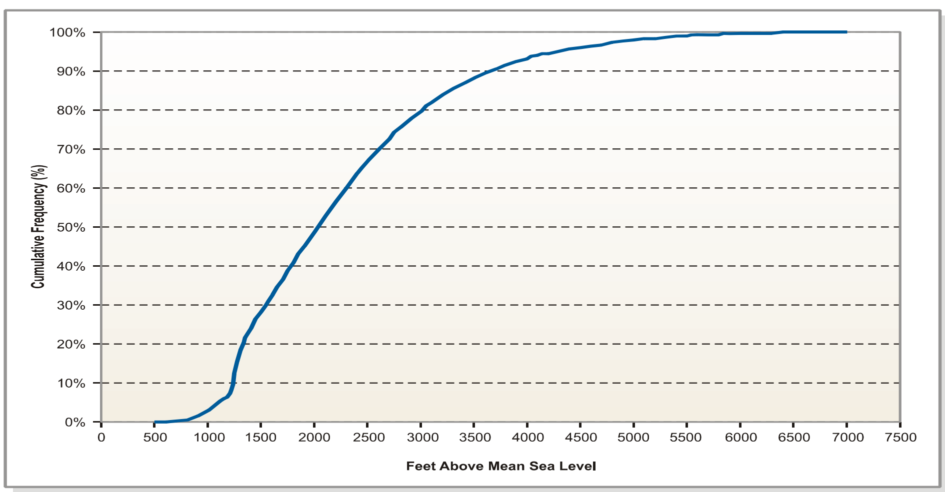
Section 2
Plan Area Setting

Lake County is a topographically diverse area in the Coast Ranges of California. Hills, mountains and valleys are the predominant landforms. The majority of agricultural and urban development uses groundwater. The geologic setting of the county is dominated by basement rock that forms the majority of ridges and mountains. There are 12 groundwater basins and one groundwater source area[1] in Lake County. The amount of information available for each basin varies significantly; however, the basins with the most development are generally better characterized.

2.1 Topography

Lake County encompasses roughly 1,261 square miles (807,000 acres) of varied topography in the Coastal Range (USDA 1989). Clear Lake is the largest water body in the county, and has an approximate elevation of 1,320 feet above mean sea level (msl). The highest point in Lake County is Snow Mountain with an elevation of 7,038 feet, and the lowest elevation is 500 feet above msl in the southeastern portion of the county in the Cache Creek drainage. Figure 2-1 illustrates Lake County topography.

Figure 2-2 identifies the area and elevation characteristics of Lake County. The figure shows the percent of land that is below each elevation. For example, the figure indicates that 50 percent of the county is below 2,000 feet and ninety percent is below 3,500 feet.



Source: Department of Water Resources

Figure 2-2
Cumulative Frequency Elevation

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[1] A groundwater "Source Area" is an area that provides significant groundwater resources and is not a valley or basin.

2.2 Land Use and Water Source

Figure 2-3 (at the end of this section) shows the agricultural land use within Lake County.

Land use is generally in valleys and areas that have topography, soils, and water sources conducive to agricultural or municipal development. As shown in Figure 2-3, vineyards (shown as purple) are present in most groundwater basins in Lake County. Vineyards are the primary crop in the Clear Lake Volcanics groundwater source area. Deciduous orchard (shown as pink) land uses occur primarily in Big Valley, Scotts Valley, and Upper Lake groundwater basins. Lakeport is in the Scotts Valley Groundwater Basin, and the City of Clearlake is in the Lower Lake, Burns Valley, and Clear Lake Cache Formation Groundwater Basins.

The majority of agricultural water in Lake County is supplied by groundwater. Figure 2-4 (at the end of this section) shows water sources for agricultural land within Lake County. Figure 2-4 illustrates that groundwater is the primary source of water for agriculture, and that surface water use occurs primarily in the northwestern lake area near Scotts Creek and Middle Creek. Surface water use also occurs in Big Valley near Clear Lake.

2.3 Geology

This section presents an overview of the geologic features of Lake County. One of the primary influences on the county's geology is its location in the Coast Range province of California. Geology in the Coast Ranges consists of a metamorphic rock (basement rock) that forms many ridges and underlies most groundwater basins; volcanic rocks that form volcanoes, hills, geysers, and hot springs; and sedimentary rocks that form groundwater basins in valleys. The current extents of geologic formations are shown in a geologic map of Lake County (Figure 2-5 at the end of this section). Table 2-1 lists major geologic formations.

Table 2-1
Major Geologic Formations in Lake County

Formation Name	*Rock Type*	*General Location*	*Age*
Franciscan Formation	Metamorphic	Throughout Lake County	150-165 million years old
Cache Formation	Sedimentary	East of Clear Lake	1.6-1.8 million years old
Clear Lake Volcanics	Volcanic	South of Clear Lake	2.5 million years old to recently
Serpentinized Ultramafic Rocks	Metamorphic	Multiple small areas in Lake County	unknown
Quaternary Alluvium	Sedimentary	Groundwater basins	recent

The geologic history of the Coast Ranges includes underwater deposition, mountain building episodes, volcanism, and regional faulting. The Franciscan Formation was originally deposited 125 million years ago at the edge of the Pacific Ocean, and the fluctuating sea levels caused alternating deposition of shale and sandstone. After the formation was deposited, it was uplifted and squeezed by movement of tectonic plates, forming the majority of the Coast Ranges as they are today. The Franciscan Formation forms the bedrock in the majority of mountains and under valleys in Lake County

Faulting occurred in Lake County, lowering a prehistoric area in the Coast Ranges that filled with water and began to deposit lacustrine sediments (Sims 1988). Lava from a nearby volcano blocked the drainage of the lake, forming an early incarnation of Clear Lake. Volcanic activity occurred intermittently through the Pleistocene with the extrusion of a number of separate lava flows, beginning the deposition of the Clear Lake Pleistocene Volcanics, including Mount Konocti and the surrounding area. Other depressions and valleys in the Coast Ranges began to be filled with sands, silts and gravels carried by streams, resulting in the deposition of alluvial basins (Brice 1953).

2.4 Groundwater Basins

Lake County has 12 groundwater basins and one groundwater source area , as shown in Figure 2-6 at the end of this section. Groundwater basins are composed primarily of shallow alluvial deposits, and deposits of the Clear Lake Volcanics over the fractured basement rock of the Franciscan Formation. Groundwater levels in the majority of Lake County's groundwater basins are high in the spring and decrease over the summer.

As part of the development of the GMP, an inventory of available information for all of the County groundwater basins was conducted. As noted above, the information available for each groundwater basin varies widely, and some basins have little or no data information to characterize groundwater conditions. In general, significant information is available for sedimentary deposits in major groundwater basins; however, very little information is available for the smaller alluvial basins and the Clear Lake Volcanics groundwater source area. Groundwater quality monitoring is performed by DWR sporadically in Lake County, however not enough monitoring has been performed to indicate groundwater quality trends. Data from the California Department of Health Services regarding Lake County public water suppliers was analyzed for constituents of concern and compared to secondary water quality thresholds (SWQLs). The SWQLs are thresholds at which water may begin to have an effected taste or odor. Some constituents were detected at levels exceeding the (SWQLs) and are listed in the description of each groundwater basin. Table 2-2 lists the groundwater basins and identifies what information is available for each basin.

Table 2-2
Summary of Available Information for Lake County Groundwater Basins

Groundwater Basin	Water Bearing Formations	Groundwater Hydrogeology	Groundwater Levels	Groundwater Quality	Subsidence	Groundwater Wells
Gravelly Valley						X
Upper Lake	X	X	X	X		X
Scotts Valley	X	X	X	X	X	X
Big Valley	X	X	X	X	X	X
High Valley	X	X	X			X
Burns Valley	X		X			X
Coyote Valley	X	X	X	X		X
Collayomi Valley	X	X	X	X		X
Lower Lake	X	X	X			X
Long Valley						X
Clear Lake Cache Formation	X					X
Middle Creek						X
Clear Lake Volcanics	X	X				X

Several terms are typical when discussing groundwater and the productivity of groundwater aquifers. The following sections describe Lake County's individual groundwater basins using these terms, if information was available. These terms include:

- **Specific Capacity -** The specific capacity of a well depends on hydraulic characteristics of the aquifer and on the construction of the well. Specific capacity is determined by dividing the wells production by the drawdown that occurs during pumping. Higher specific capacities in wells tend to be indicative of higher aquifer production.

- **Specific Yield –** The specific yield is the percent of space in the ground that will drain by gravity when the water table drops. Specific yield is reported as a percent. Higher specific yields tend to be indicative of higher aquifer production. An example of a good specific yield is 7 percent, which is a typical average specific yield of aquifers in the Sacramento Valley.

- **Transmissivity –** Transmissivity is a term used to define the ability of an aquifer to convey or transport water, similar to the capacity of a pipeline. Transmissivity is related to hydraulic conductivity and saturated thickness of an aquifer or groundwater basin. Hydraulic conductivity is the rate at which groundwater moves through an aquifer. More porous aquifers, such as sand and gravel aquifers, have high hydraulic conductivities. The saturated thickness is the total depth of groundwater in an aquifer or basin. The term transmissivity combines both these terms so it is a good overall indication of the capacity of a groundwater basin to produce water. Higher transmissivity values tend to be indicative of higher aquifer production. An example of a good transmissivity is 100,000 gallons per day per foot (gpd/ft), which is the average transmissivity of a productive aquifer in the Sacramento Valley.

- **Well Production -** Well production is the amount of water that is produced from a well, typically reported in gallons per minute (gpm).

The following sections also contain information about the wells in each groundwater basin. DWR's Well Completion Report database provided well depth and well use data. This database identifies well categories and well depth. Table 2-3 shows the number of each type of well by groundwater basin and countywide. Lake County has approximately 5,300 wells. The wells are classified by purpose as domestic, irrigation, municipal, monitoring, and other. Approximately 3,400 of the 5,300 wells in the county are in a groundwater basin as defined by DWR. The remaining 1,900 wells are in areas of the county not in a groundwater basin.

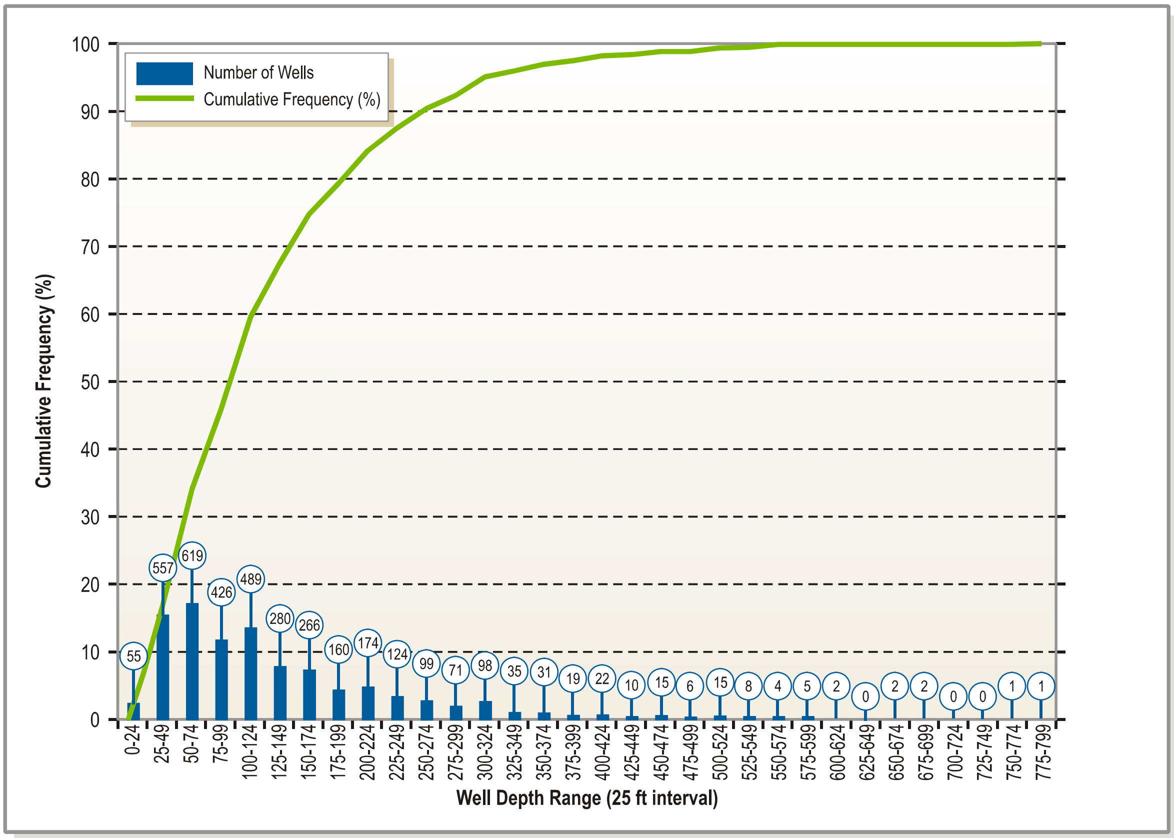
Table 2-3 presents the total number of wells by type within Lake County groundwater basins. Table 2-3 shows that of the 5,333 wells in Lake County, 3,596 wells are domestic, 813 wells are irrigation, 108 wells are municipal wells, 220 wells are monitoring wells, and 596 wells are listed as "other".

Table 2-3
Number of Wells by Use and Groundwater Basin

Groundwater Basin	*Domestic Wells*	*Irrigation Wells*	*Municipal Wells*	*Monitoring Wells*	*Other Wells*	*Totals*
Clear Lake Cache Formation	71	9	0	10	7	97
Scotts Valley	235	87	2	0	31	355
Long Valley	30	7	0	0	4	41
High Valley	19	10	0	0	8	37
Burns Valley	86	13	0	3	9	111
Collayomi Valley	141	34	1	16	22	214
Coyote Valley	86	17	5	6	13	127
Lower Lake	243	25	8	9	13	298
Gravelly Valley	13	0	1	0	3	17
Clear Lake Pleistocene Volcanics	537	59	11	8	52	667
Middle Creek	39	3	0	0	4	46
Upper Lake	243	99	6	22	68	438
Big Valley	463	297	9	29	162	960
Total of All GW Basins	2,219	664	67	101	399	3,450
All Wells not in a GW Basin	1,377	149	41	119	197	1,883
Total for Lake County	**3,596**	**813**	**108**	**220**	**596**	**5,333**

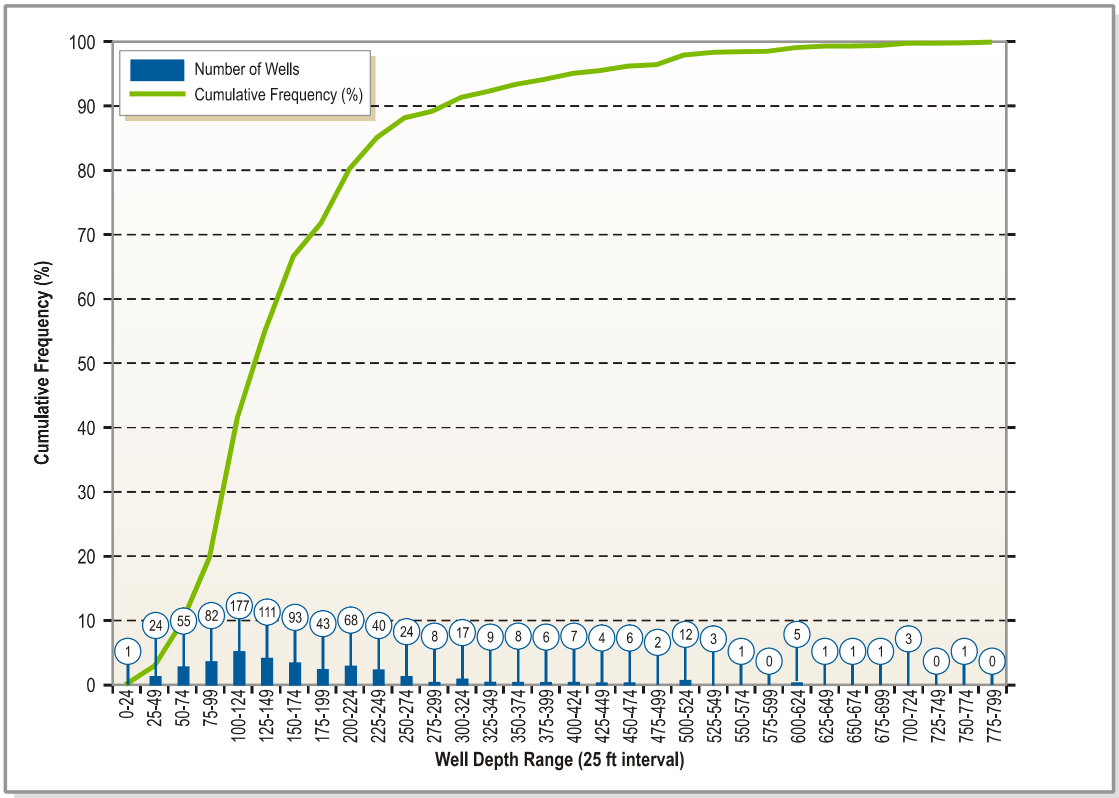
Note: "Municipal Wells" include wells listed as municipal or public. "Other Wells" Include wells listed as abandoned, exploratory other, stock, test, unknown, or unused.
Source: Department of Water Resources Well Completion Report

Each description of a groundwater basin includes cumulative frequency figures that illustrate the well depth range and cumulative frequency depth distribution for domestic and irrigation wells. Figures 2-7 and 2-8 show well depth frequency throughout Lake County. The cumulative frequency, on the left axis of the figure, shows the percent of all wells that are shallower than the line. For example, approximately 50 percent of all domestic wells are shallower than 100 feet deep, and approximately 50 percent of all irrigation wells are shallower than 125 feet deep.



Source: Department of Water Resources

Figure 2-7
Depth Distribution of Domestic Wells in Lake County



Source: Department of Water Resources

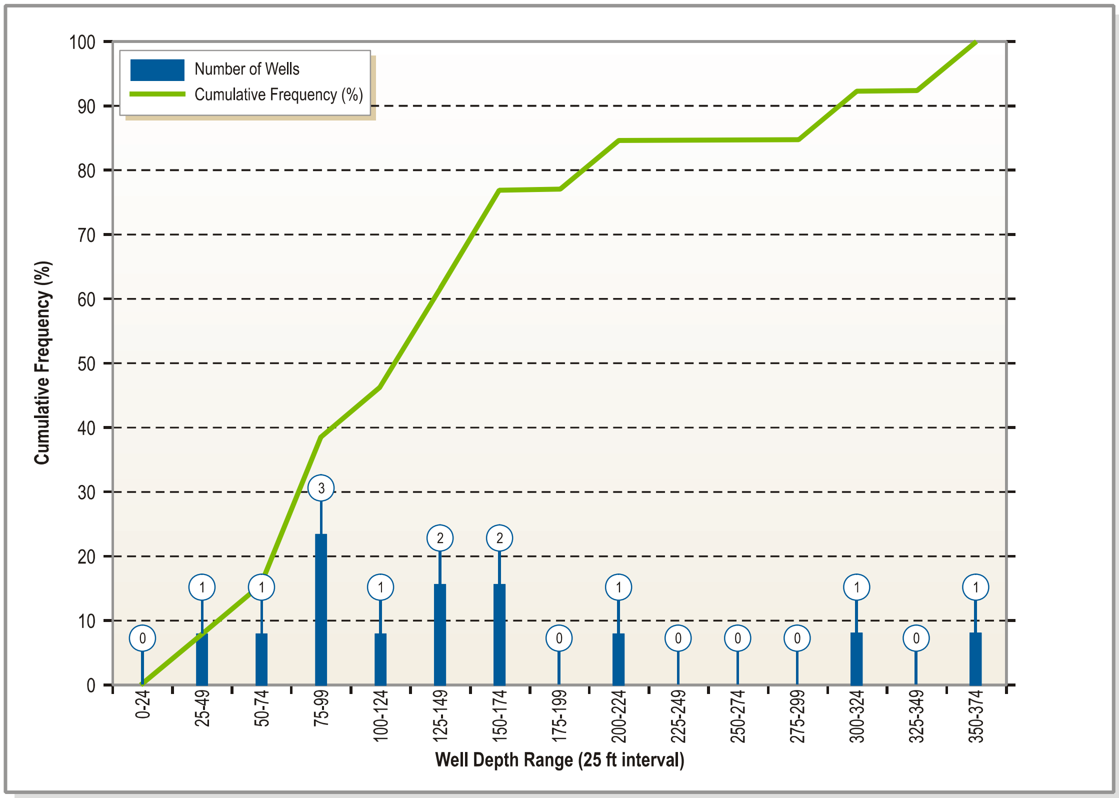
Figure 2-8
Depth Distribution of Irrigation Wells in Lake County

2.4.1 Gravelly Valley Groundwater Basin

The Gravelly Valley Groundwater Basin is in the northern portion of Lake County (Figure 2-6) in the Eel River Inventory Unit. Lake Pillsbury borders the basin to the south, and the Franciscan Formation borders the basin to the west, north, and east.

Groundwater Wells

Groundwater is used for domestic use in the Gravelly Valley Groundwater Basin. Figure 2-9 presents the well depth range and cumulative frequency depth distribution for domestic wells in the Gravelly Valley Groundwater Basin. Approximately 50 percent of all domestic wells (6 wells) are shallower than 125 feet deep. Gravelly Valley has only one irrigation well.



Source: Department of Water Resources

Figure 2-9
Depth Distribution of Domestic Wells in the Gravelly Valley Groundwater Basin

2.4.2 Upper Lake Basin

The Upper Lake Basin is northwest of the northern end of Clear Lake (Figure 2-6). The Upper Lake Basin is composed of three valleys: Middle Creek Valley, Clover Valley, and Bachelor Valley. Middle Creek and Clover Valleys are in the Middle Creek Inventory Unit, and are bordered to the east and north by the Franciscan Formation, and to the west by Lower Cretaceous Marine rocks. Bachelor Valley is in the Scott's Creek Inventory Unit and is bounded primarily by the Franciscan Formation and by Middle Creek Valley to the east.

Water-Bearing Formations

Quaternary Alluvium

Quaternary Alluvium includes channel deposits, fan deposits, and gravel, sand and fine materials (ESA 1978). The channel alluvium occurs along Middle, Alley, and Clover Creeks. The mouths of several ravines and small canyons that enter into the valley contain fan and older alluvial deposits that consist of gravel, sand, and fine materials. These deposits reach a thickness of 40 to 50 feet and decrease downstream to only a few feet (ESA 1978). Quaternary alluvium is generally a good water producing unit.

Pleistocene Terrace Deposits

The Pleistocene terrace deposits, consisting of poorly consolidated clay, silt, and sand with some gravel lenses, border the west and northwest of Middle Creek Valley. Because of the deposits' high clay content, they have a low permeability and are less significant as a groundwater source (ESA 1978).

Pleistocene Lake and Floodplain Deposits

Underlying the valley floors of Middle, Clover, and Alley creeks are fine-grained lacustrine sediments and coarser grained floodplain deposits. These deposits overlie bedrock and older unconsolidated sediments and generally range from 60 to 110 feet in thickness. Sediments in the Middle Creek Valley area form a confining layer for an underlying artesian aquifer system (ESA 1978). The floodplain deposits contain sand and gravel lenses from former stream channels. The fine-grained lake deposits have low permeability with specific yields from about 3 to 5 percent while wells screened in the sand and gravel lenses produce an average of 230 gpm (DWR 1957).

Groundwater Hydrogeology

Groundwater recharges the Upper Lake Basin at the mouths of canyons and around the periphery of the basin. Recharge also occurs along Middle Creek, Clover Creek, and Alley Creek (ESA 1978). Groundwater recharge occurs from the stream channels during the early part of the wet season, and the basin fully recharges and contributes to stream flow during most wet seasons. Lesser amounts of recharge occur to the groundwater basin through percolation of smaller streams and direct rainfall.

Groundwater levels in the Upper Lake Basin are shallow and have remained constant over the last 40 years. Figure 2-10 at the end of this section shows hydrographs in the Upper Lake Basin that indicate groundwater levels and trends. Water levels in the basin are generally within 10 feet of the ground surface in the spring. Groundwater levels have stayed constant spring to spring. The general direction of groundwater flow in Upper Lake Basin is southward toward Clear Lake. In Clover Valley, groundwater moves to the northwest, towards Middle Creek.

Groundwater in the Upper Lake Basin fluctuates between 5 and 15 feet from spring to fall. Total storage in the Upper Lake Basin is approximately 9,000 acre-feet (ESA 1978). DWR estimated total storage to be 10,900 acre-feet and usable storage to be 5,000 acre-feet. Specific yield for the depth interval of 0 to 100 feet is approximately 8 percent (DWR 1957). Average-year agricultural groundwater demand in the Upper Lake basin is approximately 4,075 acre-feet per year.

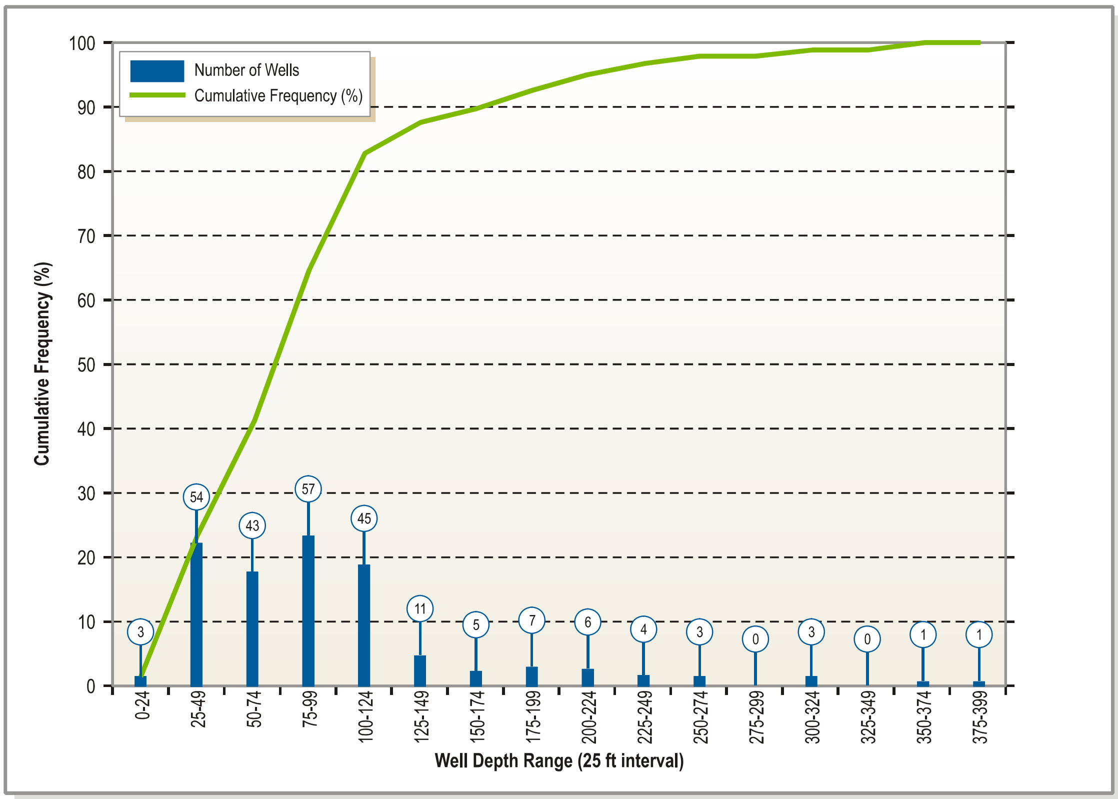
Groundwater Quality/ Inelastic Land Surface Subsidence

DWR monitors a number of wells for water quality in the Upper Lake Groundwater Basin. Monitoring is not extensive enough to determine trends in groundwater quality or the overall character of groundwater in the basin. Information obtained from DHS indicates that iron and manganese have been detected above SWQLs in the

Upper Lake Groundwater Basin. Current information regarding inelastic land surface subsidence is unavailable.

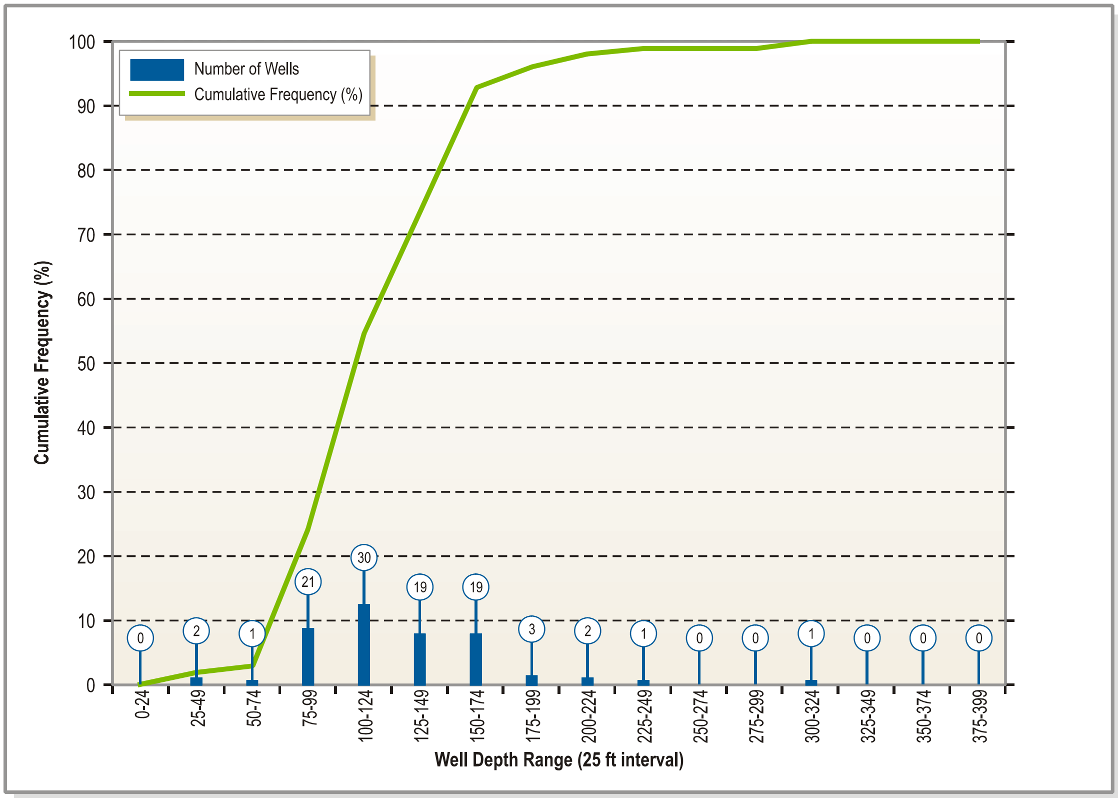
Groundwater Wells

There are 243 domestic wells and 99 irrigation wells in the Upper Lake Basin. Figures 2-11 and 2-12 present the well depth range and cumulative frequency depth distribution for domestic and irrigation wells in Upper Lake Basin. Approximately 50 percent of domestic wells are shallower than 75 feet deep, and approximately 50 percent of irrigation wells are shallower than 125 feet deep.



Source: Department of Water Resources

Figure 2-11
Depth Distribution of Domestic Wells in the Upper Lake Basin



Source: Department of Water Resources

Figure 2-12
Depth Distribution of Irrigation Wells in the Upper Lake Basin

2.4.3 Scotts Valley Basin

The Scotts Valley Basin is the source of water supply for Lakeport and adjacent agricultural areas. It is west of Clear Lake in the Scotts Valley Inventory Unit (Figure 2-6). The basin includes Scotts Valley, the foothills between Scotts Valley and Clear Lake, and the foothills immediately to the south of Lakeport. Clear Lake borders the basin to the east and the Franciscan Formation borders the basin to the north, west and south. Scotts Creek flows through Scotts Valley and drains to the northwest around White Rock Mountain into the Upper Lake Basin.

Over time, Scotts Creek has changed drainage directions and affected the development of the basin. Originally, Scotts Creek drained into Clear Lake during the deposition of the Quaternary Terrace Deposits. Clear Lake drained to the west, towards the Pacific Ocean at that time. Cache Creek then eroded back into the Cache Formation far enough to reach Clear Lake, and the lake started draining into Cache Creek to the east. Scotts Creek began to flow through Clear Lake's old drainage to the west, towards the Pacific Ocean. During this time, Scotts Creek eroded into the Quaternary Terrace Deposits, creating the depression that is now Scotts Valley. Scotts Creek deposited a layer of gravels in the bottom of Scotts Valley. Approximately 10,000 years ago, a large landslide occurred in the Scotts Creek drainage, blocking its drainage to the west and creating a lake in Scotts Valley. The lake deposited the clay that makes up the floor of Scotts Valley today. Eventually Scotts Creek eroded a new channel, carving its present course to Clear Lake around Rock Mountain into the Upper Lake Basin to Clear Lake. The old drainage of Scotts Creek that was blocked by the landslide has filled up with water to form the Blue Lakes.

Water-Bearing Formations

Quaternary Alluvium

The channel deposits of Scotts Creek and the valley deposits in the southern portion of Scotts Valley are composed of Quaternary Alluvium. Older stream channels deposited by Scotts Creek also underlie Quaternary Lake and Floodplain Deposits in the northern portion of Scotts Valley. In the southern portion of the valley, the alluvium is exposed at the surface. It is 40 to 70 feet thick (Ott Water Engineers 1987) and is the recharge area for the valley. In the northern portion of the valley, where the alluvium is buried by lake deposits, the alluvium is 85-105 feet deep, is 5-10 feet thick, and is a confined groundwater aquifer (Wahler 1970). Wells completed in the confined portion of Quaternary Alluvium produce up to 600 gallons per minute, and specific yield is estimated to vary between 20 and 25 percent (Wahler 1970).

Quaternary Lake and Floodplain Deposits

The northern portion of Scotts Valley is underlain by lake deposits of clay ranging in thickness from 60 to 90 feet (DWR 1957). This clay layer acts as a confining layer for the northern portion of Scotts Valley, where it overlies Quaternary Alluvium. Permeability in lake deposits is low, and specific yield of the clays is about 3 percent (Wahler 1970).

Quaternary Terrace Deposits

Quaternary Terrace deposits lie directly on bedrock and consist of poorly consolidated clay, silt, and sand, with some gravel. Quaternary Terrace deposits form the ridge that separates Scotts Valley from Clear Lake, and are exposed in foothills in the western and southern portions of the Scotts Valley Basin. The Quaternary Terrace Deposits also underlie the alluvium and lake deposits in Scotts Valley. The specific yield of terrace deposits is estimated to be between 5 and 10 percent, and wells in the formations sustain small yields of up to 60 gallons per minute (Wahler 1970).

Groundwater Hydrogeology

The south end of Scotts Valley serves as the principal recharge area for the entire valley (Wahler 1970). Surface water flow in Scotts Creek percolates into the aquifer in the southern portion of Scotts Valley at a rate of approximately 1,000 acre-feet per month (Wahler 1970). When Scotts Creek is not flowing, this recharge does not take place

Hydrographs in Figure 2-16 at the end of this section show groundwater levels in the Scotts Valley Basin are shallow in the spring and experience wide fluctuations over the irrigation season. Water levels in the basin are on average 10 feet below the ground surface in the spring, and spring groundwater levels have remained generally constant over the last 40 years.

Spring to summer drawdown of the water table varies by position in the Scotts Valley Basin, with Scotts Valley experiencing larger drawdown than the rest of the basin. Spring to summer drawdown in the Scotts Valley ranges from 30 to 60 feet, and drawdown near Burger Lake and south of Lakeport is roughly 10 feet. Anecdotal information from groundwater users in Scotts Valley indicates that the summer drawdown is far enough to de-water some pumps. The general direction of groundwater flow in the Scotts Valley Basin is northward along Scotts Creek in the Scotts Valley portion of the basin, and eastward towards Clear Lake in the eastern and southern portions of the basin (Wahler 1970). Groundwater levels in the basin seem to completely recover each wet season, and overall there does not appear to be any increasing or decreasing trend in long term groundwater levels.

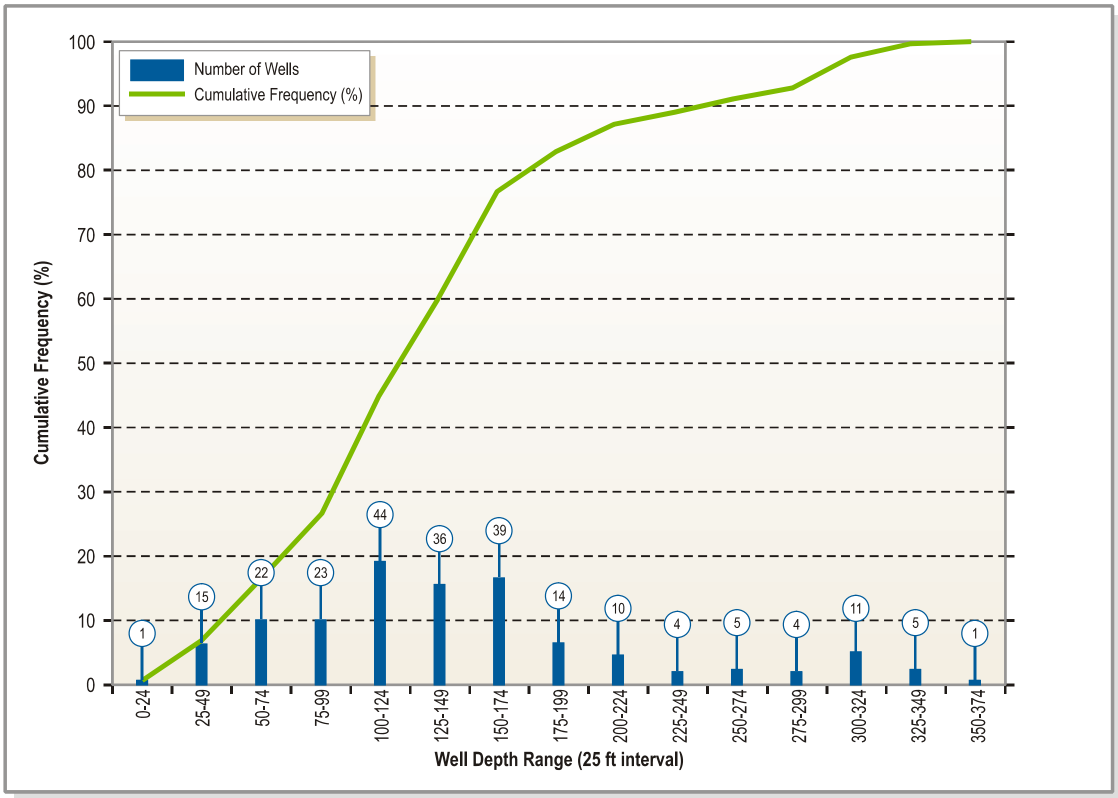
Total groundwater in storage in Scotts Valley is approximately 5,900 acre-feet (Wahler 1970). DWR estimated usable storage to be 4,500 acre-feet (DWR 1957). Specific yield for the depth interval of 0 to 100 feet is approximately 8 percent (DWR 1957). Average-year agricultural groundwater demand in the Scotts Valley Basin is approximately 2,369 acre-feet per year.

Groundwater Quality/Inelastic Land Surface Subsidence

Current published information regarding groundwater quality and inelastic land surface subsidence is unavailable. Information obtained from DHS indicates that iron, aluminum, barium and manganese have been detected above SWQLs in Scotts Valley. Anecdotal evidence in the form of elevated well casings (two to four feet above ground) indicates that the valley may have subsided by as much as four and one half feet. There have been no reports of groundwater quality issues associated with increased drawdown.

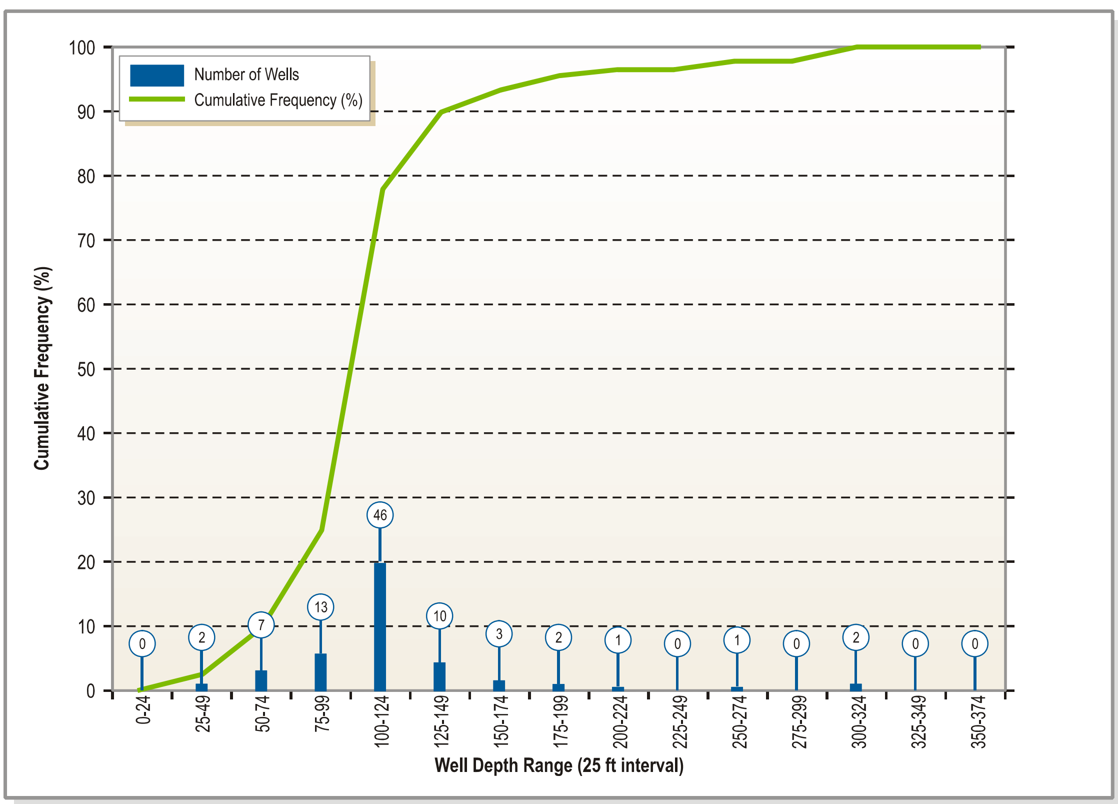
Groundwater Wells

There are 235 domestic wells and 87 irrigation wells in the Scotts Valley Basin. Figures 2-14 and 2-15 present the well depth range and cumulative frequency depth distribution for domestic and irrigation wells in Upper Lake Basin. Approximately 50 percent of domestic wells are shallower than 125 feet deep, and approximately 50 percent of irrigation wells are shallower than 100 feet deep.



Source: Department of Water Resources

Figure 2-14
Depth Distribution of Domestic Wells in the Scotts Valley Basin



Source: Department of Water Resources

Figure 2-15
Depth Distribution of Irrigation Wells in the Scotts Valley Basin

2.4.4 Big Valley Groundwater Basin

The Big Valley Basin is the source of water supply for Kelseyville and is the largest agricultural area in Lake County. It lies south of Clear Lake in the Big Valley Inventory Unit (Figure 2-6). The basin includes the lowlands portion of Big Valley near Clear Lake, and the southern uplands portion near Adobe and Kelsey Creeks. The Big Valley Groundwater Basin is bordered by Clear Lake to the north, the Clear Lake Volcanics to the east and the Franciscan Formation borders the basin to the west and south. Adobe and Kelsey Creeks flow through Big Valley and drain to the north into Clear Lake.

Big Valley is roughly triangular shaped, and is at most six miles wide and approximately eight miles long. The ground surface in the northern portion of the basin gently slopes to the north towards Clear Lake. There are uplands on the west side of the valley, and separate uplands in the south central portion of the valley that have been uplifted approximately 400 feet by faulting (Christensen 2003).

Water-Bearing Formations

Hydrogeology in Big Valley is comprised of two distinct areas: the younger alluvial and basin deposits in the north, and raised uplands comprised of the Kelseyville Formation in the south. The two areas are separated by the Big Valley Fault, which uplifted the Kelseyville Formation and created the uplands in the south.

Christenson Associates, Inc. identified 4 major aquifers in the Big Valley area in the *Big Valley Ground Water Recharge Investigation Update* (2003). The younger alluvial system in the northern portion of the basin contains two main aquifers, designated "A1" and "A2". A clay-rich lake deposits layer designated "C2" separates the aquifers from each other (Christensen 2003). The Kelseyville Formation also includes two aquifers, designated "A3", and "volcanic ash". The "A3" aquifer and "volcanic ash" aquifers are separated by a clay layer designated "C3". Figure 2-16 is a cross section of Big Valley's aquifers and shows the spatial relationships between the aquifers and clay layers.

"A1" Aquifer

Much of the northern portion of Big Valley is directly underlain by alluvial deposits ranging from 10 feet to 126 feet thick (Christensen 2003). The deposits are likely to be stream deposits, consisting of gravel, sand, and silt. The "A1" aquifer is generally unconfined except near and under Clear Lake, where it is confined by an overlying clay layer.

"A2" Aquifer

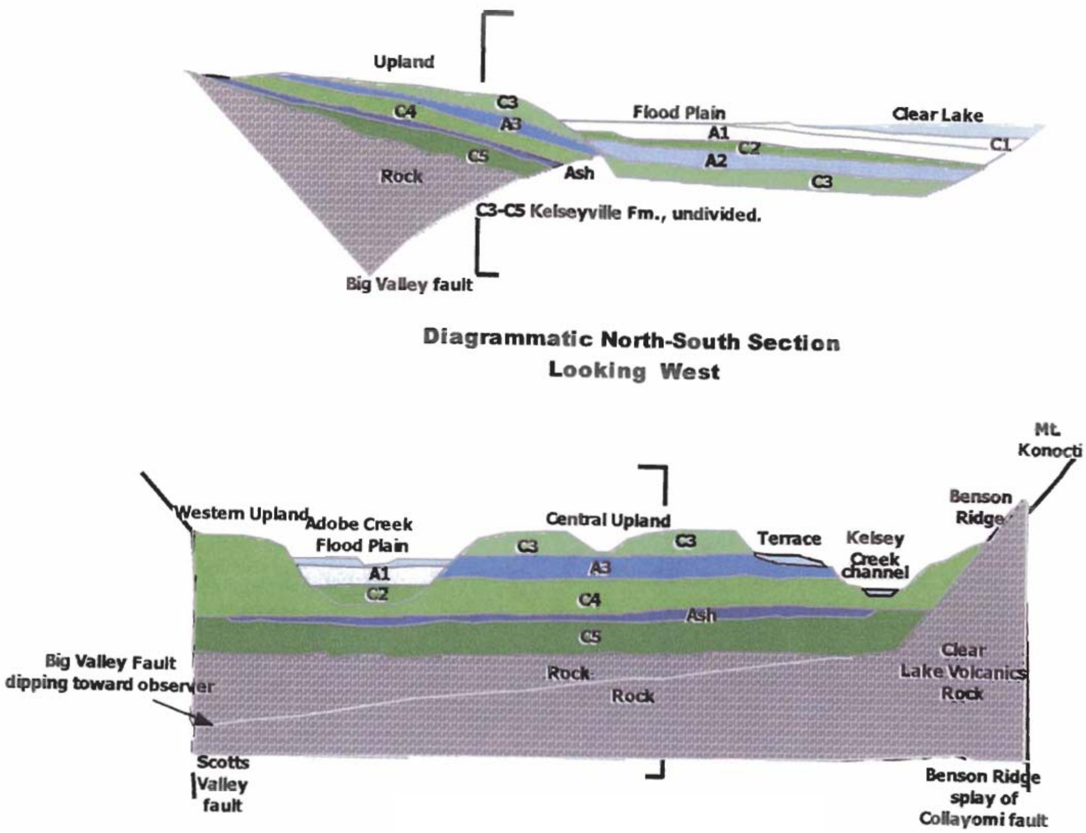
The "A2" aquifer is below the "A1" aquifer and a confining clay layer, designated "C2" (Christensen 2003). The "A2" aquifer ranges from 14 to 140 feet in thickness, and is likely to be composed of stream deposits of gravel, sand, and silt clay. The "A2" aquifer is generally confined or semi-confined.

"A3" Aquifer

Much of the uplands in the southern portion of Big Valley are underlain by the "A3" aquifer, ranging from 5 to 160 feet in thickness. The deposits in the "A3" aquifer are similar to the deposits in the "A1" and "A2" aquifers, likely being comprised of stream deposits, gravel, sand, and silt. The "A3" aquifer is generally unconfined (Christensen 2003)

"Volcanic Ash" Aquifer

The "Volcanic Ash" aquifer is below the "A3" aquifer and a confining clay layer, designated "C3" (Christensen 2003). The "Volcanic ash" aquifer is generally 2 to 5 feet thick, with thicknesses as high as 50 feet reported in two wells. The aquifer consists of volcanic tuff, and water throughout the aquifer is confined (Christensen 2003).



Source: Christensen Associates Inc.

Figure 2-16
Diagrammatic Cross Sections of Big Valley Water-bearing Formations

Groundwater Hydrogeology

The majority of recharge to groundwater in the "A1" and "A2" aquifers is from infiltration of surface flow from Kelsey and Adobe Creeks into the aquifer system. Additional recharge to the "A1" and "A2" aquifers occurs from percolation of rainfall, and underflow from the "A3" aquifer. The "A1" aquifer may also receive recharge from Clear Lake during the summer, when pumping has lowered the groundwater level below the level of Clear Lake (Christensen 2003).

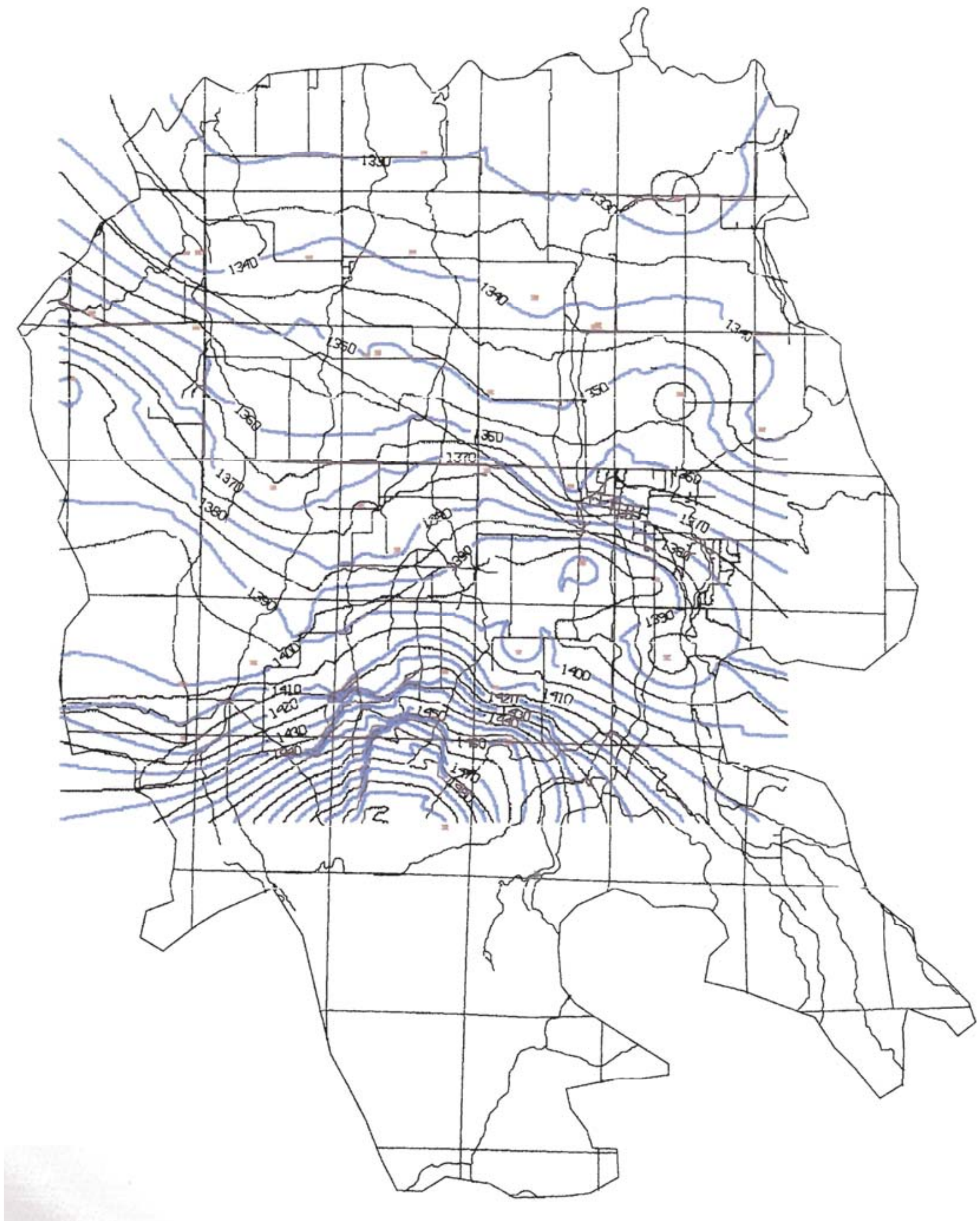
The "A3" aquifer is recharged by percolation of rainfall and by infiltration of water from Kelsey Creek. Recharge of groundwater in the "Volcanic ash" aquifer is poorly understood. It is probably recharged by underflow from uplands, and infiltration of streamflow at surface exposures of the volcanic ash (Christensen 2003).

Hydrographs in Figure 2-17 at the end of this section show groundwater levels in the Big Valley Groundwater Basin behave differently in the northern portion than in the southern portion of the basin. Hydrographs in the northern portion, the alluvial system portion of Big Valley, are typically shallow in the spring and experience wide fluctuations over the irrigation season. Water levels in the northern portion are typically five feet below the ground surface in the spring, and decrease from 10 to 50 feet in the summer. Hydrographs in the southern portion, marked in Figure 2-17 by yellow, in the uplands in Big Valley, show that water levels in this area are significantly farther below ground surface than in the northern portion. Spring groundwater levels range from 70 to 90 feet below ground surface, while summer groundwater levels are typically 30 to 40 feet below spring levels. Spring groundwater levels have remained generally constant over the last 40 years except in drought periods. Drought periods can be seen in the hydrographs between 1975 and 1977, and between 1987 and 1992.

Figure 2-18 presents a groundwater contour map of groundwater levels observed in the spring of 2000. The direction of groundwater flow in Big Valley is generally northward towards Clear Lake. The groundwater gradient in the southern portion of the valley is approximately 70 feet per mile. The gradient in the northern portion of the valley is approximately 20 feet per mile.

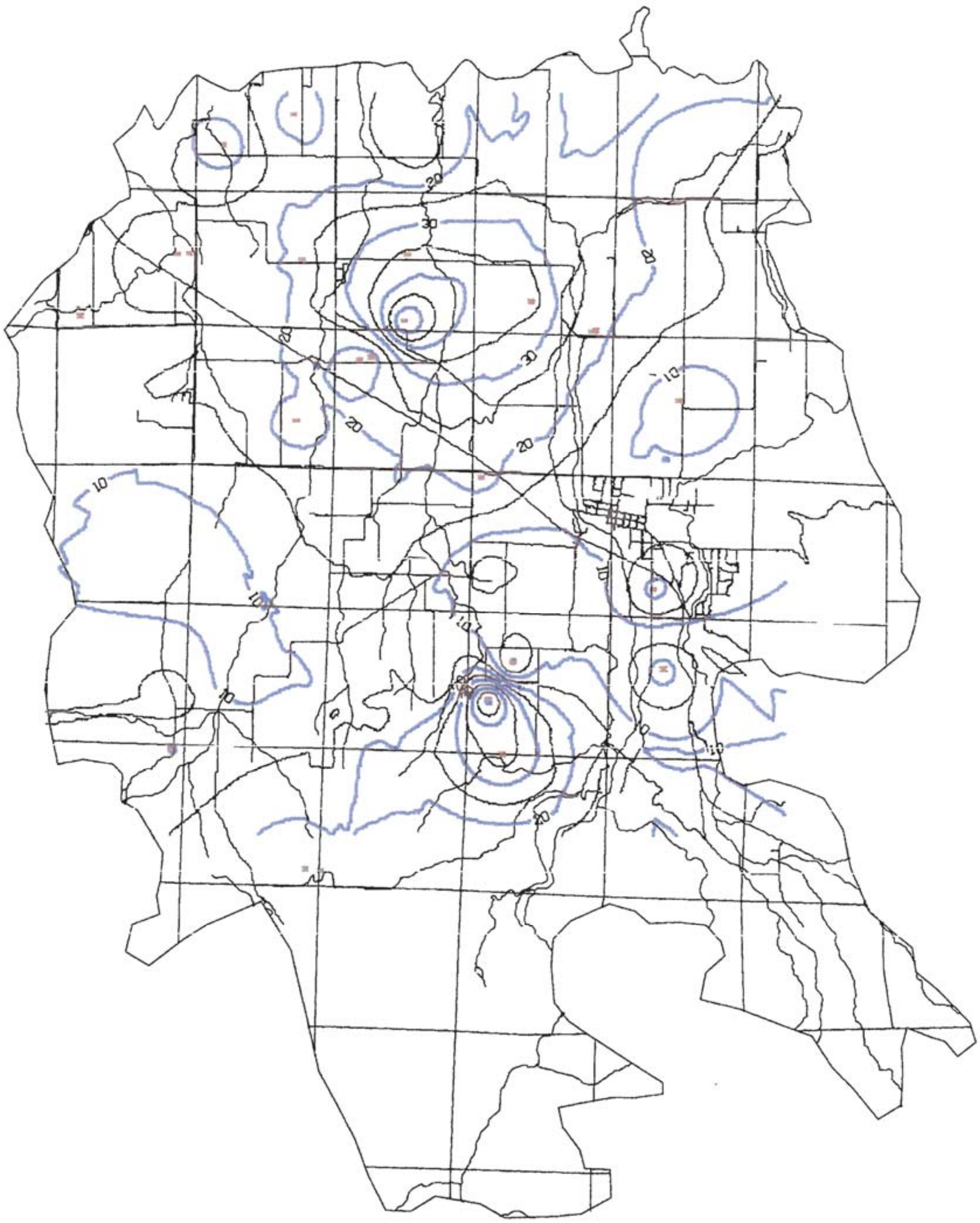
Figure 2-19 presents a contour map showing the change in groundwater levels between the spring of 2000 and the summer of 2000. Figure 2-19 shows a number of areas in Big Valley where groundwater was significantly lower over the summer. There was a 50-foot decline in water levels around the town of Finley, a 50-foot decline southeast of Kelseyville, and two 20-foot areas of declines near Kelseyville.

Groundwater in storage in Big Valley has been estimated several times. DWR estimated groundwater in storage to be 105,000 acre-feet for a saturated depth interval of 10 to 100 feet in 1960. In 2004, DWR estimated usable storage to be 60,000 acre-feet. DWR estimated specific yield in 1957 to be 8 percent. Well yields from PG&E reports in 1957 average 374 gpm for unconfined wells and 495 gpm for 'confined' wells; specific capacities were estimated to be 31 gallons per minute per foot for unconfined wells and 77 for 'confined' wells (DWR 1957). Average-year agricultural groundwater demand in the Big Valley basin is approximately 11,363 acre-feet per year.



Source: Christensen Associates Inc.

Figure 2-18
Spring 2000 Big Valley Groundwater Contour Map



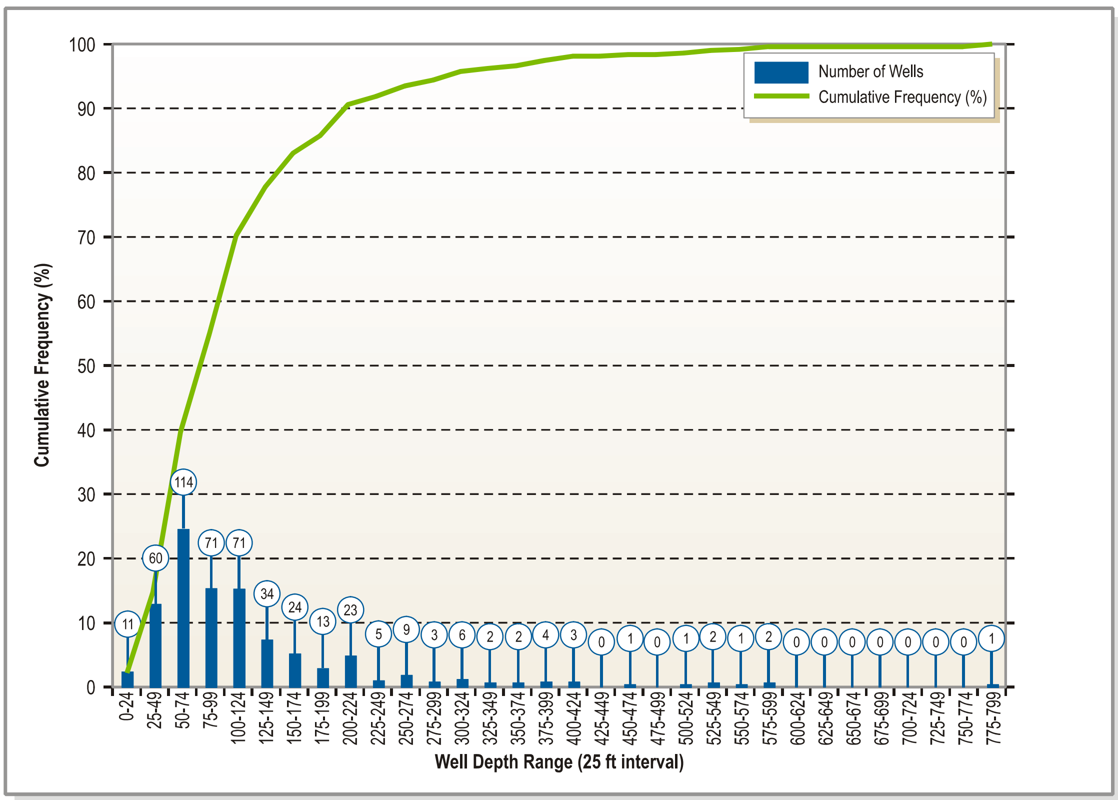
Source: Christensen Associates Inc.

Figure 2-19
Change in Big Valley Groundwater Elevations, Spring to Summer 2000

Groundwater in the Big Valley Groundwater Basin may be overdrafted during periods of drought, when there is inadequate recharge during winter months to replace water extracted during the summer months. Potential impacts of overdraft during these periods might include: water shortages for irrigation, water shortages for municipal use, deterioration of groundwater quality, dry wells, and ground subsidence.

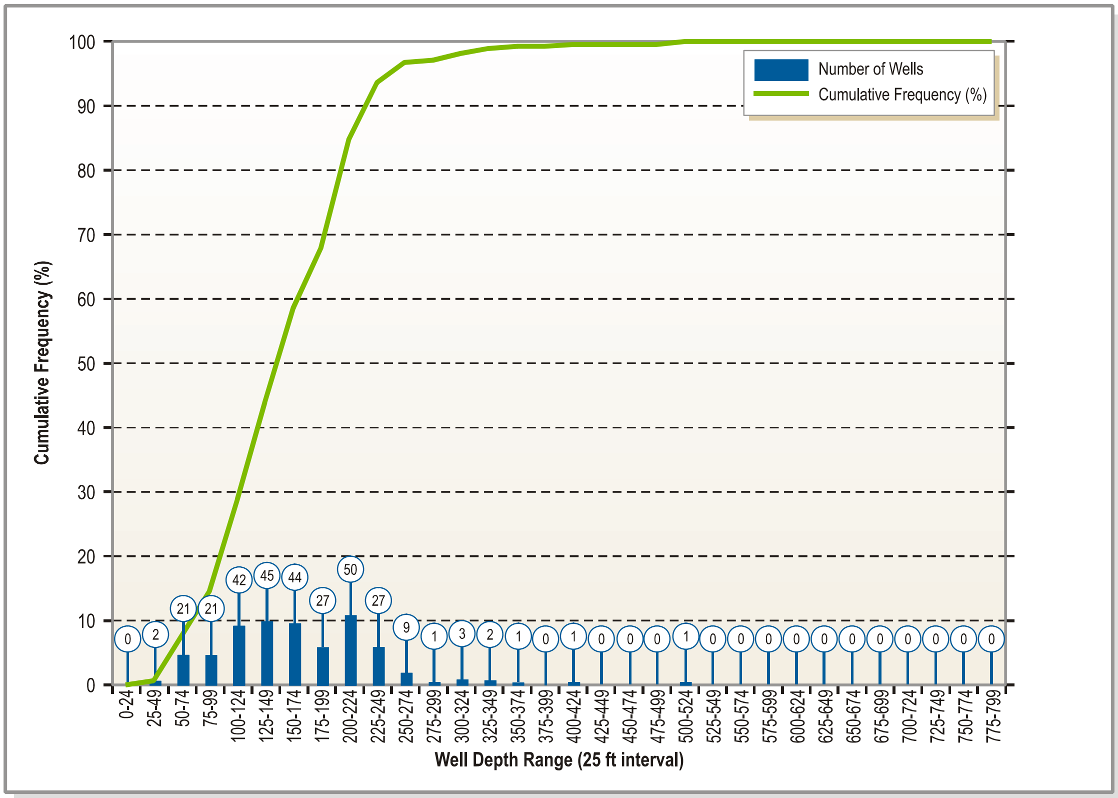
Groundwater Wells

There are 463 domestic wells and 297 irrigation wells in the Big Valley Groundwater Basin. Figures 2-20 and 2-21 present the well depth range and cumulative frequency depth distribution for domestic and irrigation wells in Big Valley Groundwater Basin. Approximately 50 percent of domestic wells are shallower than 75 feet deep, and approximately 50 percent of irrigation wells are shallower than 150 feet deep.



Source: Department of Water Resources

Figure 2-20
Depth Distribution of Domestic Wells in the Big Valley Groundwater Basin



Source: Department of Water Resources

Figure 2-21
Depth Distribution of Irrigation Wells in the Big Valley Groundwater Basin

2.4.5 High Valley Basin

The High Valley Basin includes High Valley, a small valley north of Clearlake Oaks (Figure 2-6) in the Shoreline Inventory Unit. The valley is three miles long and one mile wide. The Franciscan Formation borders High Valley on the north, west, and south, and an area of volcanic rocks near Round Mountain borders High Valley to the east. Drainage occurs through the narrow gorge of Schindler Creek to the southeast.

Water-Bearing Formations

Quaternary Alluvium

Quaternary Alluvium in High Valley consists of up to 100 feet of fine grained lake deposits. The perimeter of the deposit consists of alluvial fan deposits that may contain coarser sediments. Alluvium is generally a good water producing unit.

Holocene Volcanics

Holocene volcanics likely originated from the vicinity of Round Mountain. The volcanics underlie the fine grained alluvium in the valley and form a confined aquifer. The volcanics were initially a productive aquifer; however, well yield has reduced over time. Recharge is likely reduced by the fine grained alluvium preventing infiltration to the volcanics (DWR 2003).

Groundwater Hydrogeology

The alluvial aquifer portion of High Valley is recharged through direct precipitation. Recharge to the deeper volcanic aquifer is likely through the perimeter of the valley through alluvial fans (DWR 2003).

Hydrographs in Figure 2-22 at the end of this section show groundwater levels in High Valley have slow recovery after droughts. Water levels in the basin range from 10 to 30 feet below the ground surface in the spring. Spring groundwater levels have fluctuated considerably over the last 40 years. After the drought of 1976, spring groundwater levels had declined 45 feet, and it took 5 years for water levels to recover to pre-1976 levels. This trend of slow recovery is indicative of low recharge rates to the basin.

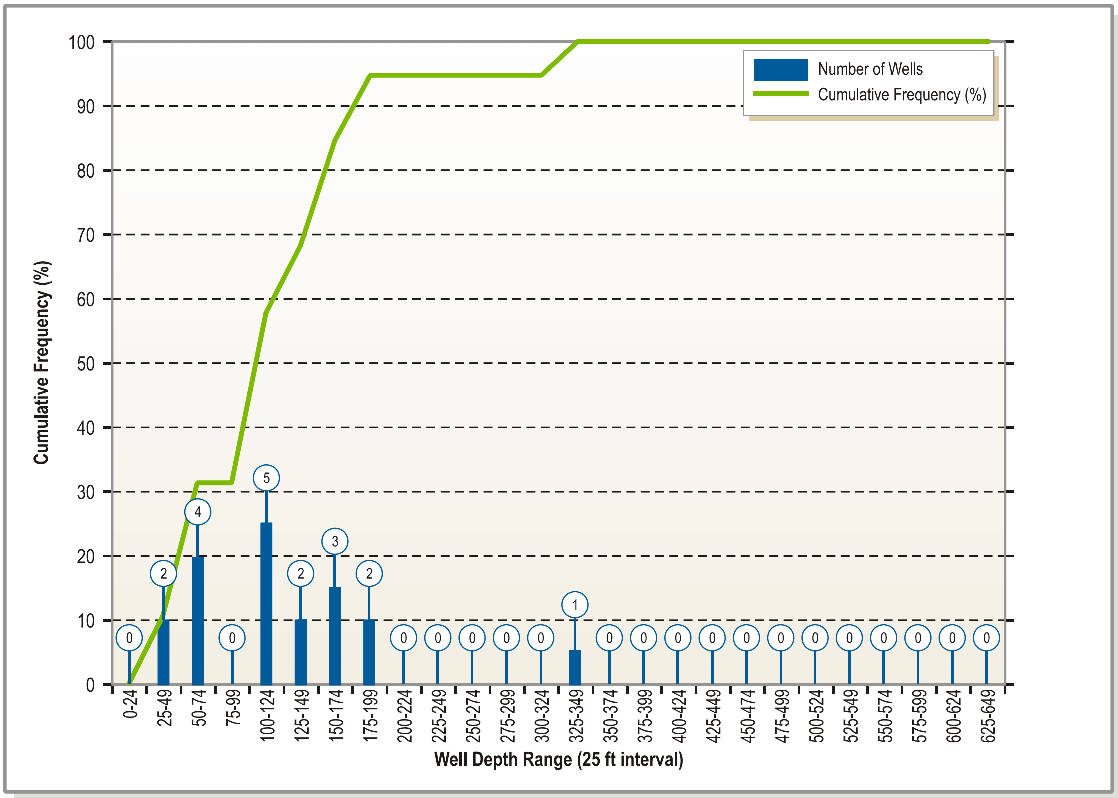
Spring to summer drawdown of the water table is 5 to 10 feet during an average year in High Valley. The general direction of groundwater flow in High Valley is unknown. Usable storage capacity is approximately 900 acre-feet (DWR 1960). Average-year agricultural groundwater demand in the High Valley basin is approximately 36 acre-feet per year.

Groundwater Quality/Inelastic Land Surface Subsidence

DWR monitors a number of wells for water quality in the High Valley Groundwater Basin. Monitoring is not extensive enough to determine trends in groundwater quality or the overall character of groundwater in the basin. Information was not available from DHS for the High Valley Groundwater Basin. Current information regarding inelastic land surface subsidence is unavailable.

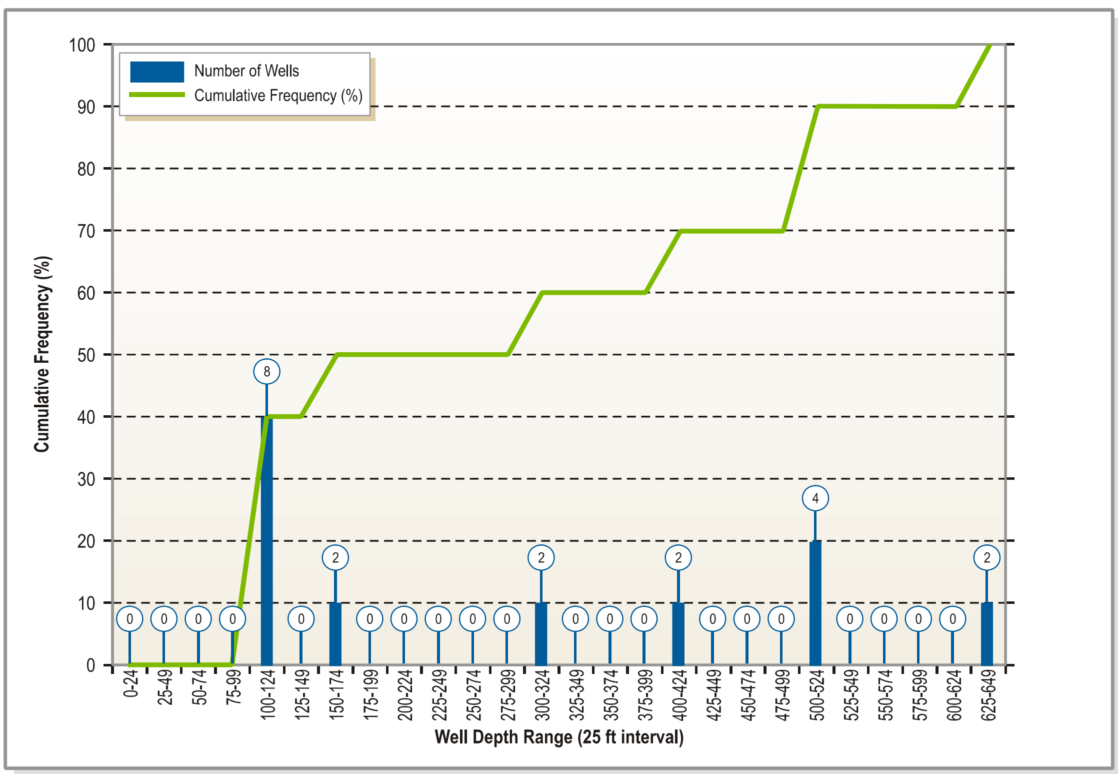
Groundwater Wells

There are 19 domestic wells and 10 irrigation wells in the High Valley Basin. Figures 2-23 and 2-24 present the well depth range and cumulative frequency depth distribution for domestic and irrigation wells in High Valley Basin. Approximately 50 percent of domestic wells are shallower than 125 feet deep, and approximately 50 percent of irrigation wells are shallower than 175 feet deep.



Source: Department of Water Resources

Figure 2-23
Depth Distribution of Domestic Wells in the High Valley Basin



Source: Department of Water Resources

Figure 2-24
Depth Distribution of Irrigation Wells in the High Valley Basin

2.4.6 Burns Valley Basin

Burns Valley Basin is in the Shoreline Inventory Unit (Figure 2-6). The Franciscan Formation borders the Burns Valley Basin on the north, Clear Lake borders the basin on the west, and the Cache Formation borders the basin on the south and east.

Water-Bearing Formations

Quaternary Alluvium

The valley lowlands contain stream channel gravel and adjacent floodplain deposits. These lowland deposits are Quaternary Alluvium and are composed of silt, sand, and gravel. The southern end of the valley has a maximum thickness of approximately 50 feet (DWR 2003). Groundwater in this formation is unconfined and typically provides water for domestic use.

Quaternary Terrace Deposits

Quaternary Terrace Deposits have been deposited on the sides of the alluvial plain in the Burns Valley Basin. The terrace deposits are approximately 15 feet above the valley floor and slope up the valley to a similar elevation as the foothill exposures of the Cache Formation. Groundwater in this formation is not well understood.

Lower Lake Formation

The Lower Lake Formation, consisting of lake deposits, underlies the alluvial and terrace deposits in the Burns Valley Basin. The formation consists of fine sands, silts, and thick interbeds of marl and limestone (Rymer 1981), and has a maximum thickness of 200 feet (DWR 2003). The formation has low permeability and provides water to wells at up to a few hundred gallons per minute (DWR 2003).

Groundwater Hydrogeology

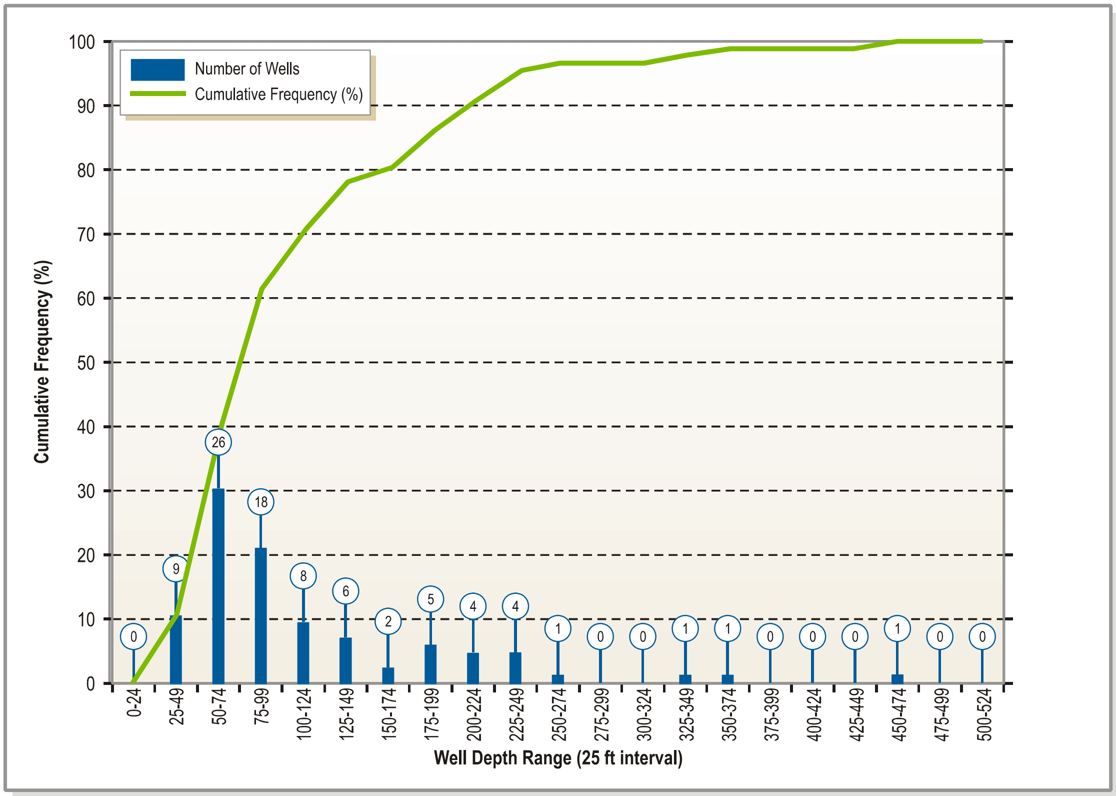
The District monitors one well in the Burns Valley Basin. The monitoring well indicates that groundwater levels fluctuate from 2 feet below ground surface in the spring to 10 feet below ground surface in the fall. The well also indicates that water levels rose in the Burns Valley Basin in 1981-1983. No information on groundwater movement is available. DWR estimates the useable storage capacity to be 1,400 acre-feet (DWR 1960). Average-year agricultural groundwater demand in the Burns Valley basin is approximately 14 acre-feet per year.

Groundwater Quality/Inelastic Land Surface Subsidence

DWR monitors a number of wells for water quality in the Burns Valley Basin. Monitoring is not extensive enough to determine trends in groundwater quality nor the overall character of groundwater in the basin. Information was not available from DHS for the High Valley Groundwater Basin. Current information regarding inelastic land surface subsidence is unavailable.

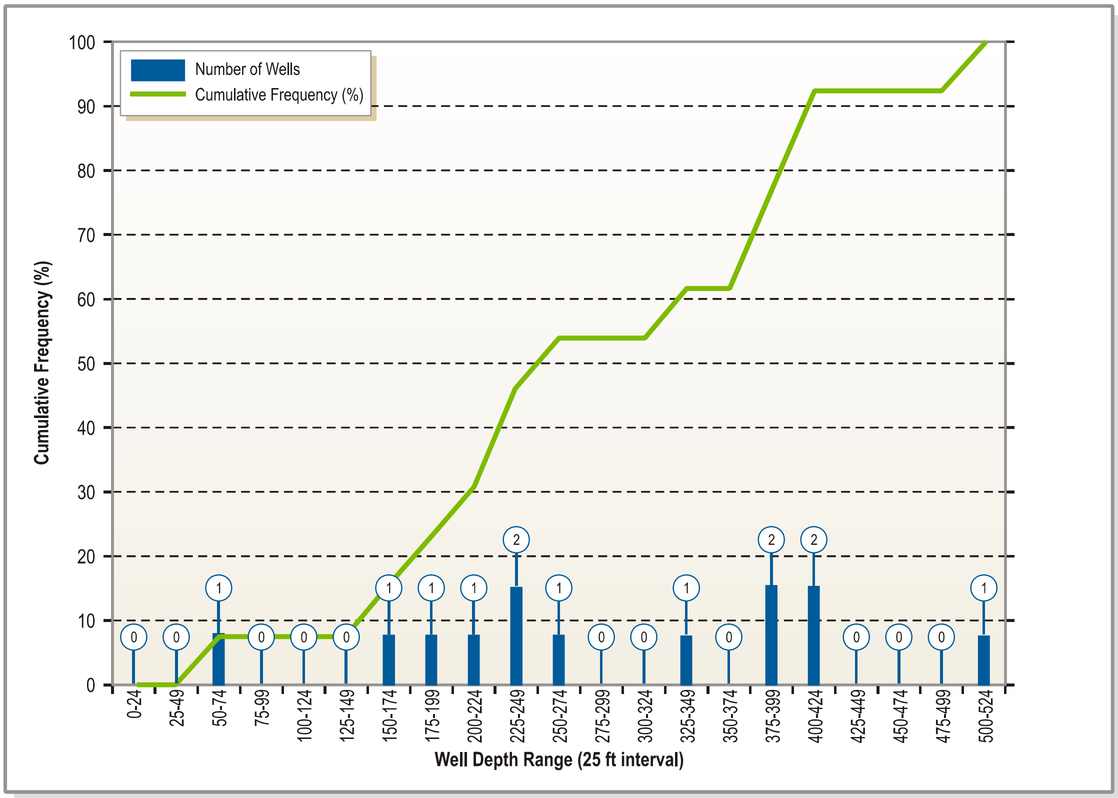
Groundwater Wells

There are 86 domestic wells and 13 irrigation wells in the Burns Valley Basin. Figures 2-25 and 2-26 present the well depth range and cumulative frequency depth distribution for domestic and irrigation wells in Burns Valley Basin. Approximately 50 percent of domestic wells are shallower than 75 feet deep, and approximately 50 percent of irrigation wells are shallower than 250 feet deep.



Source: Department of Water Resources

Figure 2-25
Depth Distribution of Domestic Wells in the Burns Valley Basin



Source: Department of Water Resources

Figure 2-26
Depth Distribution of Irrigation Wells in the Burns Valley Basin

2.4.7 Coyote Valley Basin

Coyote Valley Basin is in the southeastern portion of the county along Putah Creek (Figure 2-6) and is part of the Upper Putah Inventory Unit. Coyote Valley Basin is 5 miles long and 2.5 miles wide. Clear Lake Volcanics border Coyote Valley Basin to the east, Serpentinized ultramafic rocks border the basin to the south and west, and the Franciscan Formation borders the basin to the north. Low hills of basalt are found in the south and southeastern part of the valley.

Water-Bearing Formations

Holocene Alluvium

Holocene alluvium is the primary water-bearing unit in the basin and overlies the Cache Formation. The alluvium consists of floodplain and channel deposits of Putah Creek and alluvial fan deposits in the southwestern portion of the valley and at the valley boundaries. The deposits are primarily composed of poorly stratified sand and gravel, with limited fine grained material. The formation is predominantly interbedded coarse sand and gravel, and ranges from about 100 to 300 feet thick (DWR 1976). Groundwater within the upper 100 feet of the formation is largely unconfined (Peterson 1996). Wells drilled in the alluvium produce on average 1,000 gallons per minute (Aust 2006).

Plio-Pleistocene Volcanics and Cache Formation

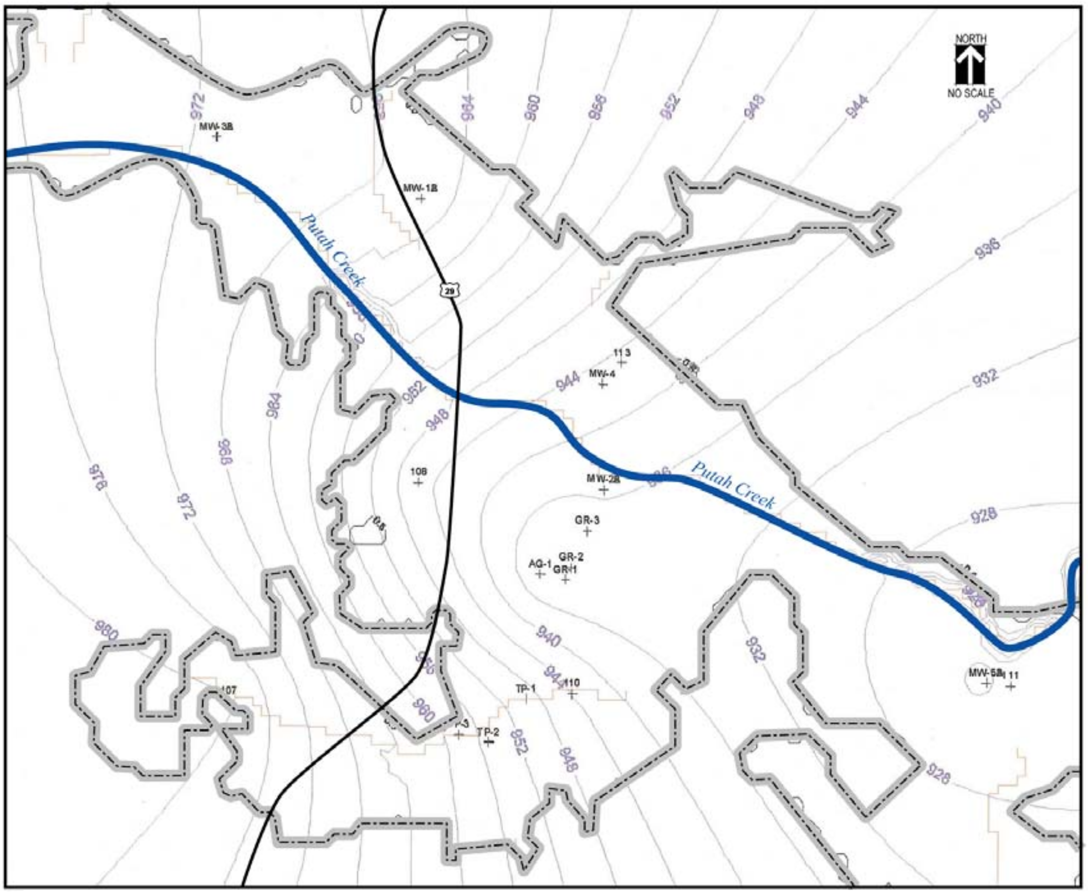
Underlying the valley alluvium is a poorly understood mixture of volcanic rocks and sediments that may be related to the Cache Formation. The southeastern part of the valley contains volcanic rocks and Cache Formation tuffaceous deposits that may be waterbearing. The poorly consolidated tuffaceous deposits are found fairly deep beneath the hills to the northeast where they are overlain and potentially interbedded with basaltic flows. The northeast edge of the valley contains Cache Formation outcrops that likely underlie much of the alluvium. The Cache Formation is made of gravel, silt, sand and the upper layers contain water-laid tuffs and tuffaceous sands become dominant (DOM 1953). The Cache Formation has low permeability because most of the strata are too high in clay or silt to allow for great water movement.

Groundwater Hydrogeology

Putah Creek is the main groundwater recharge source for Coyote Valley Basin. Some recharge occurs from precipitation on the alluvial plain and from side-stream runoff.

Hydrographs in Figure 2-27 at the end of this section show groundwater levels in the Coyote Valley Basin are shallow in the spring, decrease over the summer, and recover during the winter. Water levels in the basin are between 10 to 15 feet below ground surface on average in the spring. Spring groundwater levels have been generally stable throughout the valley.

Spring to summer drawdown of the water table varies by position in the Coyote Valley Basin, with areas in the west experiencing larger drawdown than the rest of the basin. Spring to summer drawdown in the western areas ranges from 20 to 25 feet, and drawdown on the eastern side of the valley ranges from 5 to 10 feet. The general direction of groundwater flow in the Coyote Valley is to the southeast, in the direction of Putah Creek flow (Figure 2-28). DWR estimated 29,000 acre feet of storage capacity and 7,000 acre feet of useable storage capacity in 1960. Average-year agricultural groundwater demand in the Coyote Valley basin is approximately 671 acre-feet per year.



Source: Hidden Valley Lake Community Services District

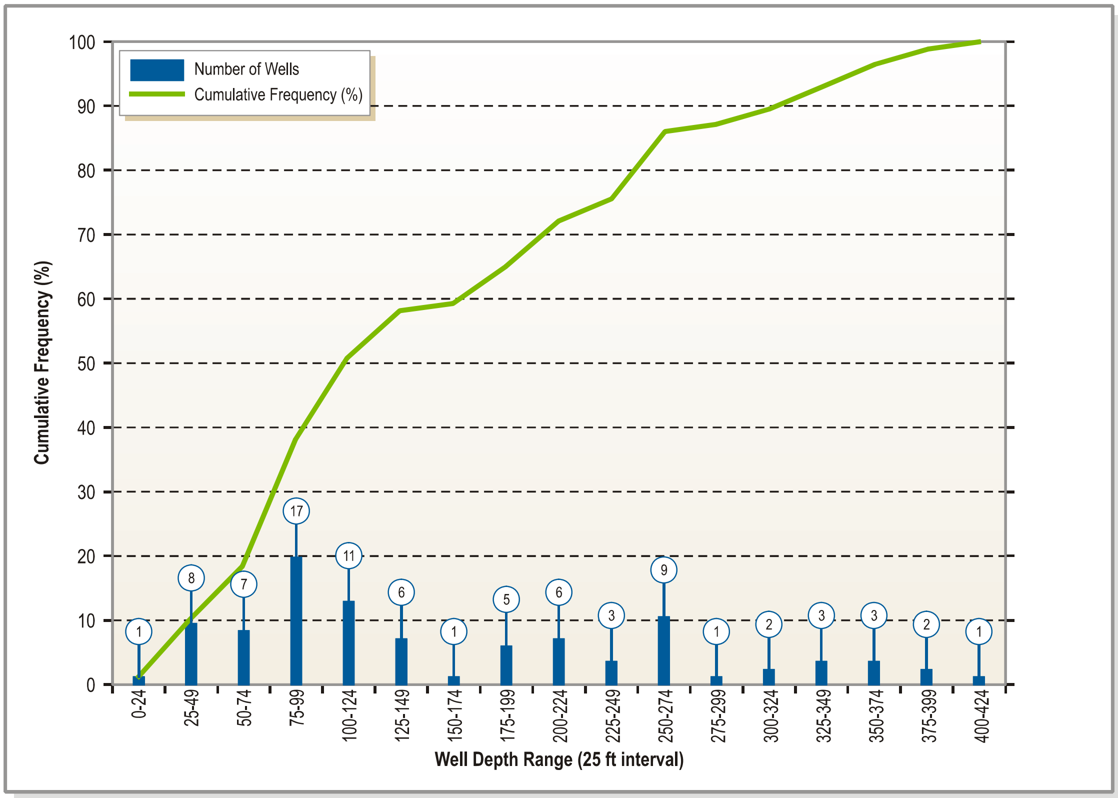
Figure 2-28
Coyote Valley Groundwater Level Contours, April 2001

Groundwater Quality/Inelastic Land Surface Subsidence

DWR monitors a number of wells for water quality in the Coyote Valley Groundwater Basin. Monitoring is not extensive enough to determine trends in groundwater quality or the overall character of groundwater in the basin. Information obtained from DHS indicates that iron and manganese have been detected above SWQLs in the Coyote Valley, and chromium was identified as a constituent of concern by Coyote Valley Stakeholders. Current information regarding inelastic land surface subsidence is unavailable.

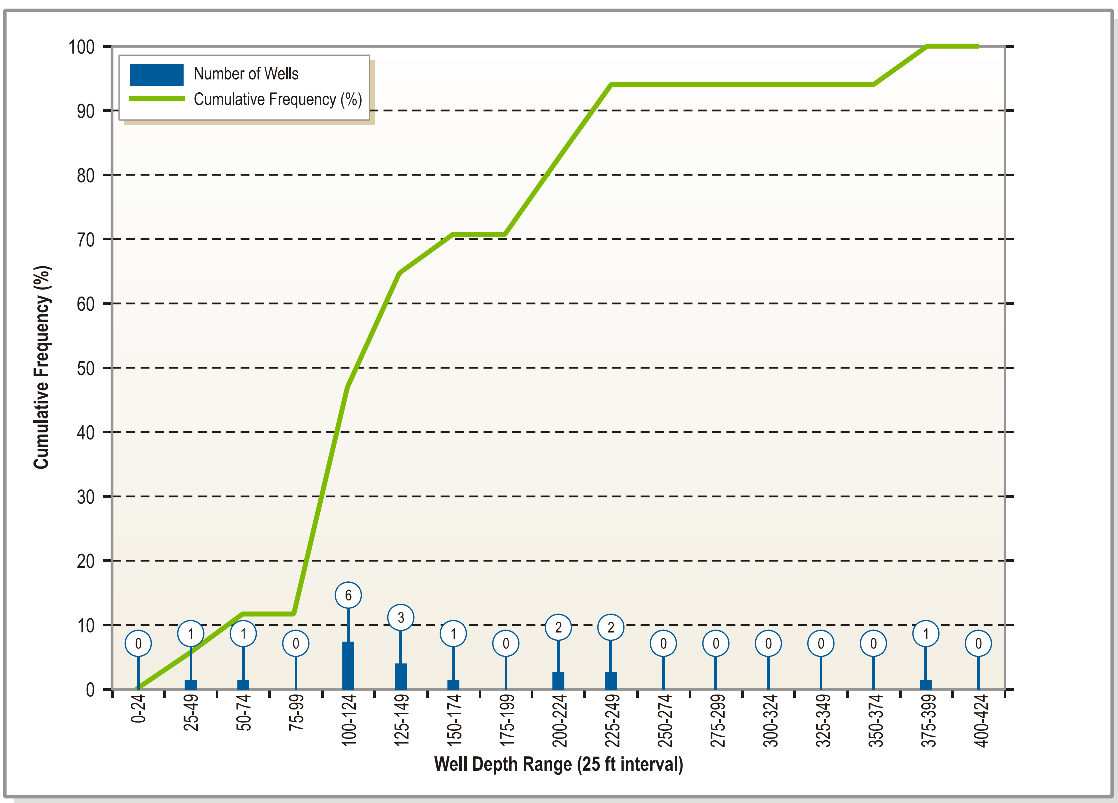
Groundwater Wells

There are 86 domestic wells and 17 irrigation wells in the Coyote Valley Basin. Figures 2-29 and 2-30 present the well depth range and cumulative frequency depth distribution for domestic and irrigation wells in Coyote Valley Basin. Approximately 50 percent of domestic wells are shallower than 125 feet deep, and approximately 50 percent of irrigation wells are shallower than 125 feet deep.



Source: Department of Water Resources

Figure 2-29
Depth Distribution of Domestic Wells in the Coyote Valley Basin



Source: Department of Water Resources

Figure 2-30
Depth Distribution of Irrigation Wells in the Coyote Valley Basin

2.4.8 Collayomi Valley Basin

The Collayomi Valley Basin is in the southern portion of Lake County (Figure 2-6) and is the source of water supply for Middletown and adjacent agricultural areas. The basin includes Collayomi and Long Valley, both in the Upper Putah Inventory Unit. The two valleys are considered a single groundwater basin due to their hydrologic continuity. The Franciscan Formation borders the basin to the west, and a mixture of Serpentinized Ultramafic Rocks and Franciscan Formation borders the basin to the north, east, and south. A small area of volcanic rocks borders the central southern portion of the valley. The boundary is typically the edge of the valley floor except where water bearing basalt and landslide debris extend beyond the valley floor.

Water-Bearing Formations

Quaternary Alluvium

Quaternary alluvium in the Collayomi Valley Basin consists of deposits of clay and silt, with localized areas of channelized gravel. Near Putah Creek, shallow deposits of fine sand and cobbles are present. The maximum thickness of alluvium in the basin is approximately 350 feet in Collayomi Valley, and 475 feet in Long Valley (DWR 1976). Alluvium generally is a productive water bearing unit.

Groundwater Hydrogeology

Recharge occurs in the Collayomi basin next to Putah, Dry, and St. Helena Creeks. Some recharge also occurs from infiltration of irrigation water and direct rainfall. Recharge in Long Valley may be impeded by hardpan conditions near the ground surface (DWR 1976).

Hydrographs in Figure 2-31 at the end of this section show groundwater levels in the Collayomi Valley Basin are shallow in the spring and experience fluctuations over the irrigation season. Water levels in the basin range from 3 to 15 feet below the ground surface in the spring, and spring groundwater levels have remained generally constant over the last 40 years.

Spring to summer drawdown of groundwater is generally between 5 and 20 feet throughout the Collayomi Valley Basin. The direction of groundwater flow in the Collayomi Valley is to the north where it discharges to Putah Creek. Groundwater flow in Long Valley is from the southeast to the northwest where it also discharges to Putah Creek. Groundwater in both valleys generally flows the same direction as surface flow (CMA 1987). Groundwater levels in the basin seem to completely recover each wet season, and overall there does not appear to be any increasing or decreasing trend in groundwater levels.

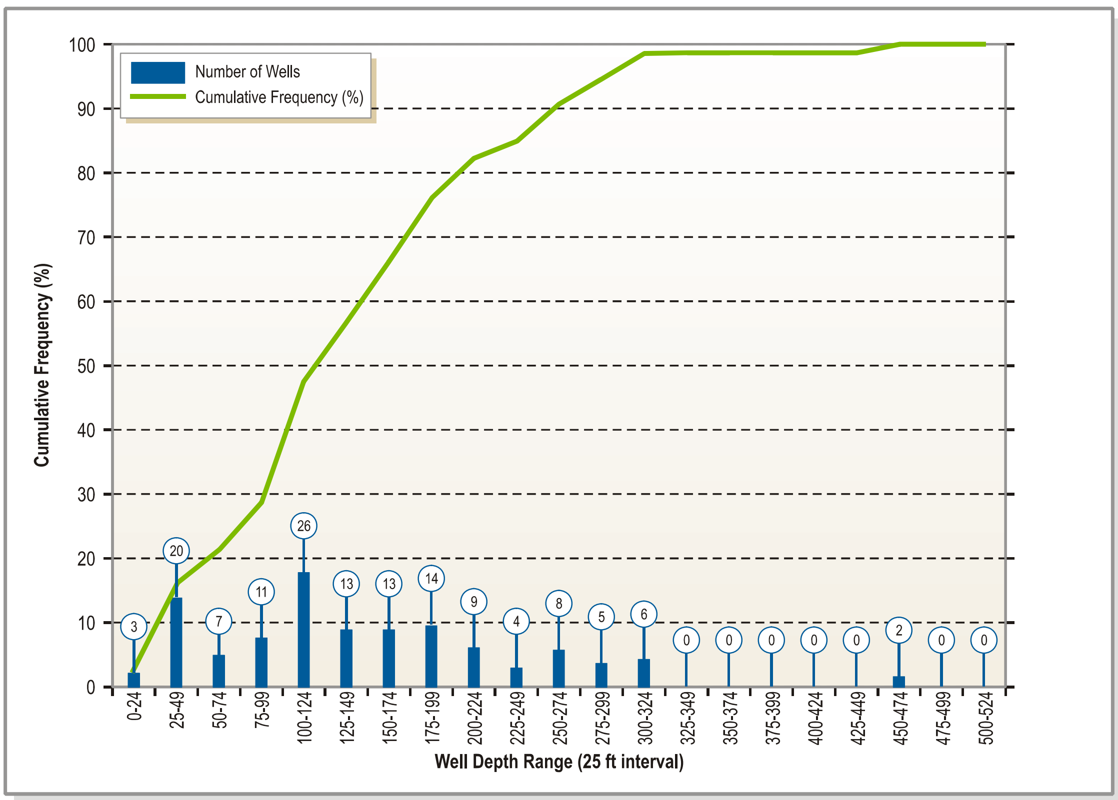
Total storage in the basin is approximately 37,000 acre-feet (CMA 1987). DWR estimates groundwater storage in the Collayomi Basin to be 29,000 acre-feet with a useable storage capacity of 7,000 acre-feet (DWR 1960).Average-year agricultural groundwater demand in the Collayomi Valley basin is 266 acre-feet per year.

Groundwater Quality/Inelastic Land Surface Subsidence

DWR monitors a number of wells for water quality in the Collayomi Valley Groundwater Basin. Monitoring is not extensive enough to determine trends in groundwater quality or the overall character of groundwater in the basin. Information obtained from DHS indicates that iron and manganese have been detected above SWQLs in Collayomi Valley and sulfide was identified as a constituent of concern by Collayomi Valley Stakeholders. Current information regarding inelastic land surface subsidence is unavailable.

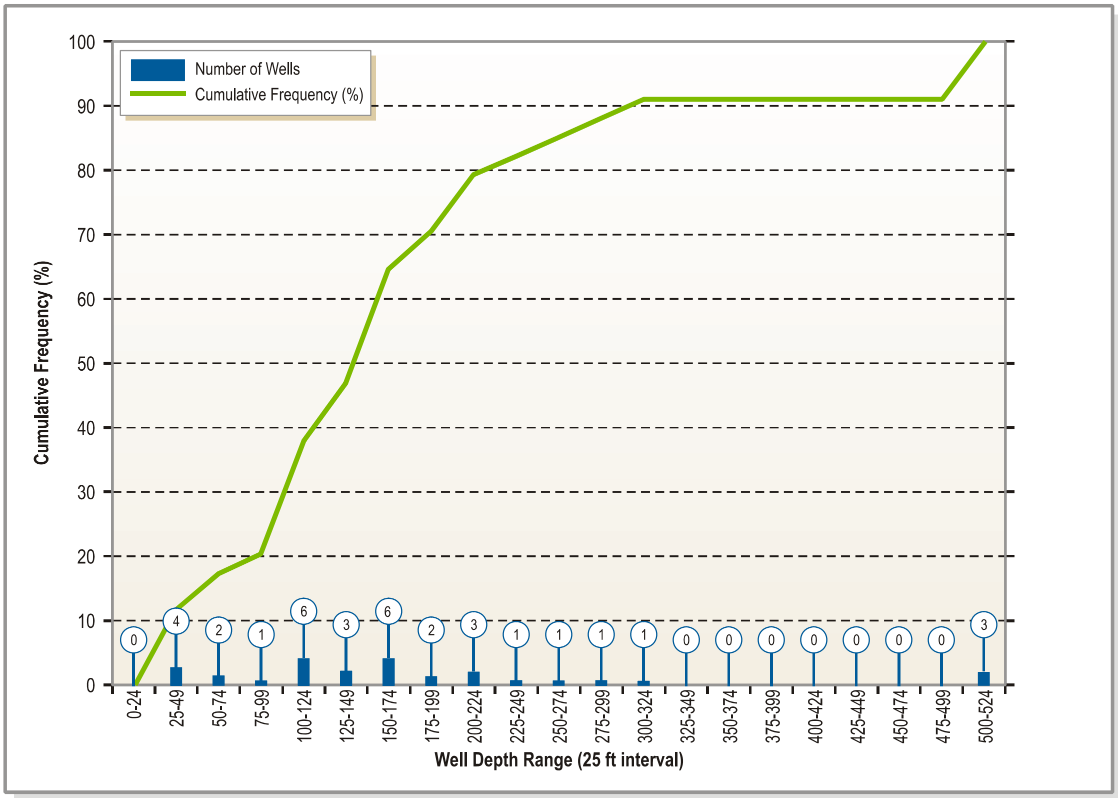
Groundwater Wells

There are 141 domestic wells and 34 irrigation wells in the Collayomi Valley Basin. Figures 2-32 and 2-33 present the well depth range and cumulative frequency depth distribution for domestic and irrigation wells in Collayomi Valley Basin. Approximately 50 percent of domestic wells are shallower than 125 feet deep, and approximately 50 percent of irrigation wells are shallower than 150 feet deep.



Source: Department of Water Resources

Figure 2-32
Depth Distribution of Domestic Wells in the Collayomi Valley Basin



Source: Department of Water Resources

Figure 2-33
Depth Distribution of Irrigation Wells in the Collayomi Valley Basin

2.4.9 Lower Lake Basin

The Lower Lake Basin is southeast of Clear Lake (Figure 2-6) in the Shoreline and Lower Lake Inventory Units. The rocks of the Great Valley sequence border the Lower Lake Basin on the south (Rymer 1981), and the Cache Formation and volcanic rock border the basin to the north. The Lower Lake Formation and volcanic rocks occur within this basin. Average-year agricultural groundwater demand in the Lower Lake basin is approximately 17 acre-feet per year.

Water-Bearing Formations

Quaternary Alluvium

Alluvial deposits consist of clay, silt, sand and gravel and are approximately 50 to 75 feet thick. Irrigation wells constructed near the alluvial deposits provide about 400 to 600 gpm (Upson 1955). The alluvial plain of Herndon Creek likely contains gravelly clay, and is interbedded with gravel layers. Wells in the area with depths of approximately 75 feet yield up to 250 gpm with 40 feet of drawdown (Upson 1955).

Lower Lake Formation

The Lower Lake Formation includes conglomerate, sandstone, siltstone, limestone, tuff, and diatomite (Rymer 1981). Younger alluvial deposits are found above the Lower Lake Formation and cover an area almost two-thirds of the basin. Permeability is variable but generally low because the strata are high in clay or silt. The formation thickness is unknown. Well yields are about 150 to 240 gpm (Upson 1955).

Groundwater Hydrogeology

Precipitation and seepage from Herndon Creek and Clear Lake are the main sources of recharge for the basin (Upson 1955). Recharge is also likely from Copsey and Seigler Canyon creeks. Infiltration of rain falling on the outcrop areas is the likely source of groundwater recharge in the Cache Formation (Upson 1955).

DWR monitored three groundwater wells in the Lower Lake Basin, but discontinued monitoring by 1995. Monitoring prior to 1995 indicates that groundwater levels fluctuated from an average of 10 feet below ground surface in the spring to an average of 20 feet below ground surface in the fall. There is no information on groundwater movement.

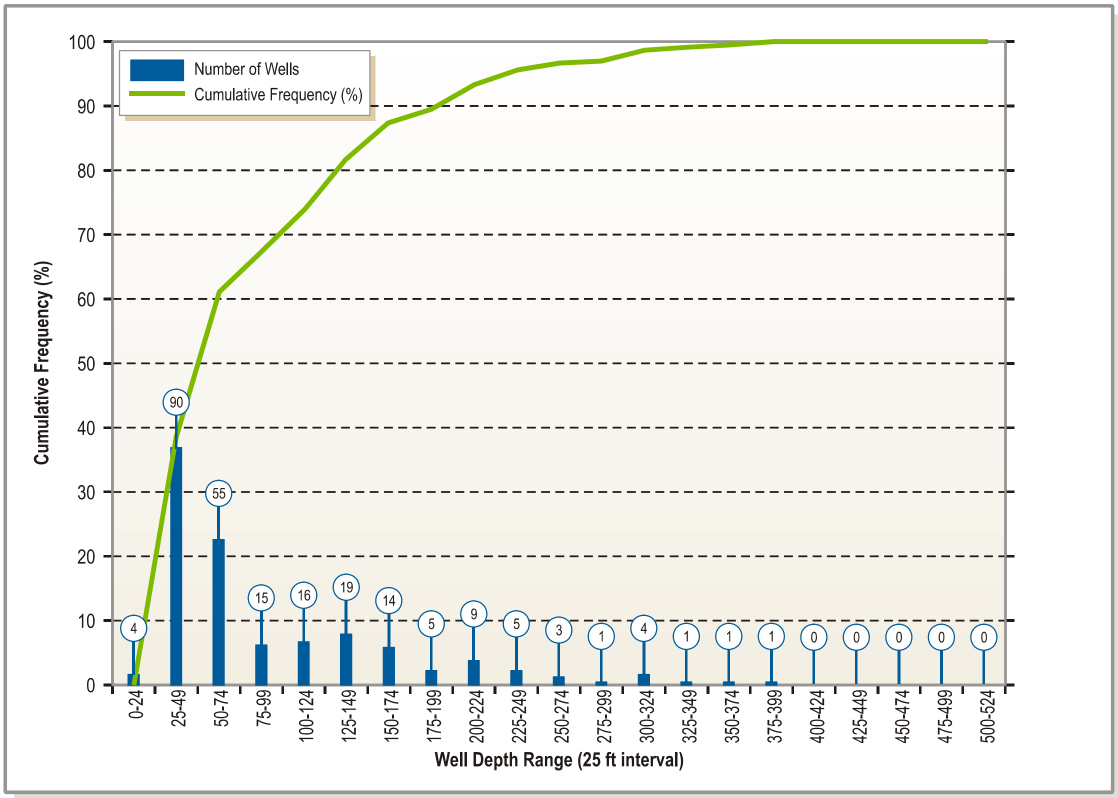
The basin's storage capacity is approximately 3,000 to 4,000 acre-feet (Upson 1955). Additional storage capacity is available as part of the Lower Lake Formation but thickness and yield are unknown.

Groundwater Quality/Inelastic Land Surface Subsidence

DWR monitors a number of wells for water quality in the Lower Lake Groundwater Basin. Monitoring is not extensive enough to determine trends in groundwater quality or the overall character of groundwater in the basin. Information was not available from DHS for the Lower Lake Basin. Current information regarding inelastic land surface subsidence is unavailable.

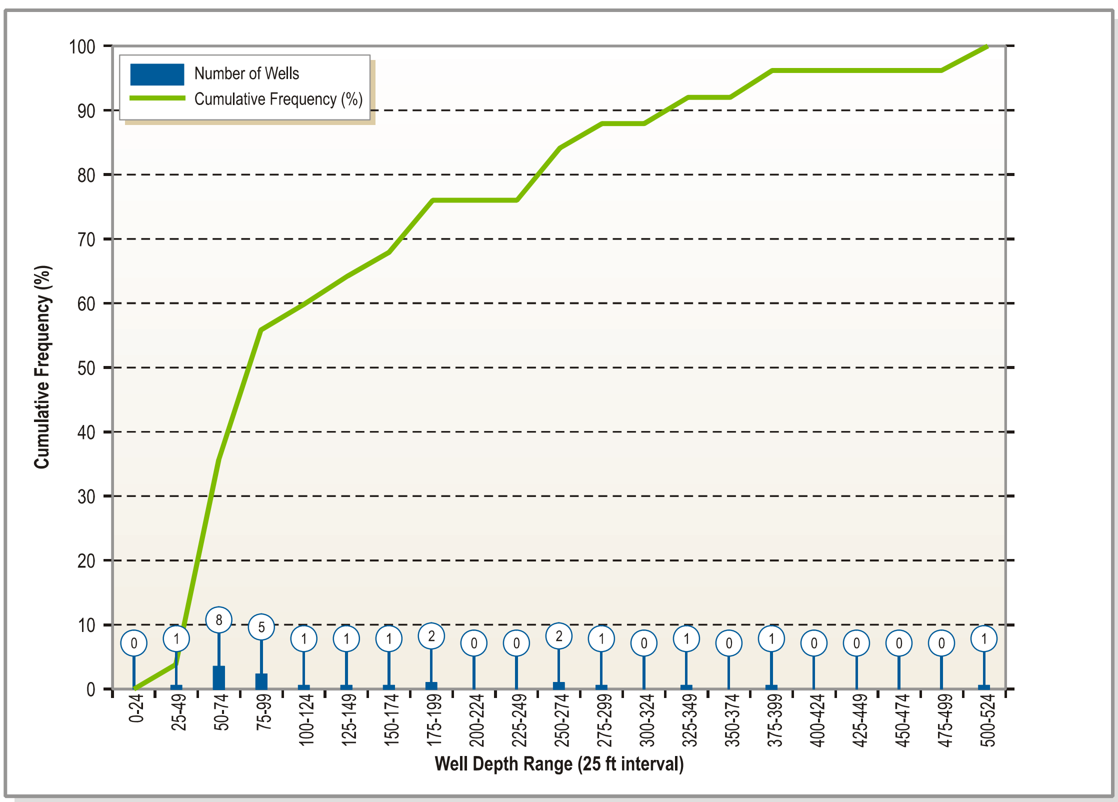
Groundwater Wells

There are 243 domestic wells and 25 irrigation wells in the Lower Lake Basin. Figures 2-34 and 2-35 present the well depth range and cumulative frequency depth distribution for domestic and irrigation wells in Lower Lake Basin. Approximately 50 percent of domestic wells are shallower than 50 feet deep, and approximately 50 percent of irrigation wells are shallower than 100 feet deep.



Source: Department of Water Resources

Figure 2-34
Depth Distribution of Domestic Wells in the Lower Lake Basin



Source: Department of Water Resources

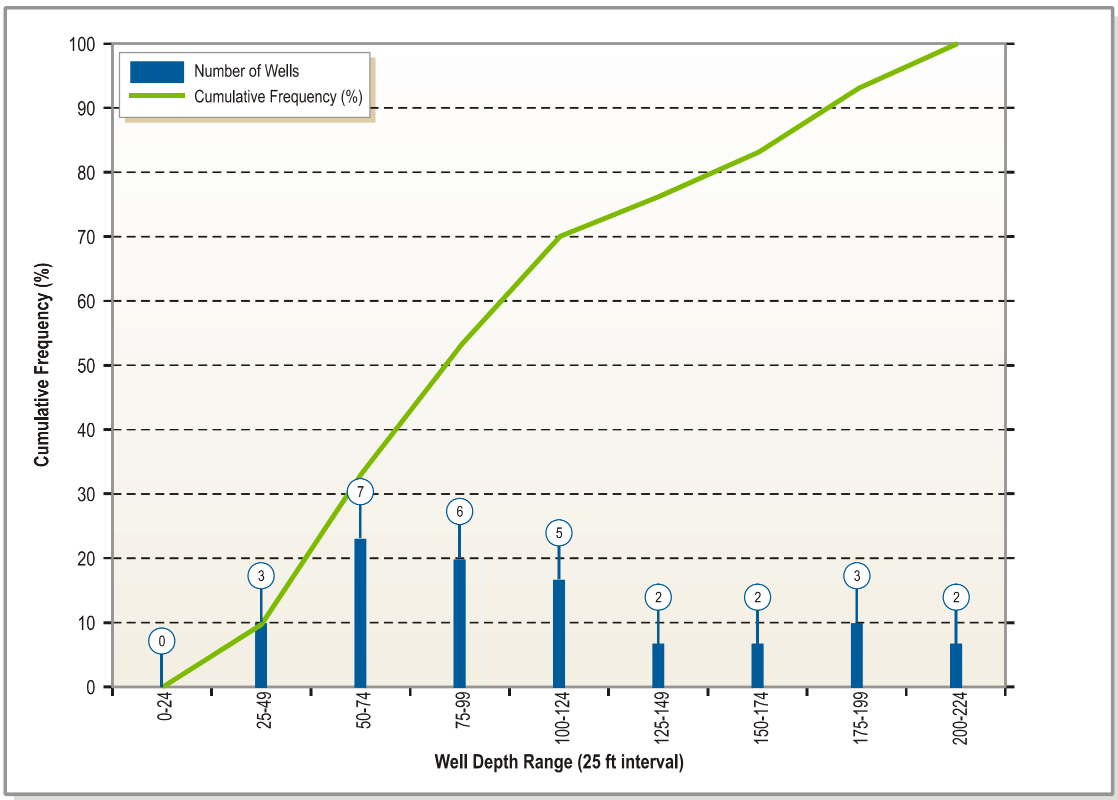
Figure 2-35
Depth Distribution of Irrigation Wells in the Lower Lake Basin

2.4.10 Long Valley Groundwater Basin

Long Valley Groundwater Basin is in the northeast portion of the county (Figure 2-6) in the Cache Creek Inventory Unit. The Franciscan Formation borders most of the Long Valley Groundwater Basin. Volcanic rocks form a small section of the southern boundary. The basin is made up of alluvial fill. Very little information exists about this groundwater basin. Average-year agricultural groundwater demand in the Long Valley basin is approximately 253 acre-feet per year.

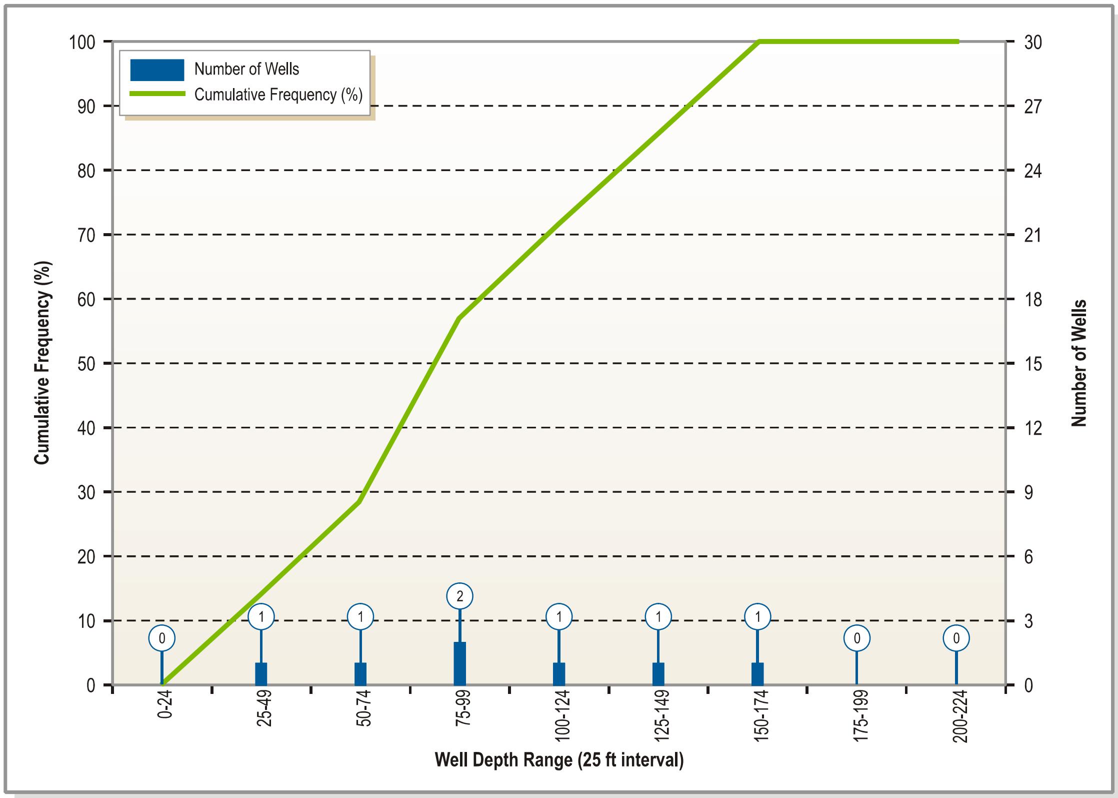
Groundwater Wells

There are 30 domestic wells and 7 irrigation wells in the Long Valley Groundwater Basin. Figures 2-36 and 2-37 present the well depth range and cumulative frequency depth distribution for domestic and irrigation wells in Long Valley Groundwater Basin. Approximately 50 percent of domestic wells are shallower than 100 feet deep, and approximately 50 percent of irrigation wells are shallower than 100 feet deep.



Source: Department of Water Resources

Figure 2-36
Depth Distribution of Domestic Wells in the Long Valley Groundwater Basin



Source: Department of Water Resources

Figure 2-37
Depth Distribution of Irrigation Wells in the Long Valley Groundwater Basin

2.4.11 Clear Lake Cache Formation Groundwater Basin

The Clear Lake Cache Formation Groundwater Basin is east of Clear Lake and is in both the Shoreline and Cache Creek Inventory Units (Figure 2-6). The Clear Lake Cache Formation Groundwater Basin shares a boundary with the Burns Valley Groundwater Basin in the southwest. Lower Cretaceous marine and Mesozoic ultra-basic intrusive rocks bound the south of the basin. Lower Cretaceous marine deposits border the east portion of the basin, and the Franciscan Formation borders the north and west portions of the basin.

Water-Bearing Formations

Cache Formation

The Cache Formation is generally of low porosity, and is the only water-bearing formation in the Clear Lake Cache Formation Groundwater Basin. The Cache Formation ranges in age from 1.6 to 1.8 million years old and is over 13,000 feet thick (Hearn 1988). The Cache Formation is characterized by sandstone, conglomerate, gray sandstone with light-olive-gray conglomerate lower in the section. It represents fluvial deposition, and was deposited in a fault-controlled, subsiding basin (Rymer 1981). The Cache Formation overlies the Franciscan Formation and Serpentinized Ultramafic Rocks, and is overlain by the Clear Lake Pleistocene Volcanics, and the Lower Lake Formation (Rymer 1981). The Cache Formation dips to the southwest.

Groundwater Hydrogeology

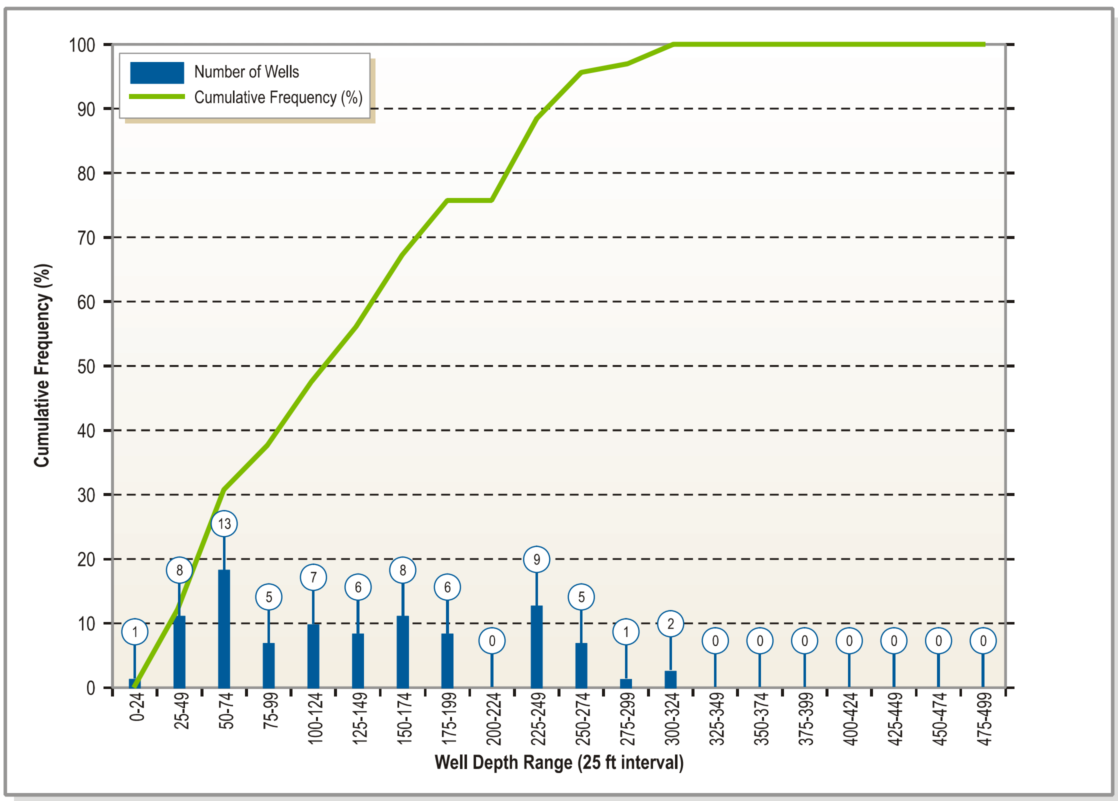
Groundwater levels have not been monitored in the Cache Formation. Other hydrogeologic information for the basin is unavailable. Average-year agricultural groundwater demand in the Clear Lake Cache Formation basin is approximately 85 acre-feet per year.

Groundwater Quality/Inelastic Land Surface Subsidence

Current information regarding groundwater quality and inelastic land surface subsidence is unavailable.

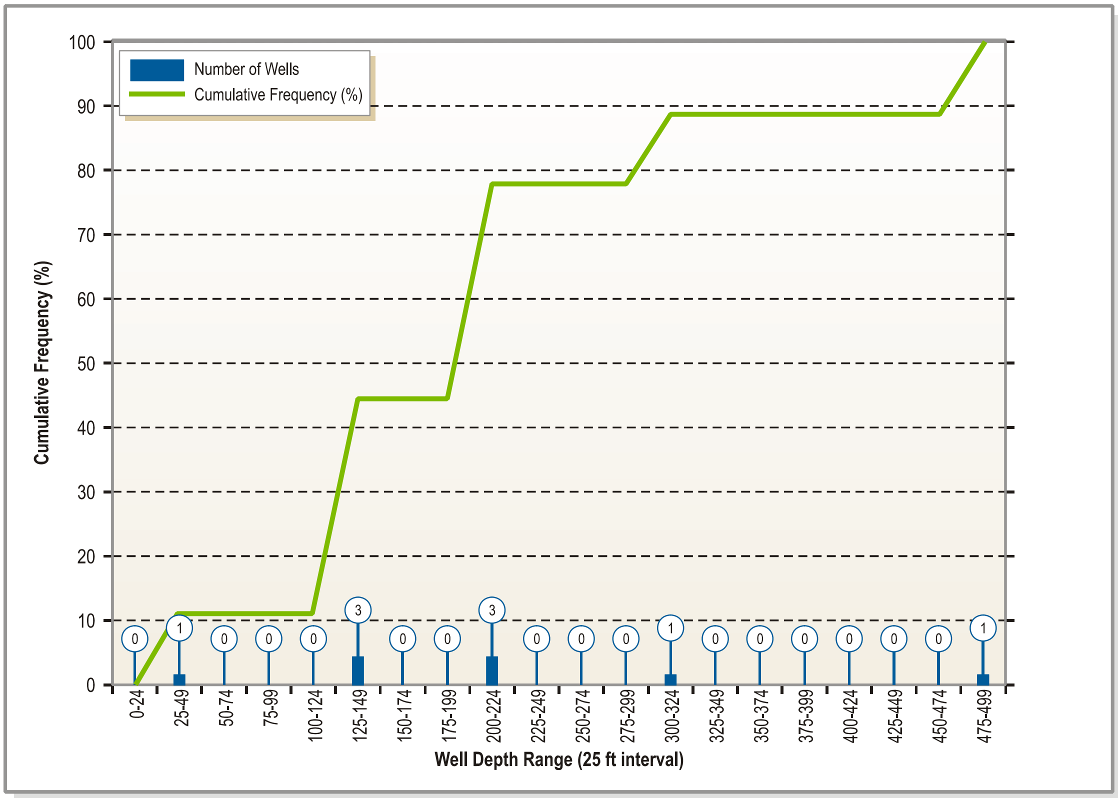
Groundwater Wells

There are 71 domestic wells and 9 irrigation wells in the Clear Lake Cache Formation Groundwater Basin. Figures 2-38 and 2-39 present the well depth range and cumulative frequency depth distribution for domestic and irrigation wells in Clear Lake Cache Formation Groundwater Basin. Approximately 50 percent of domestic wells are shallower than 125 feet deep, and approximately 50 percent of irrigation wells are shallower than 200 feet deep.



Source: Department of Water Resources

Figure 2-38
Depth Distribution of Domestic Wells in the Clear Lake Cache Formation Groundwater Basin



Source: Department of Water Resources

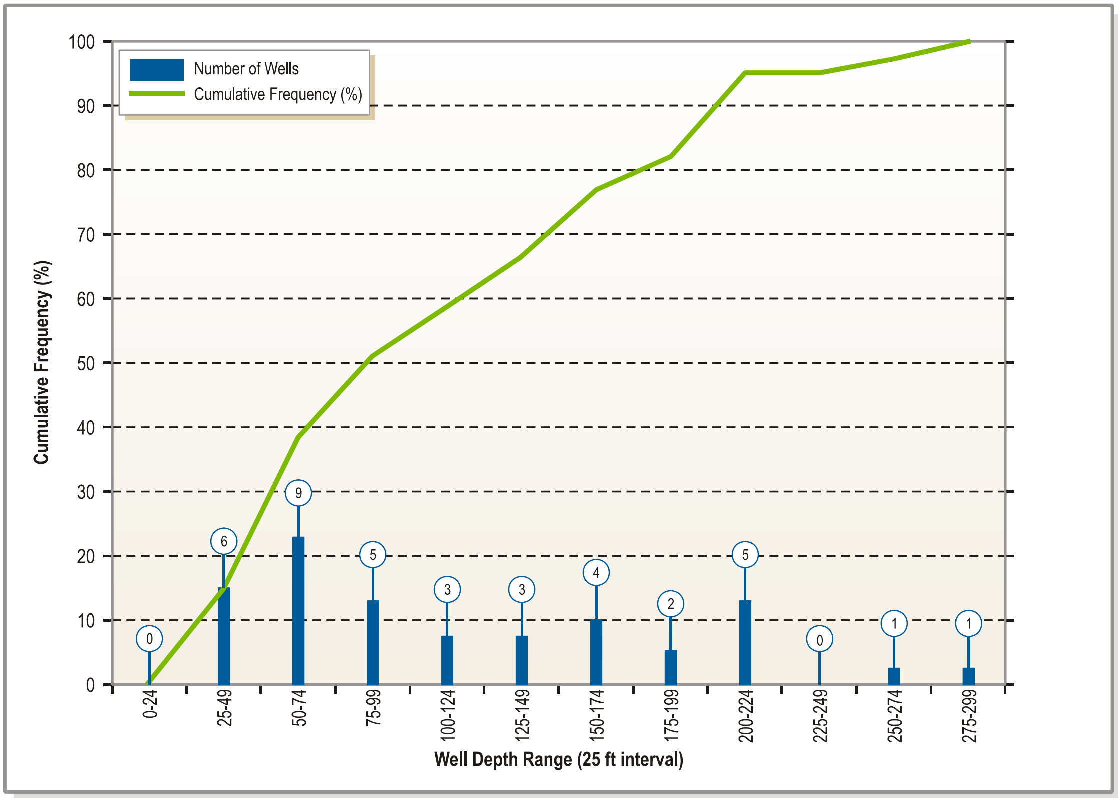
Figure 2-39
Depth Distribution of Irrigation Wells in the Clear Lake Cache Formation Groundwater Basin

2.4.12 Middle Creek Groundwater Basin

The Middle Creek Groundwater Basin is in the Middle Creek Inventory Unit (Figure 2-6). The Franciscan Formation borders the Middle Creek Groundwater Basin to the north and east. Lower Cretaceous Marine deposits bound the basin to the west. The basin is made up of alluvial fill. Little information is available about the Middle Creek Groundwater Basin. Average-year agricultural groundwater demand in the Middle Creek basin is approximately 73 acre-feet per year.

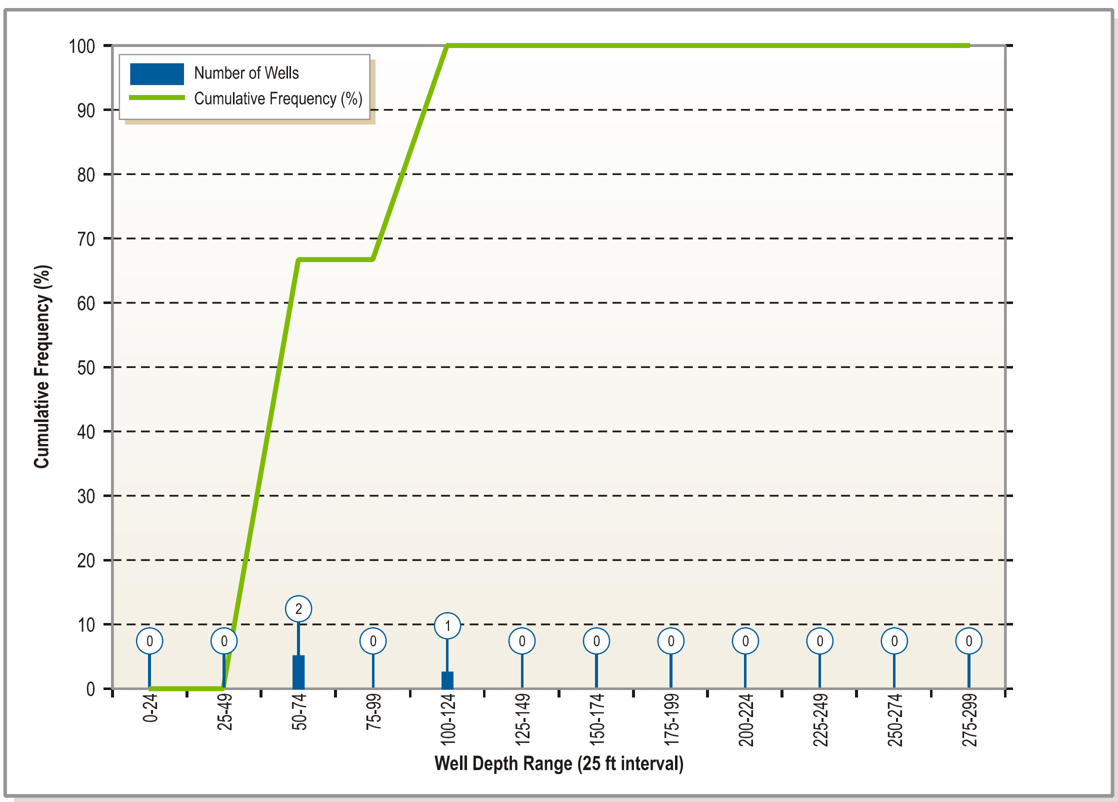
Groundwater Wells

There are 39 domestic wells and 3 irrigation wells in the Middle Creek Groundwater Basin. Figures 2-40 and 2-41 present the well depth range and cumulative frequency depth distribution for domestic and irrigation wells in Middle Creek Groundwater Basin. Approximately 50 percent of domestic wells are shallower than 100 feet deep, and approximately 50 percent of irrigation wells are shallower than 75 feet deep.



Source: Department of Water Resources

Figure 2-40
Depth Distribution of Domestic Wells in the Middle Creek Groundwater Basin



Source: Department of Water Resources

Figure 2-41
Depth Distribution of Irrigation Wells in the Middle Creek Groundwater Basin

2.4.13 Clear Lake Volcanics Groundwater Source Area

The Clear Lake Volcanics groundwater source area is south of Clear Lake and is in the Shoreline, Middle Putah, and Upper Putah Inventory Units. The Clear Lake Volcanics share a boundary with the Big Valley Groundwater Basin to the west (Figure 2-6). The Franciscan Formation bounds the south and east of the area.

Water-Bearing Formations

Clear Lake Volcanics

The Clear Lake Volcanics consist of basalt, andesite, and other volcanic rocks in a complex sequence. The Clear Lake Volcanics are heavily faulted and fractured, and are over 4,000 feet thick near Mount Konocti (Hearn 1988). A well drilled near the intersection of Red Hills Road and Highway 29 revealed that the formation was 1,600 feet thick at that location (Slade 2002). Groundwater in the Clear Lake Volcanics occurs primarily in fractures, joints, and within weathered zones that formed in between volcanic eruptions. The amount of groundwater available to a well in the formation is highly dependent on the size, openness, frequency, and interconnection of fractures and joints encountered in the well.

Groundwater Hydrogeology

Overall, the hydrogeologic properties of the Clear Lake Volcanics vary widely between different locations in the area, and are not well defined. In some areas, pump tests have been performed to determine aquifer properties. Pump tests determine an aquifer's characteristics at a particular well location. Pump tests typically reveal specific capacity and transmissivity. Specific capacity is a calculated number based on the pumping rate in gallons divided by a measurement of the difference of static and pumping levels in the well. Higher specific capacities indicate a productive well, and low specific capacities indicate an unproductive well. Transmissivity is the capacity of an aquifer to transmit water. A higher transmissivity indicates the aquifer is able to transmit more water.

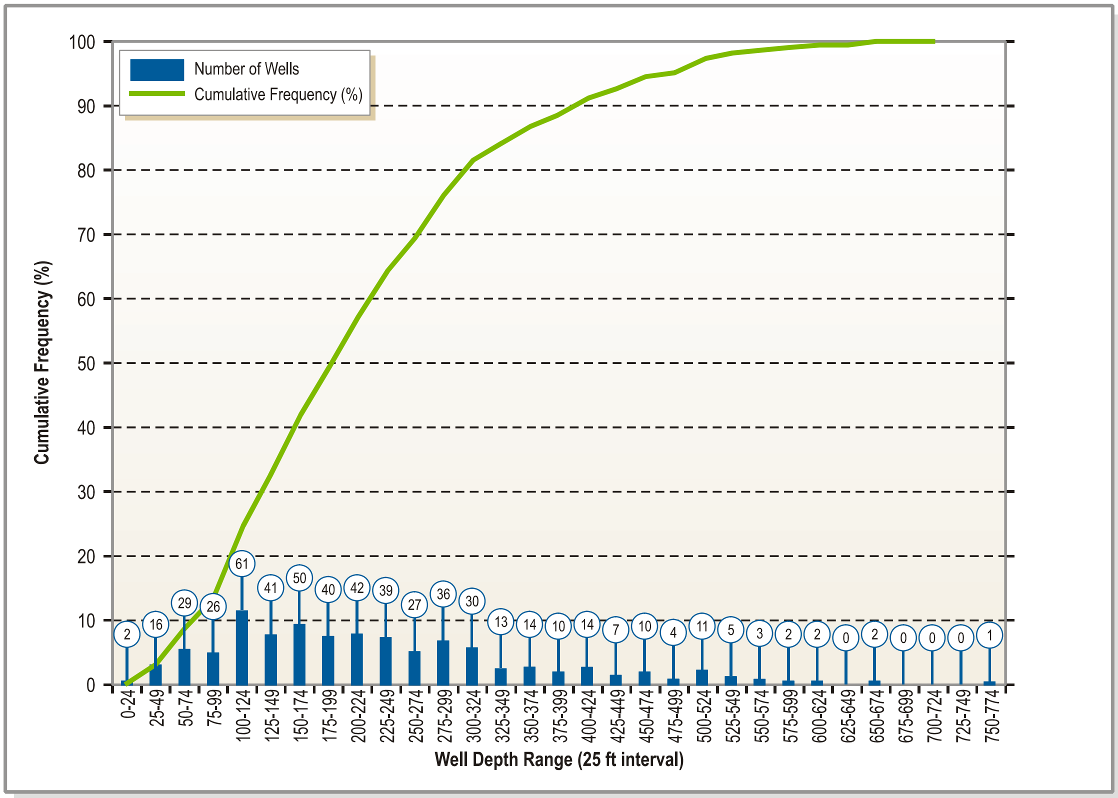
A pumping test performed on a well east of Soda Bay Road in the Clear Lake Volcanics revealed a specific capacity of 43 gpm/ft, and a transmissivity ranging between 20,000 and 86,000 gpd/ft (Hicke 2002). Other pump tests performed near the intersection of Red Hills Road and Highway 29 indicated specific capacities of 1.25, 47.6, and 18.7 gpm/ft, and pumping rates of 555 gpm, 150 gpm, and 670 gpm. Average-year agricultural groundwater demand in the Clear Lake Volcanics basin is approximately 2,271 acre-feet per year.

Groundwater Quality/Inelastic Land Surface Subsidence

Published information regarding groundwater quality and inelastic land surface subsidence is unavailable. Information obtained from DHS indicates that iron, aluminum and manganese have been detected above SWQLs in the Clear Lake Volcanics.

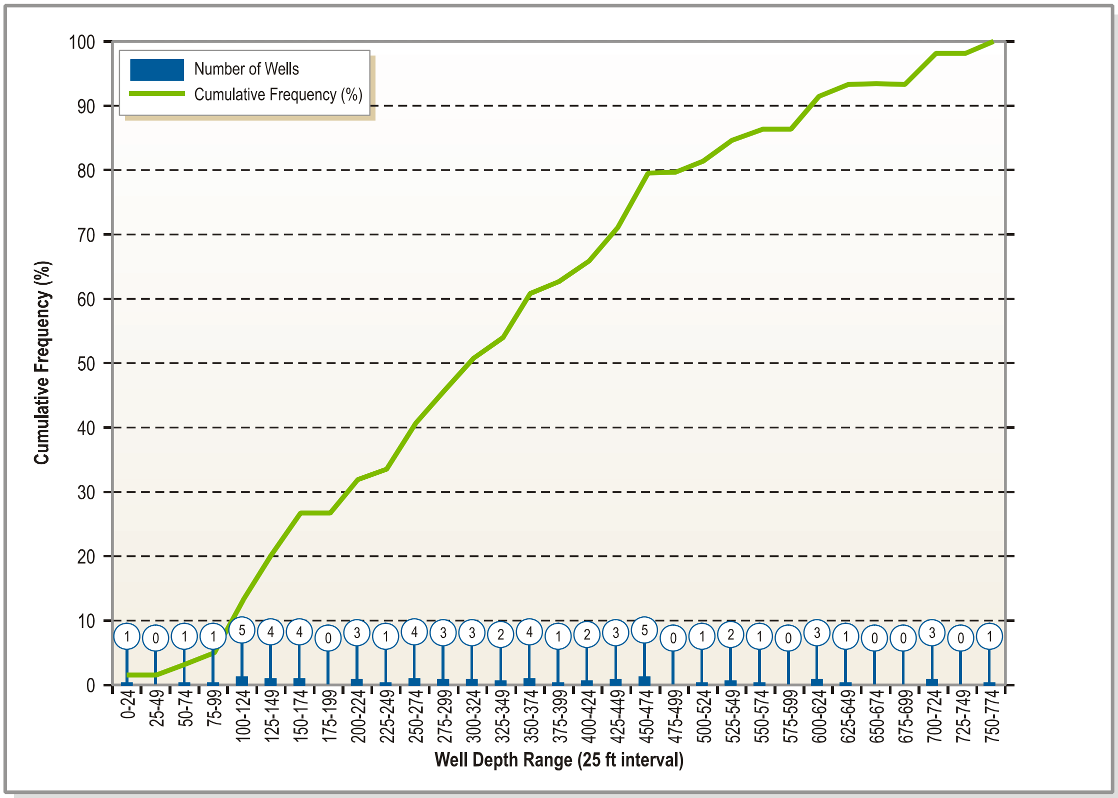
Groundwater Wells

There are 537 domestic wells and 59 irrigation wells in the Clear Lake Volcanics Groundwater Source Area. Figures 2-42 and 2-43 present the well depth range and cumulative frequency depth distribution for domestic and irrigation wells in Clear Lake Volcanics Groundwater Source Area. Approximately 50 percent of domestic wells are shallower than 200 feet deep, and approximately 50 percent of irrigation wells are shallower than 325 feet deep.



Source: Department of Water Resources

Figure 2-42
Depth Distribution of Domestic Wells in the Clear Lake Volcanics Groundwater Source Area



Source: Department of Water Resources

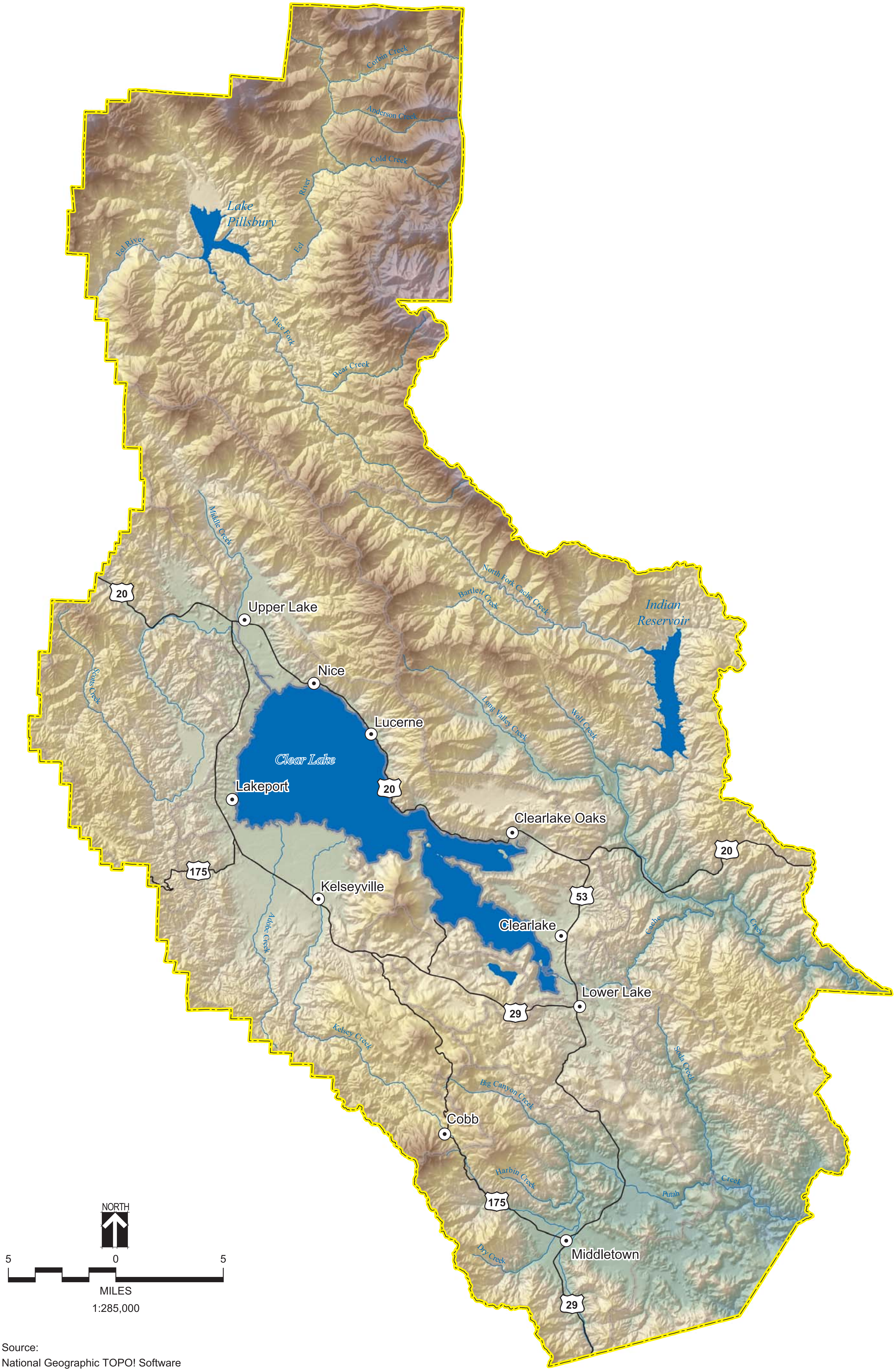
Figure 2-43
Depth Distribution of Irrigation Wells in the Clear Lake Volcanics Groundwater Source Area

2.5 Agricultural Water Demand by Groundwater Basin

Water demand was calculated to estimate the average year agricultural water use overlying groundwater basins in Lake County. The calculation was performed using 2001 land use data from DWR, and crop irrigation requirements for an average water year from DWR. Acreage of land use of each crop was multiplied by the crop's water demand and a factor representing irrigation efficiency, and then demand for each crop was totaled by groundwater basin. Calculations for each groundwater basin are presented in Appendix B. This data provides a snapshot of approximate water demand near the year 2001; land use changes that occurred after 2001 are not represented by this calculation.

Table 2-4 ***Agricultural Demand in Lake County by Groundwater Basin During an Average Year***						
Groundwater Basin	***Land Irrigated with Surface Water (acres)***	***Land Irrigated with Groundwater (acres)***	***Irrigated Land Total (acres)***	***Surface Water Demand (acre-ft)***	***Groundwater Demand (acre-ft)***	***Total Demand (acre-ft)***
Gravelly Valley	0	0	0	0	0	**0**
Upper Lake Valley	1,117	1,509	2,920	4,182	4,075	**8,257**
Scotts Valley	0	856	856	0	2,369	**2,369**
Big Valley	23	6,765	6,788	91	11,363	**11,454**
High Valley	0	64	64	0	36	**36**
Burns Valley	162	5	167	91	14	**105**
Coyote Valley	1,059	348	1,407	3,402	671	**4,073**
Collayomi Valley	33	317	350	146	266	**412**
Lower Lake Valley	0	31	31	0	17	**17**
Long Valley	0	118	118	0	253	**253**
Clear Lake Cache Formation	26	132	158	15	85	**100**
Middle Creek	0	18	18	0	73	**73**
Clear Lake Volcanics	185	2,979	3,164	820	2,271	**3,091**

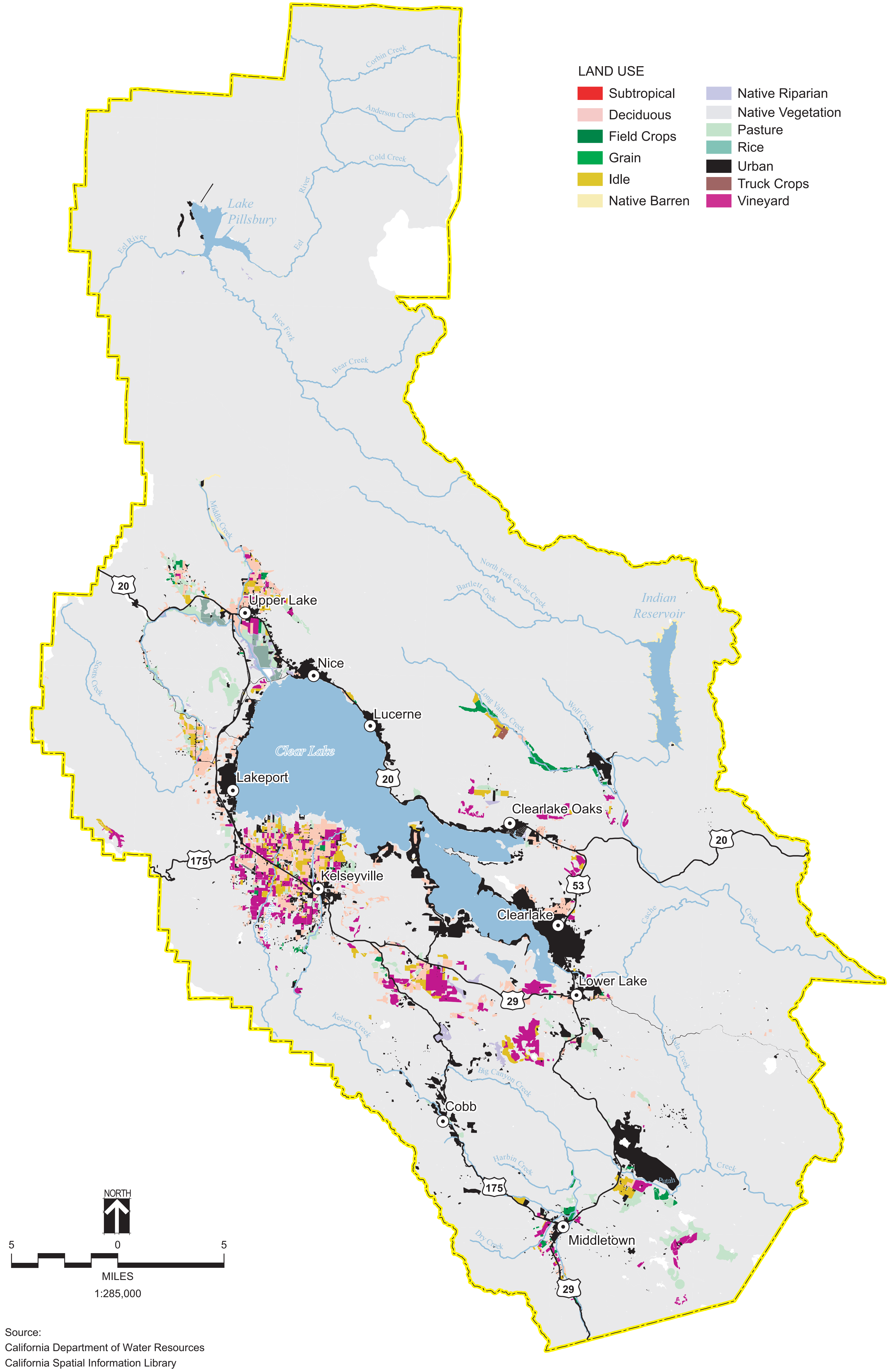
Table 2-4 presents the agricultural water demand for an average year by groundwater basin. Table 2-4 indicates that groundwater is the primary source of water for the Lake County groundwater basins. Groundwater basins with a groundwater demand over 1,000 acre-feet per year include: Upper Lake Valley, Scotts Valley, Big Valley, and the Clear Lake Volcanics Groundwater Source Area.



Source:
National Geographic TOPO! Software
California Spatial Information Library

CDM

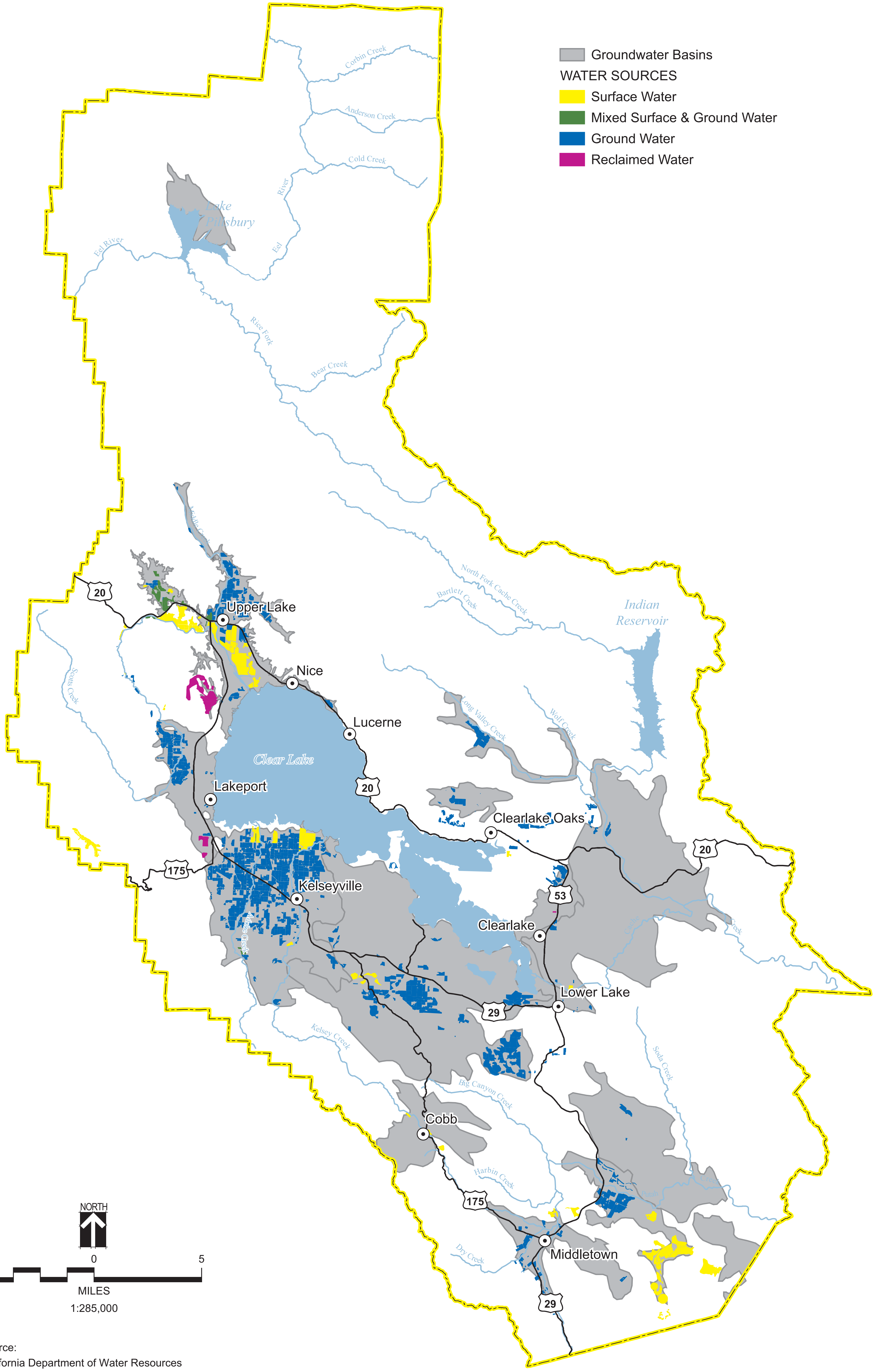
Figure 2-1
Topography



Source:
California Department of Water Resources
California Spatial Information Library

CDM

Figure 2-3
Land Use



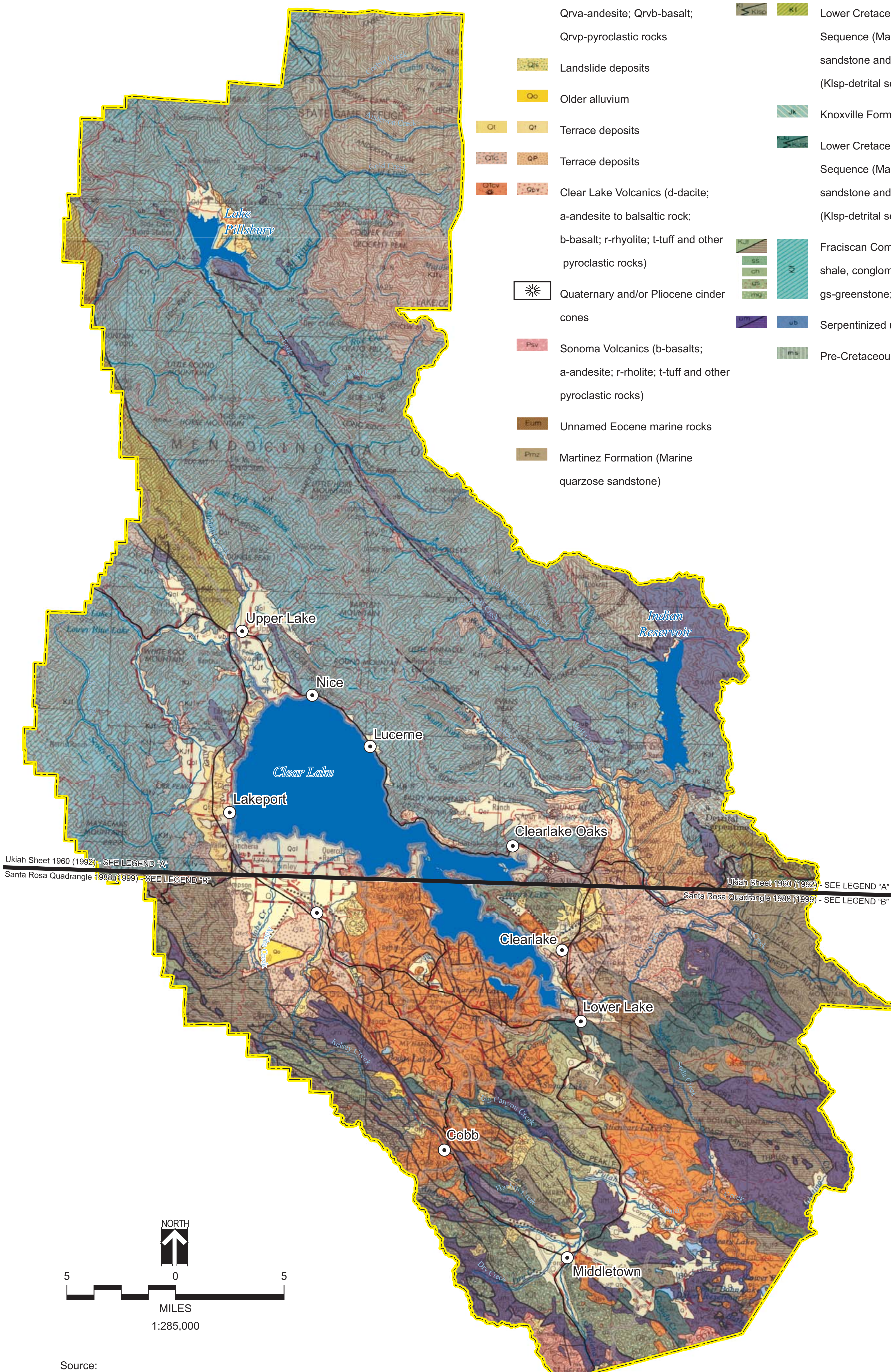
Source:
California Department of Water Resources
California Spatial Information Library

CDM

Figure 2-4
Water Sources

B	A	
Q	Qol	Alluvium
	Qrv	Recent volcanic; Qrvr-rhyolite; Qrva-andesite; Qrvb-basalt; Qrvp-pyroclastic rocks
	Qls	Landslide deposits
	Qo	Older alluvium
Qt	Qt	Terrace deposits
QTc	QP	Terrace deposits
QTcv	Qbv	Clear Lake Volcanics (d-dacite; a-andesite to balsaltic rock; b-basalt; r-rhyolite; t-tuff and other pyroclastic rocks)
		Quaternary and/or Pliocene cinder cones
	Psv	Sonoma Volcanics (b-basalts; a-andesite; r-rholite; t-tuff and other pyroclastic rocks)
	Eum	Unnamed Eocene marine rocks
	Pmz	Martinez Formation (Marine quarzose sandstone)

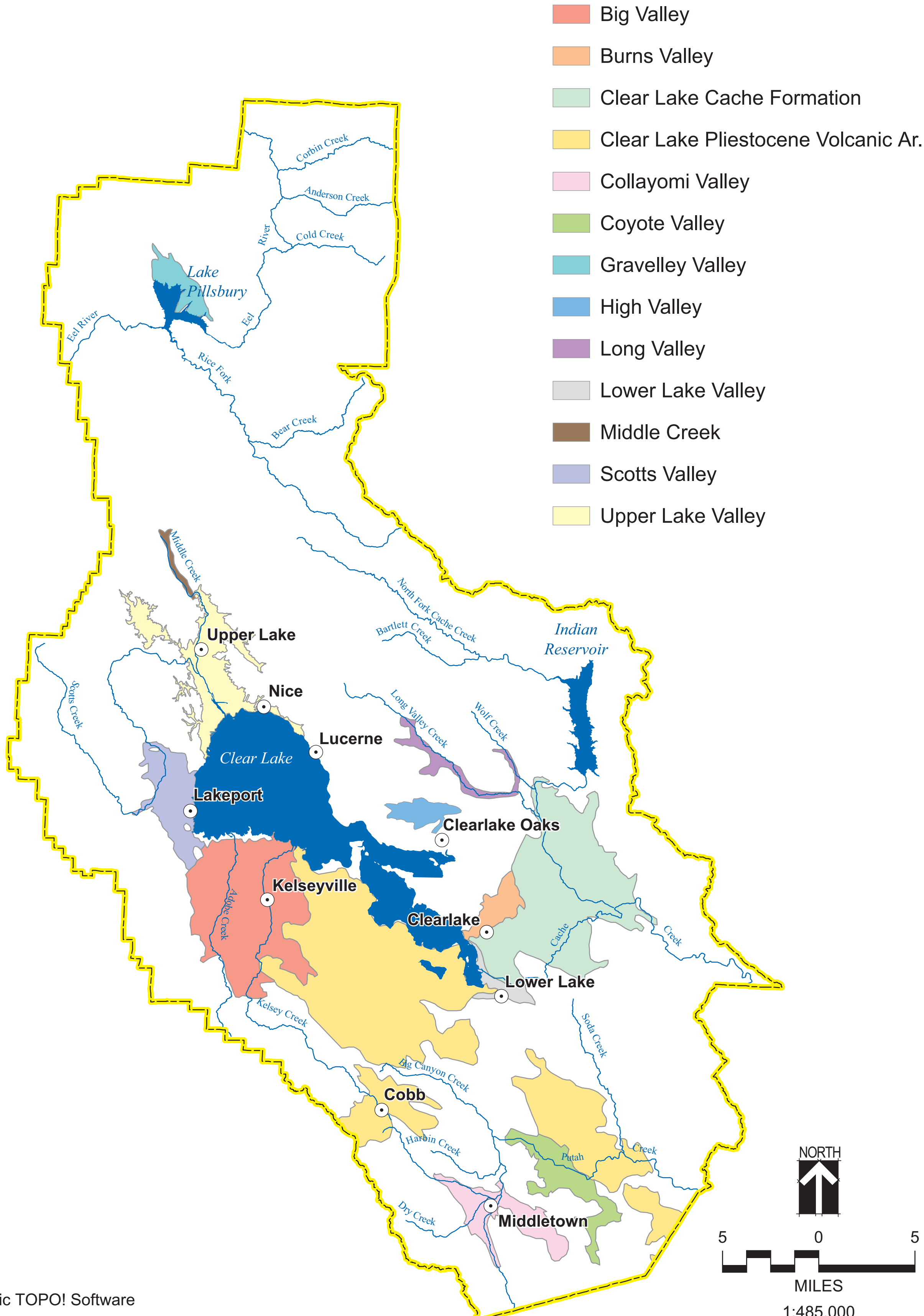
B	A	
Ku	Ku	Upper Cretaceous (Undifferentiated marine rocks)
Klsp	Kl	Lower Cretaceous Great Valley Sequence (Marine mudstone, sandstone and conglomerate) (Klsp-detrital serpentine)
	Jk	Knoxville Formation
	KJsp	Lower Cretaceous Upper Jurassic Sequence (Marine mudstone, sandstone and conglomerate) (Klsp-detrital serpentine)
KJf, ss, ch, gs, mg	Jf	Fraciscan Complex* (ss-sandstone, shale, conglomerate; ch-chert; gs-greenstone; mg-metagraywacke)
um	ub	Serpentinized ultramafic rocks*
	ms	Pre-Cretaceous metasedimentary rocks



Source:
Geology from California Geological Survey
California Spatial Information Library

CDM

Figure 2-5
Geology



Source:
National Geographic TOPO! Software
California Spatial Information Library

Figure 2-6
Groundwater Basins

CDM

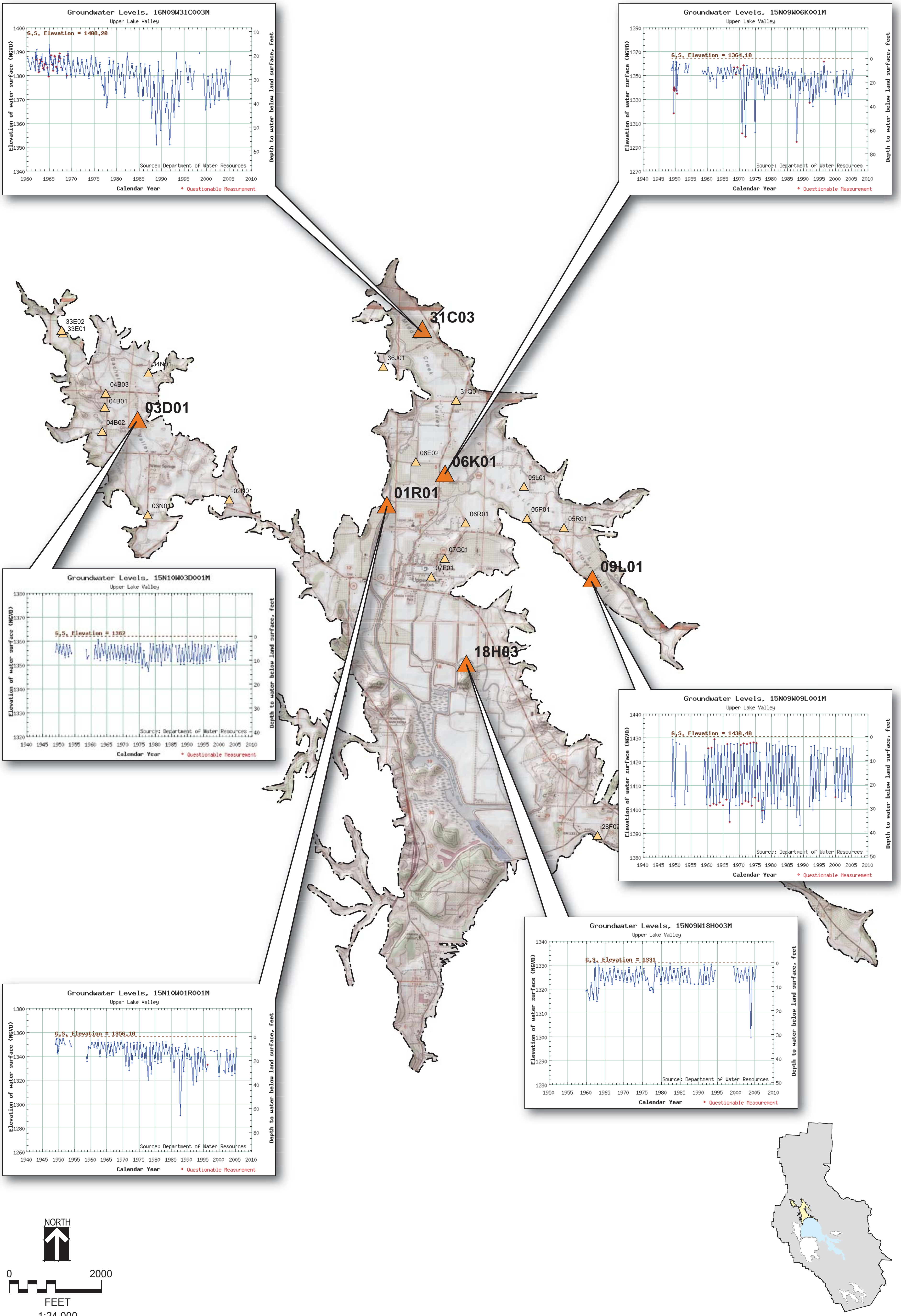
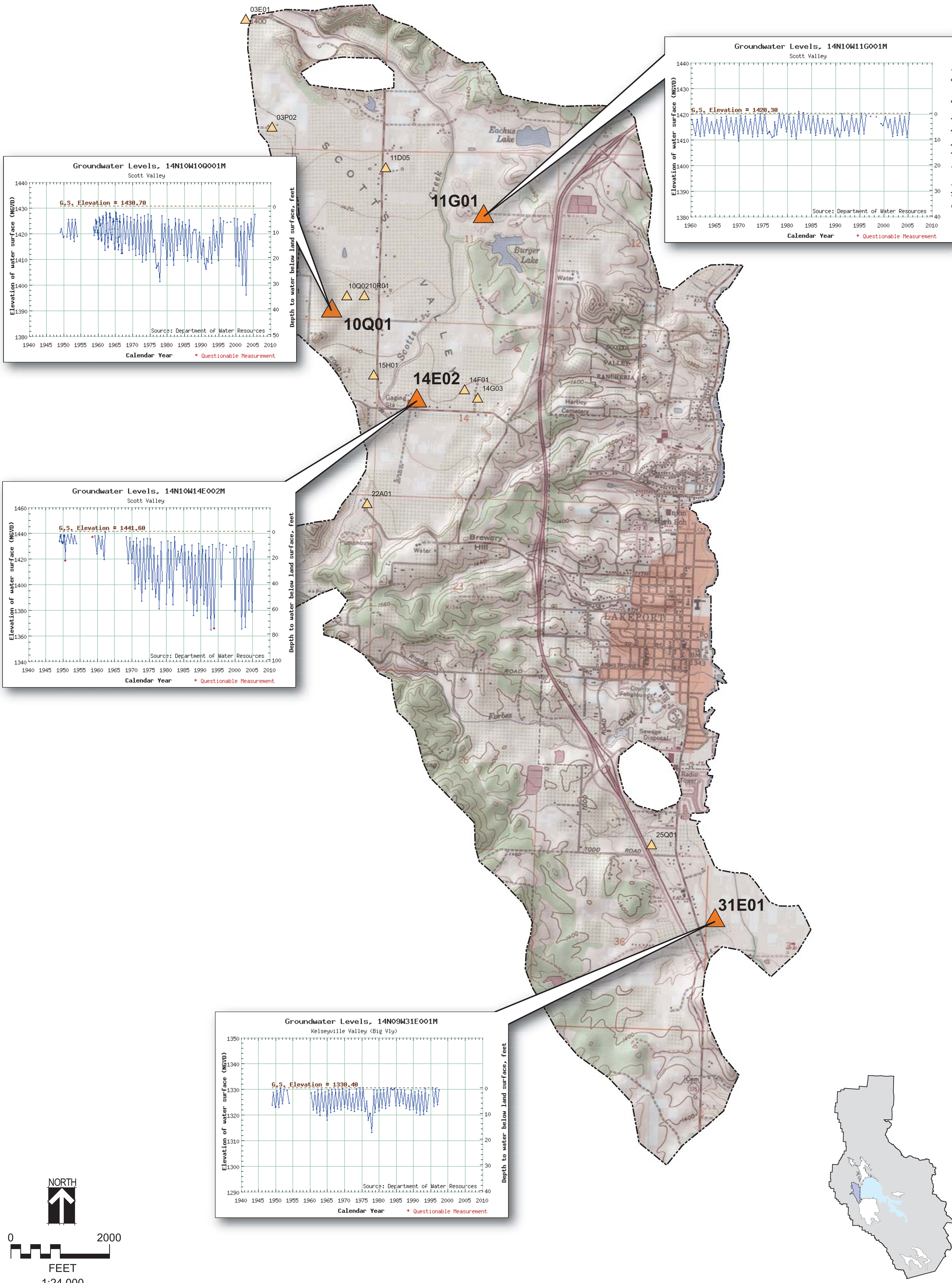


Figure 2-10
Select Hydrographs in the
Upper Lake Valley Groundwater Basin

CDM



CDM

Figure 2-13
Select Hydrographs in the
Scotts Valley Groundwater Basin

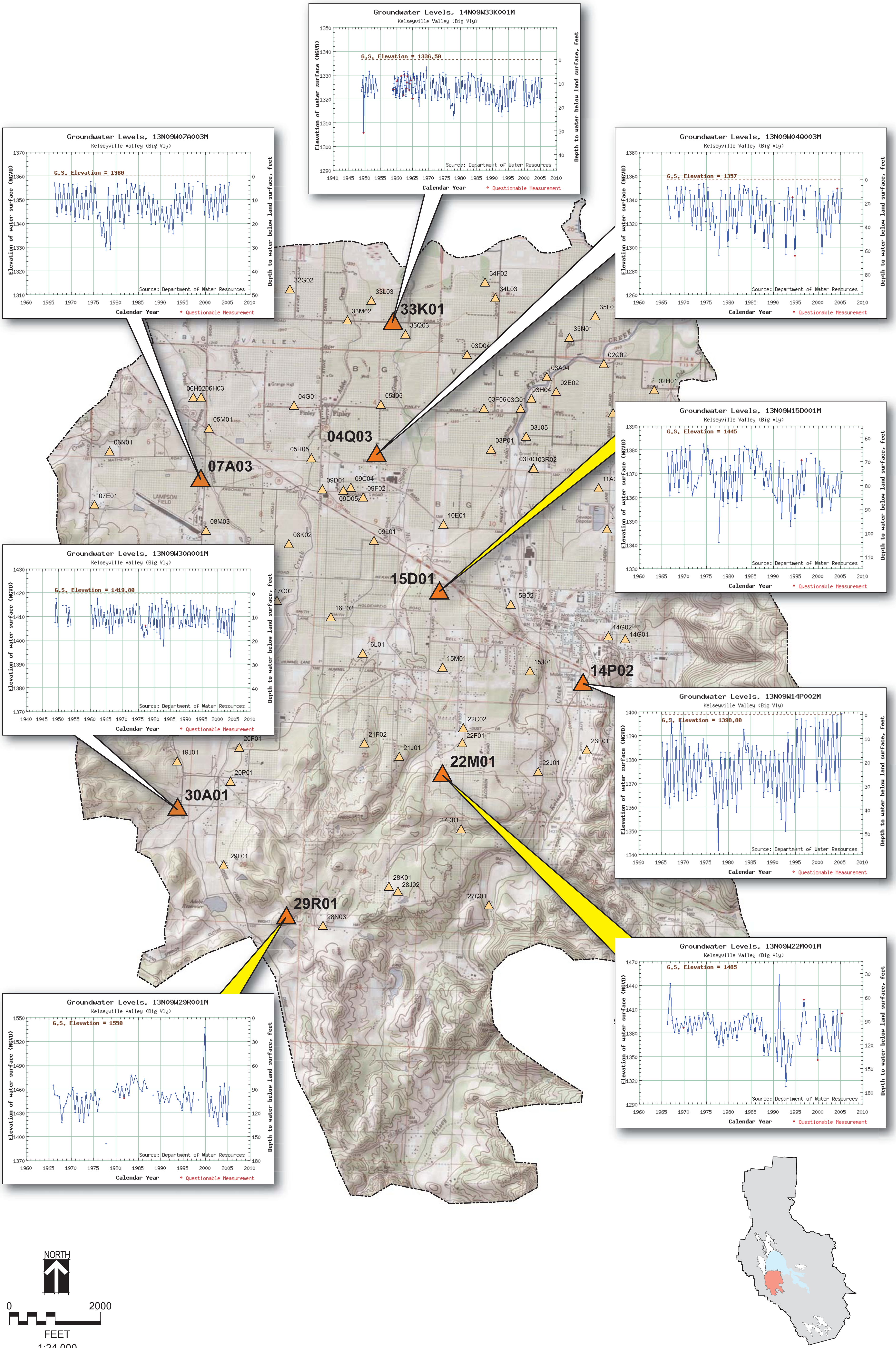
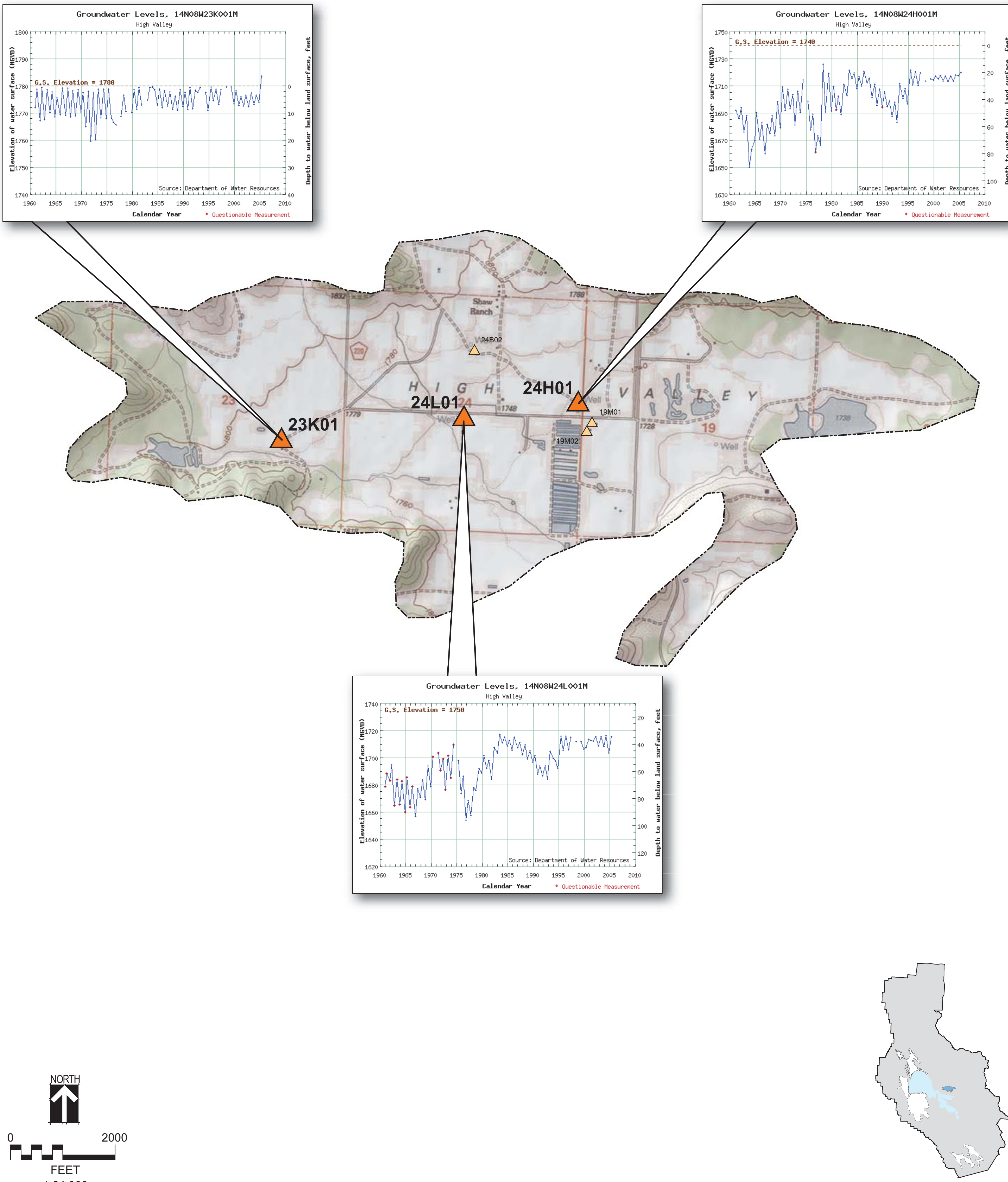


Figure 2-17
Select Hydrographs in the Big Valley Groundwater Basin

CDM



CDM

Figure 2-22
Select Hydrographs in the
High Valley Groundwater Basin

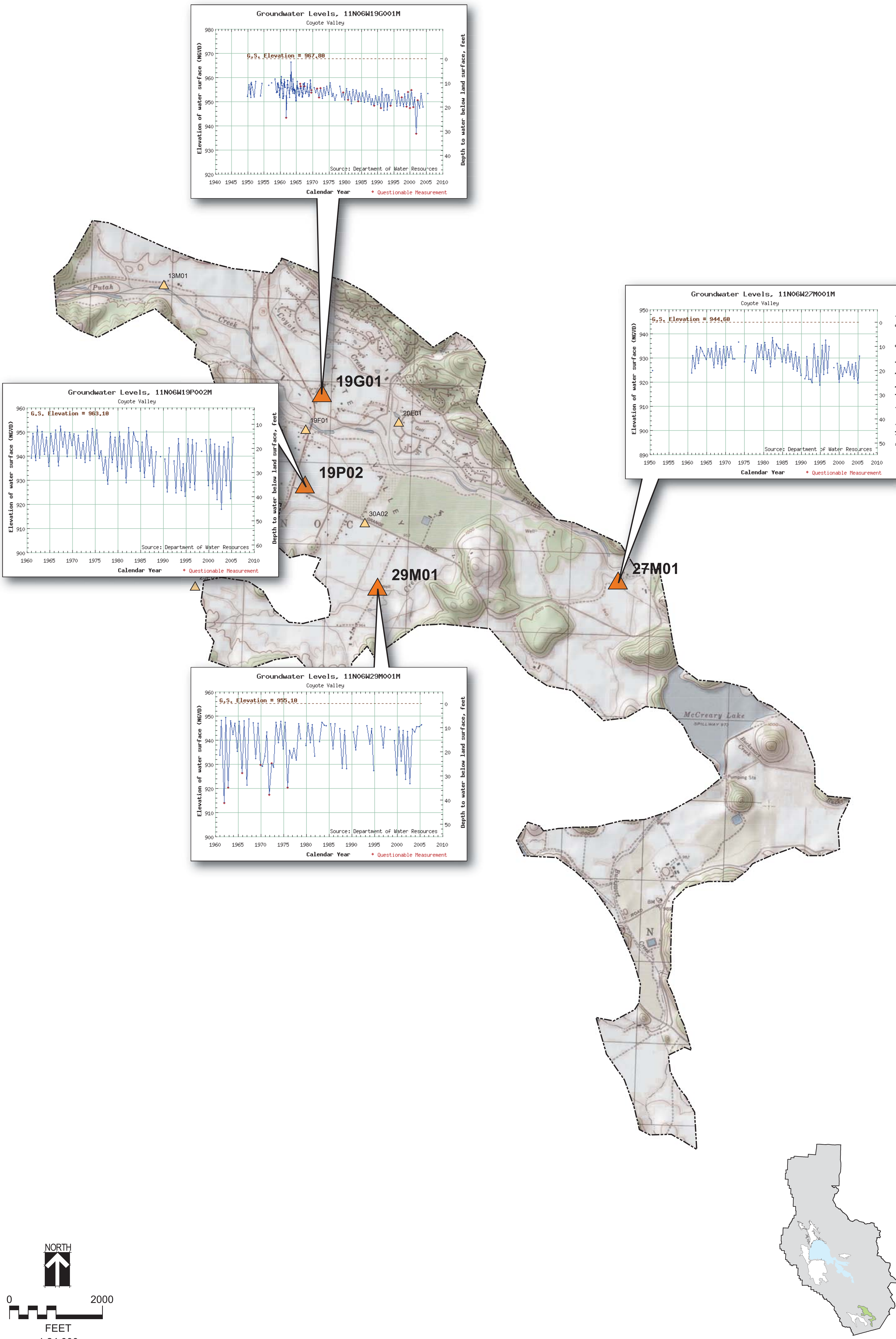
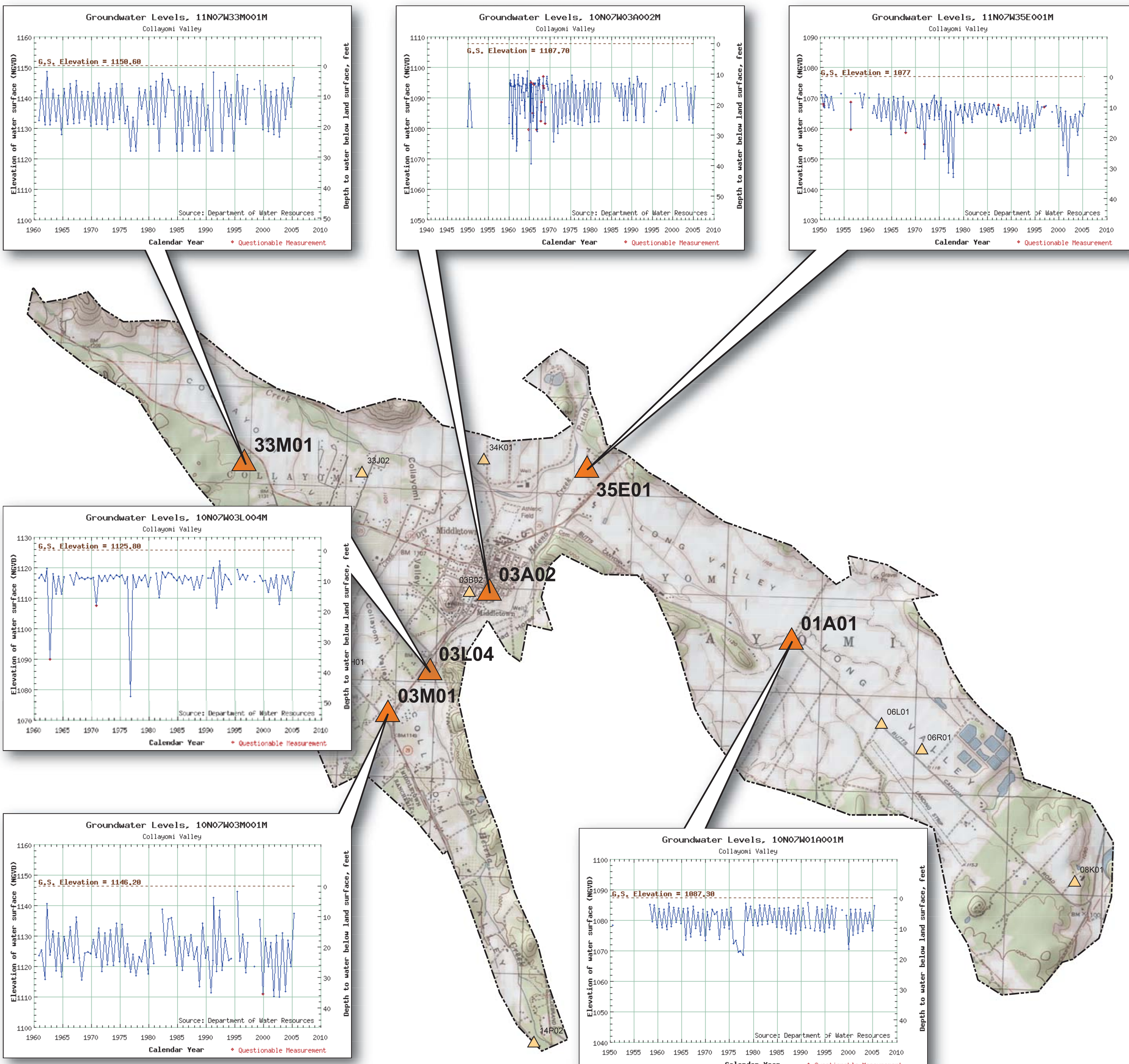


Figure 2-27
Select Hydrographs in the
Coyote Valley Groundwater Basin

CDM



CDM

Figure 2-31
Select Hydrographs in the
Collayomi Valley Groundwater Basin

Section 3
Basin Management Objectives

Basin Management Objectives (BMOs) are required under the California water Code (CWC) § 10753.7 (a) (1). BMOs are flexible guidelines for the management of groundwater resources that describe specific actions to be taken by stakeholders to meet locally developed objectives at the basin or sub-area scale. SB 1938 amended existing law related to groundwater management by local agencies requiring any public agency seeking State funds administered through DWR for the construction of groundwater projects or groundwater quality projects to prepare and implement a groundwater management plan with certain specified components – including BMOs.

This section presents the BMOs developed by each groundwater basin in Lake County. An important feature of the BMO method of groundwater management is that it is intended to provide a flexible approach that can be adapted to changing local conditions and increased understanding the groundwater resource. The more traditional way of managing groundwater basins typically focused on often difficult to define concepts such as safe yield, replenishment and overdraft.

3.1 Stakeholder Participation

Development of effective BMOs require local participation to incorporate the best local understanding of the resource and the needs and issues affecting the groundwater users. Stakeholders include private well owners, water agencies, local government representatives, and other interested parties. To develop the BMOs for Lake County, the District held six stakeholder meetings to discuss groundwater basin issues; some meetings combined stakeholders from different groundwater basins.

The stakeholder outreach meetings conducted are listed below:

- Big Valley, on December 7th, 2005
- Scotts Valley on December 14th, 2005
- Clear Lake Volcanics, on December 7th, 2005
- Upper Lake Basin, Middle Creek, and Gravelly Valley on December 14th, 2005
- Collayomi and Coyote Valleys on December 15th, 2005
- Lower Lake Valley, Burns Valley, Clear Lake Cache Formation, Long Valley, and High Valley on December 15th, 2005

The District developed draft BMOs for the individual groundwater basins prior to each stakeholder meeting to facilitate the discussions. The stakeholders discussed their specific groundwater basin issues and concerns and provided feedback to modify and refine the draft BMOs. Appendix C includes summaries from each stakeholder meeting.

3.2 Basin Management Objectives

BMOs typically address groundwater levels, groundwater quality, and inelastic land subsidence. Lake County stakeholders consistently identified the need for increased monitoring to better characterize the groundwater hydrology in their basin. Figure 3-1 shows where groundwater levels are currently monitored in Lake County. Groundwater levels are not monitored in five of the county's 13 groundwater basins. In three groundwater basins, there is limited groundwater level monitoring (5 or fewer locations). Groundwater quality is monitored only at public water systems in compliance with California Department of Health Services (DHS) requirements. Inelastic land subsidence is not monitored in Lake County.

BMOs can be quantitative or qualitative. Quantitative BMOs are typically based on numeric thresholds and define specific actions that need to be implemented when conditions exceed the predetermined thresholds. Qualitative BMOs describe objectives or goals within a groundwater basin. Quantitative BMOs require a comprehensive understanding of the hydrogeology and hydrology of a groundwater basin and sufficient monitoring of water levels, quality, and subsidence. Qualitative BMOs are likely to prescribe improved understanding and monitoring of groundwater. Because of the limited monitoring of groundwater levels, quality, and land subsidence in Lake County, stakeholders chose to develop qualitative BMOs.

The following sections present stakeholders concerns and BMOs developed for each basin. Many of the BMOs are consistent from one basin to another and reflect the common theme of gaining an increased understanding of groundwater resources throughout Lake County. The stakeholders believe that implementing the BMOs chosen will help address their groundwater concerns.

3.2.1 Scotts Valley Groundwater Basin

Stakeholders at the Scotts Valley Groundwater Basin meeting identified large decreases in summer groundwater levels compared to spring levels as a major concern for the basin. Because of the limited storage in the Scotts Valley groundwater aquifer and large summer demands for groundwater, the basin experiences substantial drawdown during the summer season.

The stakeholders developed BMOs for the Scotts Valley Groundwater Basin, as identified in Table 3-1. The BMOs focus on maintaining long term groundwater resources by increased monitoring of groundwater levels, quality, and subsidence and protection of recharge areas. Consistent monitoring would improve understanding of the Scotts Valley Groundwater Basin and provide valuable data for better management of the water source for all users. Restoring recharge areas and minimizing drawdown during summer months would improve water supply reliability for the region. Assuring an affordable water supply was also important to the stakeholders.

Table 3-1 ***Scotts Valley Groundwater Basin BMOs***
Prevent long-term declines in groundwater levels
Maintain groundwater levels to assure an adequate and affordable irrigation and domestic water supply
Protect and restore groundwater recharge areas
Minimize winter to summer drawdown
Monitor and or reduce nitrate, iron, and manganese concentrations
Increase groundwater level monitoring
Increase groundwater quality monitoring
Increase subsidence monitoring
Prevent inelastic land subsidence

3.2.2 Clear Lake Volcanics Groundwater Source Area

Stakeholders at the Clear Lake Volcanics Groundwater Source Area meeting identified the lack of groundwater information as a major concern. Because of the uncertain character of fractured rock aquifers, it is difficult to determine the amount of storage and groundwater movement within the basin. The stakeholders emphasized the need for groundwater monitoring.

Table 3-2 identifies BMOs that the stakeholders developed for the Clear Lake Volcanics Groundwater Source Area. The BMOs focus on increasing understanding of the groundwater basin through monitoring of groundwater levels, quality, and subsidence. Consistent monitoring would provide valuable data for better management of the water source for all users and help sustain water supply in the future.

Table 3-2 ***Clear Lake Volcanics Groundwater Source Area BMOs***
Prevent long-term declines in groundwater levels
Maintain groundwater levels to assure an adequate and affordable irrigation and domestic water supply
Develop an understanding of groundwater within the area
Maintain a sustainable water supply now and into the future
Increase groundwater level monitoring
Increase groundwater quality monitoring
Increase monitoring and understanding of groundwater levels, groundwater quality, land subsidence, and connections between these elements

3.2.3 Upper Lake Groundwater Basin

Stakeholders at the Upper Lake Groundwater Basin meeting identified water quality issues as a major concern for the basin. Iron, manganese, sulphur and nitrates have been detected in water supplies in the basin. Some of the constituents may be related to geothermal water intrusion into the groundwater basin. Supply was less of a concern for the stakeholders because the groundwater levels remain high throughout the year.

The stakeholders developed BMOs for the Upper Lake Groundwater Basin, as identified in Table 3-3. The BMOs focus on understanding water quality issues and increasing groundwater levels, quality, and subsidence monitoring. Consistent monitoring would improve the understanding of the Upper Lake Groundwater Basin's water quality and would provide valuable data for better management of the water source for all users.

Table 3-3 ***Upper Lake Groundwater Basin BMOs***
Prevent long-term declines in groundwater levels
Maintain groundwater levels to assure an adequate and affordable irrigation and domestic water supply
Develop an understanding of groundwater within the basin
Maintain a sustainable water supply now and into the future
Prevent geothermal groundwater intrusion
Increase groundwater level monitoring
Increase groundwater quality monitoring
Increase monitoring and understanding of groundwater levels, groundwater quality, land subsidence, and connections between these elements
Monitor and understand iron, manganese, sulphur, and nitrate water quality issues
Increase subsidence monitoring
Prevent inelastic land subsidence

3.2.4 Collayomi Valley and Coyote Valley Groundwater Basins

Stakeholders at the Collayomi Valley and Coyote Valley Groundwater Basins meeting identified water quality issues as a major concern for both basins. Iron and manganese have been detected in water supplies in both basins. Sulfide, boron, aluminum and nickel were detected in a water supply well in Collayomi Valley, and chromium was detected in a water supply well in Coyote Valley. Some of the constituents may be related to geothermal water intrusion into the groundwater basins.

The stakeholders developed BMOs for the Collayomi and Coyote Groundwater Basins, as identified in Table 3-4. The BMOs focus on monitoring water quality constituents to sustain long-term groundwater resources. Consistent monitoring would improve understanding of the Collayomi and Coyote Groundwater Basins' water quality and would provide valuable data for better management of the water source for all users.

Table 3-4 ***Collayomi Valley and Coyote Valley Groundwater Basins BMOs***
Prevent long-term declines in groundwater levels
Maintain groundwater levels to assure an adequate and affordable irrigation and domestic water supply
Develop an understanding of groundwater within the basin
Maintain a sustainable water supply now and into the future
Understand geothermal water occurrence
Reduce nitrate concentrations
Increase groundwater quality monitoring
Increase monitoring and understanding of groundwater levels, groundwater quality, land subsidence, and connections between these elements
Monitor and understand iron, manganese, boron and chromium water quality issues
Understand well depths consistent with basin pumping or available yield
Increase subsidence monitoring
Prevent inelastic land subsidence

3.2.5 Lower Lake Valley, Burns Valley, Clear Lake Cache Formation, Long Valley, and High Valley Groundwater Basins

Stakeholders at the Lower Lake Valley, Burns Valley, Clear Lake Cache Formation, Long Valley, and High Valley Groundwater Basins meeting identified water level monitoring issues as a major concern for the basins. Most of the basins do not have wells that are part of the District's or DWR's groundwater level monitoring grid.

The stakeholders developed BMOs for the five basins, as identified in Table 3-5. The BMOs focus increasing groundwater levels, quality, and subsidence monitoring. Consistent monitoring would improve understanding of the five basins' water levels, water quality and would provide valuable data for better management and sustainability of the water source for all users.

Table 3-5 ***Lower Lake Valley, Burns Valley, Clear Lake Cache Formation, Long Valley, and High Valley Groundwater Basins BMOs***
Prevent long-term declines in groundwater levels
Maintain groundwater levels to assure an adequate and affordable irrigation and domestic water supply
Develop an understanding of groundwater within the basin
Maintain a sustainable water supply now and into the future
Prevent geothermal groundwater intrusion
Increase groundwater level monitoring
Increase groundwater quality monitoring
Increase monitoring and understanding of groundwater levels, groundwater quality, land subsidence, and connections between these elements
Monitor and understand iron, manganese, and nitrate water quality issues
Increase subsidence monitoring
Prevent inelastic land subsidence

3.2.6 Big Valley Groundwater Basin

Stakeholders at the Big Valley Groundwater Basin meeting indicated that issues and objectives for Big Valley were outlined in the existing *Big Valley Groundwater Management Plan* (1999). Additionally, stakeholders identified large summer well drawdowns and the intrusion of geothermal water as issues of concern in the basin.

BMOs for the Big Valley basin were developed through review of the *Big Valley Groundwater Management Plan.* Table 3-6 identifies BMOs for the Big Valley Groundwater Basin. The BMOs focus on maintaining long term groundwater resources by increased monitoring of groundwater levels, quality, and subsidence. Consistent monitoring would improve understanding of the Big Valley Groundwater Basin's water quality and help identify effects of groundwater extraction to adjacent water users and on other resources. BMOs for the Big Valley basin also emphasize protection of recharge areas to sustain high groundwater levels into the future.

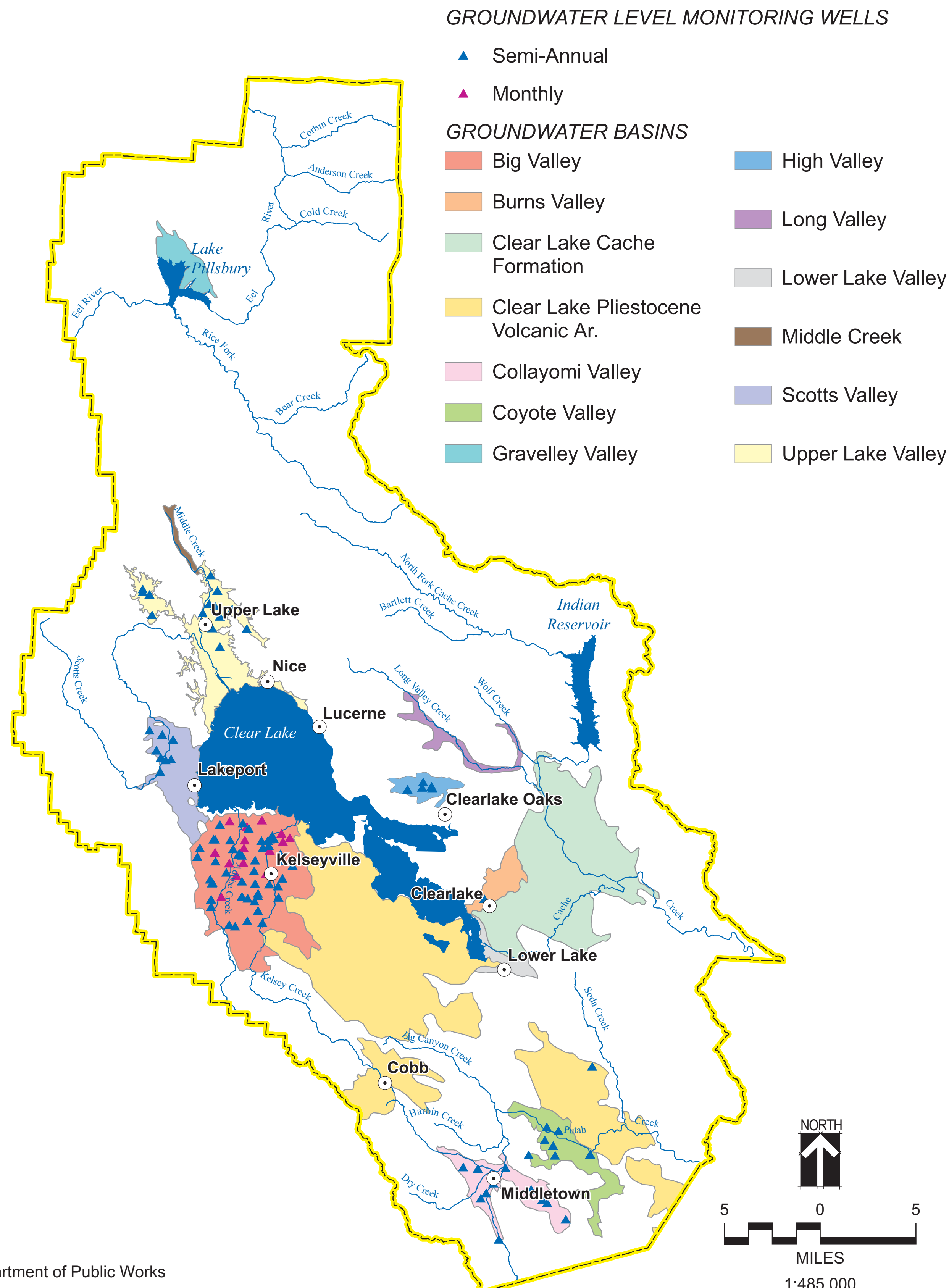
Table 3-6 ***Big Valley Groundwater Basin BMOs***
Maintain high groundwater levels to prevent geothermal water intrusion
Determine and maintain a safe yield of groundwater for use within the basin
Identify and monitor the relationship between basin groundwater extraction and impacts on groundwater supplies within and adjacent to the basin.
Develop data and information that identify impacts on groundwater in adjacent areas that might be affected by groundwater use
Establish mitigation measures to offset identified adverse impacts of groundwater extraction
Establish quantitative limitation on groundwater extractions for particular areas and establish criteria for well spacing and operations to limit adverse impacts of groundwater extraction on basin wells.
Protect the recharge area for the volcanic ash aquifer located north of Wight Way
Protect the creek beds of Adobe Creek , Kelsey Creek and Manning Creek to optimize their recharge capabilities
Continue to operate the Kelsey Creek Detention Structure to maximize groundwater recharge, allow creek bedload movement, minimize operating costs, and maintain passage for the Clear Lake Hitch
Expanding the monitoring program to include wells that provide a more accurate assessment of groundwater levels, including wells that provide an increased area of coverage

3.2.7 Middle Creek and Gravelly Valley Groundwater Basins

No stakeholders from the Middle Creek or Gravelly Valley groundwater basins attended the BMO meeting. BMOs were identified for the two basins based upon existing published information indicating the basins' hydrogeology. Water levels and water quality are not monitored in either basin.

BMOs for the two basins are identified in Table 3-7. The BMOs focus on maintaining long term groundwater resources by increased monitoring of groundwater levels, quality, and subsidence. Consistent monitoring would improve understanding of the two basins' water levels and water quality.

Table 3-7 ***Middle Creek and Gravelly Valley Groundwater Basins BMOs***
Prevent long-term declines in groundwater levels
Maintain groundwater levels to assure an adequate and affordable irrigation and domestic water supply
Develop an understanding of groundwater within the basin
Maintain a sustainable water supply now and into the future
Prevent geothermal groundwater intrusion
Increase groundwater level monitoring
Increase groundwater quality monitoring
Increase monitoring and understanding of groundwater levels, groundwater quality, land subsidence, and connections between these elements
Monitor and understand iron, manganese, and nitrate water quality issues
Increase subsidence monitoring
Prevent inelastic land subsidence



Source:
Lake County Department of Public Works
California Spatial Information Library

Figure 3-1
Groundwater Level Monitoring Wells

CDM

Section 4
Plan Components

The District is already performing many of the groundwater management activities associated with a GMP, as described in this section. Through plan implementation, the District is formalizing its groundwater management objectives and plan components designed to achieve the District's groundwater related objectives, outlined in section 1.4.

The District does not have funds available for implementation of a comprehensive groundwater management program. While state and federal agencies may assist in establishing or expanding the monitoring grid or other programs, a reliable source of funds is required to continue management after grant funds are expended. Without a reliable source of funding, the District will not be able to fully implement the groundwater management plan without sacrificing other programs.

As detailed in section 1.5, the Lake County GMP includes required, recommended, and suggested components. These components have been grouped and are discussed in this section, under the following headings:

- Groundwater Monitoring
- Inter-Agency Coordination
- Water Well Policies
- Management of Groundwater Projects

For each component, this section identifies current Lake County activities, potential future activities, and implementation steps the District will take to facilitate groundwater management related to each component.

4.1 Groundwater Monitoring

To fully understand the condition of groundwater resources in Lake County, the District should implement a BMO driven groundwater monitoring program . The monitoring program would provide information needed to document current conditions, assess long-term trends, and to support development and implementation of BMOs. A complete groundwater monitoring program will monitor three elements: groundwater levels; water quality; and inelastic land subsidence.

Groundwater monitoring is an essential tool to assist implementation of the GMP. Groundwater level monitoring can identify areas of overdraft, which may dewater streams and lower water tables, causing environmental damage through reduced riparian zones. Groundwater quality monitoring can help identify areas of degrading water quality, potentially identifying specific water quality issues. Subsidence monitoring can indicate when subsidence is occurring, when it otherwise would be missed.

4.1.1 Groundwater Levels

The District, in cooperation with DWR monitors a number of wells within the various groundwater basins of Lake County. The District and DWR currently monitor a network of 95 wells on a semiannual basis The District also monitors 16 wells on a monthly basis. The extent of the groundwater monitoring grid is shown in Figure 3-1. The Gravelly Valley, Long Valley, Middle Creek, Clear Lake Cache Formation and Lower Lake Groundwater Basins do not currently have groundwater level monitoring.

The District will work to expand its groundwater level monitoring activities in conjunction with stakeholders in each basin. Developing and analyzing historical trends in groundwater levels is also important to assess impacts of changes in groundwater use in a basin. These trends can help determine if the basin is in overdraft or a stable condition.

The District could implement several methods of groundwater level monitoring. The use of dedicated monitoring wells provides the most valuable information in terms of assessing groundwater level trends. Because monitoring wells are not actively pumped for supply purposes, there is less potential for misinterpreting results. The water level in a pumping well can be influenced by a number of factors, such as whether or not the pump is on. Even if the pumping well is not on at the time of water level measurement, the water level may not reflect the ambient groundwater level if the well itself has not equilibrated to aquifer conditions.

If the use of dedicated monitoring wells is not possible, water level data obtained from production wells can also yield valuable information. When recording water levels from production wells, additional information such as the pumping condition is necessary. Data such as typical pumping rates, capacities, and run times can also be useful in analyzing water level data. This information can be useful in assessing aquifer characteristics from pumping and non-pumping data from the same well.

It is important to maintain a regular monitoring schedule in order to facilitate trend analysis. Groundwater levels in the basins are typically cyclic on an annual basis. Most of the stresses on the groundwater levels in a basin occur annually. For example, agricultural pumping peaks during the summer and subsides during the winter. Also, natural recharge to groundwater is greatest during the winter months when precipitation levels are high.

By having a regular monitoring schedule, comparisons of water levels from year to year can be made. A typical unstressed condition can be viewed by looking at the trend in winter water levels; while an analysis of a stressed condition can be seen from summer water levels. Monitoring water levels 4 times a year (March, July, August, and October) is a typical schedule.

4.1.2 Groundwater Quality

The monitoring of groundwater quality is also useful in assessing the state of groundwater basins. The purpose of monitoring water quality is to assess any trends in water quality changes due to changes in groundwater related activities in the County. For example, excess groundwater pumping may induce groundwater flow from deeper aquifers containing water that is less desirable water containing high boron levels.

DWR performs groundwater quality monitoring on a number of wells in Lake County. DWR currently monitors a number of wells in the County intermittently. Figure 4-1 shows the approximate locations where groundwater quality has been monitored in Lake County. DWR monitors for a number of constituents, including temperature, pH, total dissolved solids, metals, nitrogen compounds, and dissolved potassium, sodium, calcium, magnesium, boron and hardness. DWR monitors groundwater quality in varying locations and over differing periods of time. Currently groundwater quality information is not collected in the Gravelly Valley, Long Valley, Clear lake Cache Formation, Middle Creek, and Clear Lake Volcanics groundwater basins.

Groundwater is also monitored as part of the Department of Health Services drinking water program. Information from the DHS drinking water database indicates that most groundwater basins in Lake County have issues with iron, manganese and boron. The District recognizes that geothermal upwelling could be the cause of these volcanic related elements in the water.

Groundwater users have raised concerns about saline intrusion that increases total dissolved solids (TDS). TDS indicates the quantity of inorganic salts and small amounts of organic matter. The California Environmental Protection Agency (EPA) secondary drinking water standard for TDS is 500 milligrams per liter (mg/L), and the agricultural water quality goal for TDS is 450 mg/L. The secondary standards refer to the levels above which the constituent may be objectionable because of aesthetics or taste.

To improve groundwater quality understanding, the District should collect water quality samples once a year during times of peak usage (i.e. summer). Parameters measured should include, but not be limited to, temperature, pH, electrical conductivity (EC), and TDS. With appropriate groundwater quality monitoring data, the District can improve its understanding of the location and extent of saline intrusion and develop methods to prevent further intrusion. The District could also identify and address incidents of geothermal water upwelling to improve water quality. Locations of groundwater sampling should be driven by local indicators.

4.1.3 Inelastic Land Subsidence

Groundwater pumping in a basin could result in inelastic land subsidence. This subsidence occurs from the irrecoverable compaction of the soil matrix when water is removed. Land subsidence is not monitored in Lake County; however, there have been anecdotal reports of land subsidence in Big Valley and Scotts Valley.

A variety of methods are available to measure land subsidence. Extensometers use a pipe inside a well casing. The pipe inside the casing extends from land surface to some depth through compressible sediments. A table at land surface holds instruments that monitor change in distance between the top of the pipe and the table. The inner pipe and casing go through the entire thickness of the studied sediments and measures subsidence in those sediments. If subsidence occurs, the ground surface (and the table) will sink, but the pipe will not, and the distance between the pipe and the table will become smaller than it was before subsidence occurred. Figure 4-2 shows a diagram of a typical extensometer.

Another approach utilizes Global Positioning Satellites (GPS) to conduct surveys to calculate the ground surface. GPS surveys have the ability to calculate vertical and horizontal locations and can reveal the vertical extent of land subsidence (USGS 2004). Any change in ground surface elevation between surveys would be detected in the newer survey.

A newer approach utilizes Interferometric Synthetic Aperture Radar (INSAR). With this method, individual radar images from satellites are compared and interferograms are produced. The United States Geological Survey is currently using INSAR to determine tectonic movement along fault lines. Under the best conditions, land-surface elevation changes on the order of 1 inch or less can be determined using this method.

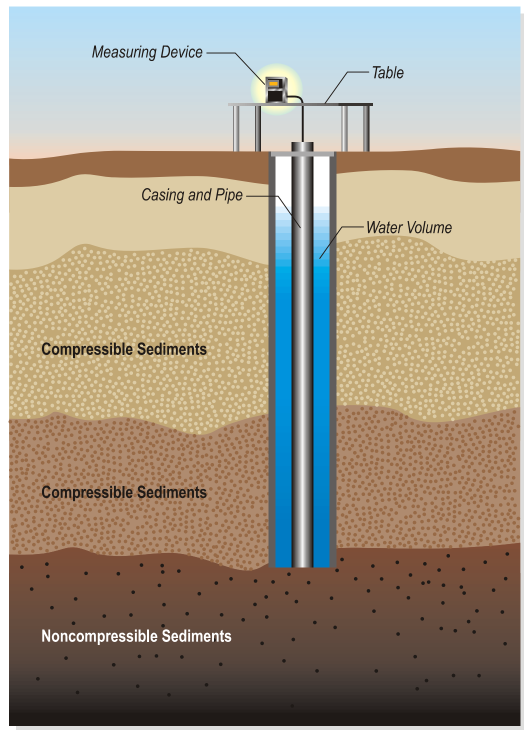


Figure 4-2
Extensometer Diagram

4.1.4 Groundwater Monitoring Implementation Steps

The District will take the following actions to initiate a sound groundwater monitoring program:

- Work with local stakeholders and DWR to develop an expanded monitoring program. The expanded monitoring program would:
  - Identify areas that may need additional groundwater level, groundwater quality, or subsidence monitoring based on identified data gaps, trends and the BMOs.

  - Identify the appropriate monitoring methodology for each area based on existing or new infrastructure.
  - Prioritize the rehabilitation or construction of new wells based on the needs of each area and available funding.

- Work with state and federal agencies to secure funding for expansion of the monitoring grid.
- Coordinate with DWR and local landowners to ensure that selected wells are maintained as part of a long-term monitoring program.
- Develop a monitoring schedule.
- Develop a reporting plan to share data with appropriate stakeholders.

4.2 Interagency and Department Cooperation

Effective groundwater management requires coordination and cooperation among relevant local, state, and federal agencies. The District will continue to work proactively with the following agencies and departments:

California Department of Water Resources. DWR and the District work cooperatively to monitor groundwater levels in Lake County. DWR performs groundwater quality monitoring in areas of Lake County. DWR has provided monitoring at three critical creek locations in Lake County, however, funding for these gauges has been eliminated. The District also has successfully acquired funding from DWR as part of the AB303 program.

State Water Resources Control Board (SWRCB). The SWRCB is the lead state water agency responsible for maintaining water quality standards and providing the framework and direction for groundwater protection efforts.

United States Geological Survey (USGS). The USGS monitors creek flow on a number of creeks in Lake County. The District may work with the USGS to keep creek monitoring programs going into the future.

Lake County Department of Agriculture, Environmental Health, Public Health, Planning, and Public Works. The District provides water resources information to many departments in Lake County's government to assist those departments in making land use and water use decisions. The District provides comments to planning agencies regarding water resources.

Local Water Purveyors. The District works with local water purveyors, and will review and respond as a responsible agency for issues directly related to water use in Lake County.

4.2.1 Cooperation Implementation Steps

The District will take the following actions to involve appropriate government agencies, local districts, and County departments in groundwater management actions:

- Continue to work cooperatively with DWR on groundwater management activities
- Continue to support and be responsive to the actions and needs of other Lake County departments
- Consult appropriate federal agencies, as necessary, on groundwater management activities

4.3 Water Well and Groundwater Policies

Improperly constructed wells can result in a number of potential problems, including low yields, groundwater contamination by establishing a preferential pathway for pollutants entering a well from the surface, or by allowing communication between aquifers of varying quality. Similarly, unused, abandoned or improperly destroyed wells can cause groundwater contamination through the means described above, but these wells also pose a serious physical hazard to humans and animals. Extraction of groundwater for export may negatively affect Lake County's groundwater resources, and has been addressed by a groundwater export ordinance.

As described in detail in sections 4.3.1 through 4.3.3, Lake County has adopted ordinances that address well construction and abandonment standards based on CWC code requirements and DWR recommendations. Lake County has also adopted a groundwater export ordinance, that requires a permit to export groundwater, as detailed in section 4.3.4.

4.3.1 Well Construction and Abandonment

The California Water Code (13700 through 13806) requires proper construction of wells. Minimum standards for the construction of wells are specified in DWR Bulletins 74-81 and 74-90. These standards apply to all water wells, cathodic protection wells, and monitoring wells.

Lake County adopted County Ordinance #1823 in 1989. Ordinance #1823 sets minimum standards for the construction of new water wells, adopting recommendations from DWR's Bulletin 74-81. The ordinance requires all new domestic, industrial, agricultural, and monitoring wells to comply with minimum construction requirements. Requirements include minimum setback requirements from contamination sources, installation of a sanitary seal, and flood plain considerations. Additionally, existing wells that are no longer used are required to be destroyed in a manner that adequately protects groundwater. The Lake County Department of Health Services, Environmental Health Unit (Environmental Health) administers the program by issuing permits and conducting site inspections for all new well construction. The Program is supported in part by fees set by County Ordinance #2205, however no fees are charged for a well destruction permit.

4.3.2 Wellhead and Recharge Area Protection

Several California state regulatory programs are designed to protect public health, and also protect groundwater resources. Some programs include: permitting programs for underground storage tanks, hazardous waste generators, on-site septic systems, solid waste facilities, and actions from the State Water Quality Control Board (SWQCB).

Environmental Health conducted a Groundwater Protection Program from January 1997 through 1998. The main objectives of the project were to:

- Develop a county-wide contaminant source inventory using Geographic Information System (GIS) technology.
- Identify and abate potential sources of groundwater contamination by performing inspections of suspected hazardous material facilities not currently on the permit inventory and septic systems in selected areas throughout the County.
- Increase public awareness of groundwater protection issues through outreach.

This effort resulted in a GIS database that enhances the County's ability to link groundwater quality problems to probable sources of contamination and allows environmental health staff to focus their efforts. The program allowed Environmental Health to identify unpermitted hazardous materials facilities.

Lake County adopted the Creek Management Plan in 1981, which was replaced by the Aggregate Resource Management Plan (ARMP) in 1992. One of the driving forces behind these plans were concerns about gravel mining impacts to groundwater recharge and supply. The ARMP sets policies for all gravel extraction operations that protect the groundwater supply. The ARMP is administered by the Lake County Community Development Department, Planning Division, assisted by technical information from the District.

A Wellhead Protection Area (WHPA), as defined by the 1986 Amendments, is "the surface and subsurface area surrounding a water well or wellfield supplying a public water system, through which contaminants are reasonably likely to move toward and reach such water well or wellfield." The WHPA may also be the recharge area that provides the water to a well or wellfield. Unlike surface watersheds that can be easily determined from topography, WHPAs can vary in size and shape depending on geology, pumping rates, and well construction.

Under the Act, states are required to develop an EPA-approved Wellhead Protection Program. To date, California has no formal state-mandated program, but instead relies on local agencies to plan and implement programs. For this reason, AB 3030 was enacted. A number of local governments, including Santa Clara Valley Water District, Descanso Community Water District, West San Bernardino County Water District, and Monterey County Water Management District, are in various stages of developing local ground water management programs that include WHPAs. Wellhead Protection Programs are not regulatory by nature, nor do they address specific sources. They are designed to focus on the management of the resource rather than control a limited set of activities or contamination sources.

4.3.3 Groundwater Export Ordinance

Groundwater export projects can adversely impact groundwater resources. Exporting groundwater can lower groundwater tables, create overdraft, and adversely affect third parties. The Lake County Board of Supervisors enacted Chapter 28, Regulation of the Extraction and Exportation of Groundwater from Lake County, to protect the County's groundwater resources.

On February 9, 1999, the Lake County Board of Supervisor enacted Chapter 28, which recognizes that groundwater is an important resource to Lake County that is critical to future development. Chapter 28 recognizes that groundwater is used for agricultural and domestic uses, and is tied to groundwater quality and land subsidence. Chapter 28 (Section 28-1) requires a permit to extract groundwater for use outside of Lake County.

Chapter 28 outlines the process for obtaining a permit to export groundwater. Each application must be accompanied by a California Environmental Quality Act compliant environmental review and a hydrogeologic analysis that indicates the proposed project's affect on local aquifers. After review by the Planning Department of Lake County, the applicant is required to present his or her case in a public hearing before Lake County's Planning Commission. Other interested members of the public may also provide input. The permit will only be granted if the Planning Commission finds that the extraction will not cause or increase overdraft and will not result in adverse affects on reasonable and beneficial uses of overlying water. When granting a permit, the Planning Commission may impose additional conditions such as observation or monitoring wells, to prevent adverse effects.

4.3.4 Water Well Policy Implementation Steps

The District will take the following actions:

- Support Environmental Health's efforts to further wellhead and recharge protection.
- Support administration of the ARMP
- Consider support of a wellhead protection program in Lake County
- Evaluate the need for a recharge area identification program in Lake County
- Support continuation of Lake County's groundwater export ordinance.

4.4 Management of Groundwater Projects

In order for the District to effectively manage the groundwater resources of Lake County, knowledge of projects that affect groundwater must be maintained by the District. Any proposal for projects involving conjunctive use, groundwater recharge or storage, remediation of contamination should be maintained at the District level. By having a knowledge of proposed actions, the District can study the benefits and impacts of the actions in the context of any other projects occurring in that particular groundwater basin. Isolated projects within a basin have the potential to adversely impact each other. Working with basin-wide project knowledge can aid in minimizing adverse impacts.

4.4.1 Groundwater Recharge Projects

The District currently operates the Kelsey Creek Detention Structure. This project is designed and operated to: maximize groundwater recharge, allow bedload movement through the detention structure, prevent the structure from aggravating flooding, minimize operating costs, and maintaining passage for the Clear Lake Hitch. (Smythe 2006)

Further protection of groundwater resources may require the planning and construction of additional groundwater recharge projects. The District would need to evaluate the need for these projects and comply with appropriate permitting, regulatory, and environmental requirements.

4.4.2 Conjunctive Use Projects

Conjunctive use is a method of jointly managing the use of groundwater and surface water supplies to maximize recharge into a basin. The District supports implementation of the Adobe Creek Conjunctive Use Project. The purpose of the project is to improve groundwater management in Big Valley, through modification of the seasonal operation of the Highland Springs Reservoir, through reallocating flood control storage to conjunctive use and fish spawning enhancement (Christensen 2002). This re-operation would require installation of new flow control gates on the principal spillway of the reservoir. The proposed project would result in the seasonal reallocation of 1,070 acre-feet of water to conjunctive use and fish.

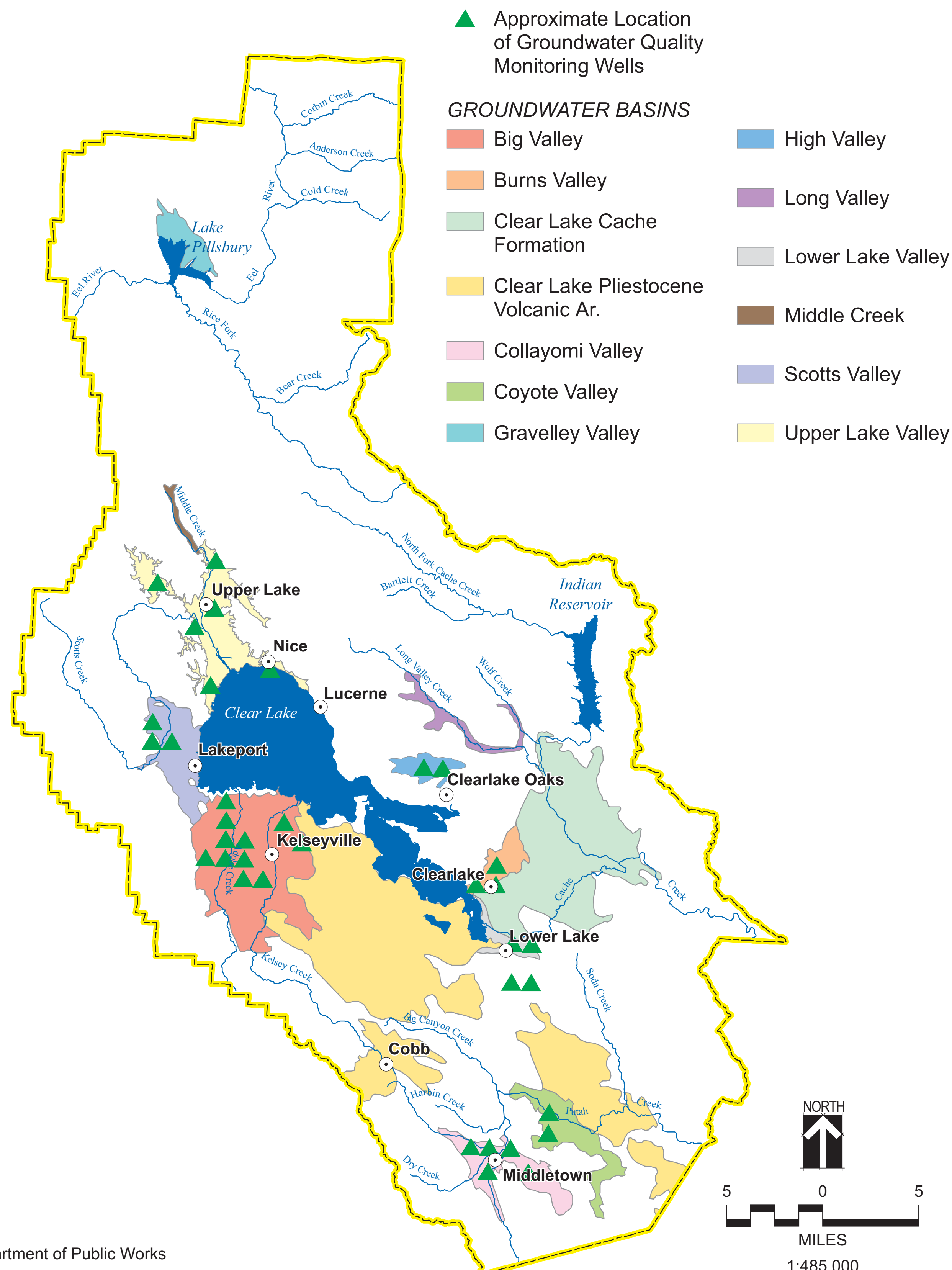
The District can investigate future opportunities for additional conjunctive use projects. The District would need to evaluate the need for these projects and comply with appropriate permitting, regulatory, and environmental requirements.

4.4.3 Groundwater Project Implementation Steps

To improve management of groundwater projects, the District will take the following actions:

- Pursue funding from state and federal agencies for groundwater sustainability activities.

- Pursue implementation of the Adobe Creek Conjunctive Use Project
- Continue to operate the Kelsey Creek Detention Structure
- Identify other potential opportunities for groundwater recharge or conjunctive use projects



Source:
Lake County Department of Public Works
California Spatial Information Library

Figure 4-1
Groundwater Quality Monitoring Wells

CDM

Section 5
Implementation Summary and Recommendations

The District is committed to improving management of groundwater resources in Lake County, however the District does not have funds available for implementation of a comprehensive groundwater management program. While state and federal agencies may assist in establishing or expanding the monitoring grid or other programs, a reliable source of funds is required to continue management after grant funds are expended. Without a reliable source of funding, the District will not be able to fully implement the groundwater management plan without sacrificing other programs.

This GMP describes the District's groundwater management objectives, the physical setting of Lake County, individual BMOs, and components of the GMP. These sections fulfill AB3030 recommended components and SB1938 required components for a GMP, and some of the recommended components from DWR's Bulletin 118-2003. This sectional also summarizes implementation of the GMP and develops further recommendations based on DWR's Bulletin 118-2003 suggested components.

5.1 GMP Implementation Summary

The District developed objectives to improve groundwater management in the County. These objectives, also described in Section 1, include:

- Improve understanding of groundwater levels and quality in Lake County;
- Maintain a sustainable, high quality water supply for agricultural, environmental, and urban uses;
- Minimize the long-term drawdown of groundwater levels;
- Protect groundwater quality;
- Minimize changes to surface water flows and quality that directly affect groundwater levels or quality;
- Minimize the effect of groundwater pumping on surface water flows and quality;
- Facilitate groundwater replenishment and cooperative management projects; and
- Prevent inelastic land surface subsidence from occurring as a result of groundwater pumping.

Section 4 describes components of the GMP to help meet the above objectives. Table 5-1 summarizes the GMP plan components and implementation steps.

Table 5-1
GMP Implementation Summary

Component	Implementation Step
Groundwater Monitoring	Work with local stakeholders and DWR to develop an expanded monitoring program that would: ▪ Identify areas that may need additional groundwater level, groundwater quality, or subsidence monitoring based on identified data gaps, trends, and BMOs ▪ Identify the appropriate monitoring methodology for each area based on existing or new infrastructure ▪ Prioritize the rehabilitation or construction of new wells based on the needs of each area and available funding
	Work with state and federal agencies to secure funding for expansion of the monitoring grid
	Coordinate with DWR and local landowners to ensure that selected wells are maintained as part of a long-term monitoring program
	Develop a monitoring schedule
	Develop a reporting plan to share data with appropriate stakeholders
Interagency and Department Cooperation	Continue to work cooperatively with DWR on groundwater management activities
	Continue to support and be responsive to the actions and needs of other Lake County Departments
	Consult appropriate federal agencies, as necessary, on groundwater management activities
Water Well Policies	Support Environmental Health's efforts to further wellhead and recharge protection
	Support administration of the ARMP
	Evaluate the need for a wellhead protection program in Lake County
	Evaluate the need for a recharge area identification program in Lake County
Management of Groundwater Projects	Pursue funding from state and federal agencies for groundwater sustainability activities
	Pursue implementation of Adobe Creek Conjunctive Use Project
	Continue to operate the Kelsey Creek Detention Structure
	Identify other potential opportunities for groundwater recharge or conjunctive use projects

5.2 Recommended Components

The following recommended components are based on DWR's Bulletin 118-2003. These additional components will further improve groundwater management and facilitate successful implementation of this GMP in the long-term.

5.2.1 Progress Reports

The District will issue annual progress reports which will include a summary of the physical conditions of the groundwater basins and an assessment of current management actions. Annual progress reports will provide an analysis of groundwater trends in the plan area, allowing for dissemination of groundwater information to assist in County planning activities. The District will make the reports available to interested stakeholders. The annual report will include:

- Groundwater level monitoring results for the preceding year along with a trend analysis
- Groundwater quality monitoring reports, with historical trends
- A summary of management actions taken during the period being reported

- A discussion of how the management actions are achieving progress towards meeting management objectives
- A summary of proposed management actions
- A summary of actions taken to coordinate with other agencies and departments

5.2.2 GMP Periodic Updates

This GMP documents the current understanding of groundwater conditions and existing management practices. As more information is gathered through monitoring and investigations, the District and stakeholders will gain an increased understanding of the groundwater resources in Lake County. As a result of this increased knowledge, management objectives and measures will need to be updated and the GMP will be updated accordingly. The District will continually consider improvements to the groundwater management techniques outlined in the GMP. The District will work to incorporate these improvements as they develop.

5.2.3 Advisory Committee

The District will consider establishing a Water Advisory Committee (WAC) of stakeholders within the plan area that will help guide the development and implementation of the GMP. Stakeholders could include landowners, representatives from water suppliers, and representatives from county or state agencies. These individuals should have local knowledge of the area to provide insight and direction to the implementation of the GMP. The WAC would be involved in reviewing physical conditions and management reports and recommending changes to the GMP to improve management of the resource.

Section 6
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Appendix A

Resolution of Intent to Adopt GMP

BOARD OF DIRECTORS
LAKE COUNTY WATERSHED PROTECTION DISTRICT

RESOLUTION NO. 2005-172

A RESOLUTION OF INTENT TO PREPARE A GROUNDWATER MANAGEMENT PLAN FOR LAKE COUNTY

WHEREAS, State Water Code, part 2.75, Section 10750, et seq., establishes a procedure whereby groundwater management may be conducted by a local agency such as a flood control district; and

WHEREAS, State Water Code, Uncodified Act 4145, "Lake County Watershed Protection District Act," provides authority for groundwater management by Lake County Watershed Protection District; and

WHEREAS, Section 24.5 of the Lake County Watershed Protection District Act provides for the establishment of a zone commission of seven members to represent residents and property owners of that zone; and

WHEREAS, on October 4, 2005, the Board of Directors of the Lake County Watershed Protection District did hold a public hearing to ascertain whether or not to adopt a resolution of intention to draft a groundwater management plan.

NOW THEREFORE, BE IT RESOLVED THAT:

1. The Board of Directors of the Lake County Watershed Protection District intends to have drafted a groundwater management plan for the purposes of implementing the plan and establishing a groundwater management program in the County.
2. The Clerk is directed to publish this resolution of intention as required by Water Code Section 10753.3.

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THIS RESOLUTION was passed by the Board of Directors of the Lake County Watershed Protection District at a regular meeting thereof held on October 4, 2005, by the following vote:

AYES: Directors Smith, Lewis, Farrington, Brown and Robey

NOES: None

ABSENT OR NOT VOTING: None

LAKE COUNTY WATERSHED
PROTECTION DISTRICT

Chair, Board of Directors

ATTEST: KELLY COX
Clerk of the Board

By: Deputy

APPROVED AS TO FORM:
CAMERON L. REEVES
County Counsel

By:

E8Agrm...LakeCoGM

Appendix B

Agricultural Demand in Lake County by Groundwater Basin

Agricultural Water Demand by Groundwater Basin Water Use
Average Year Data
Upper Lake Groundwater Basin

Crop	Unit ET of Applied Water (acre-feet/acre)	Unit Applied Water (acre-feet/acre)								Irrigated Acreage (Acres)				ET of Applied Water (Acre-feet)				Applied Water (Acre-feet)			
		Surface		Mixed		Ground		Total		Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total
ALFALFA	2.8	70%	4.00			70%	4.00					32.0	32.0	0.0		90.0	90.0	0.0		128.0	128.0
ALFALFA - X																					
ALMONDS	2.4	80%	3.00			80%	3.00														
CORN	1.6	73%	2.19			78%	2.05														
EUCALYPTUS																					
GRAIN	0.3	70%	0.43			70%	0.43			9.0			9.0	3.0		0.0	3.0	4.0		0.0	4.0
GRAPES	0.5	90%	0.56			90%	0.56			139.0		334.0	473.0	70.0		167.0	237.0	78.0		187.0	265.0
MEADOW PASTURE																					
MEADOW PASTURE - X																					
OLIVES - CITRUS																					
OTHER DECIDUOUS	2.2	80%	2.75			80%	2.75														
OTHER FIELD																					
OTHER TRUCK	1.5	78%	1.92			78%	1.92														
PASTURE	3.1	70%	4.43			76%	4.08			276.0		458.0	734.0	856.0		1,420.0	2,276.0	1,223.0		1,869.0	3,092.0
PASTURE - X																					
PEARS	2.2	75%	2.93			80%	2.75			154.0		443.0	597.0	339.0		975.0	1,314.0	451.0		1,218.0	1,669.0
PISTACHIOS	2.5	90%	2.78			90%	2.78														
RICE	2.7	60%	4.50			60%	4.50			539.0			539.0	1,455.0		0.0	1,455.0	2,426.0		0.0	2,426.0
STRAWBERRIES and FLOWERS	1.5	70%	2.14			70%	2.14					32.0	32.0	0.0		48.0	48.0	0.0		68.0	68.0
WALNUTS	2.3	76%	3.03			80%	2.88					283.0	283.0	0.0		651.0	651.0	0.0		815.0	815.0
Total Irrigated Crop Acreage										**1,117.0**		**1,582.0**	**2,699.0**	**2,723.0**		**3,351.0**	**6,074.0**	**4,182.0**		**4,285.0**	**8,467.0**

Agricultural Water Demand by Groundwater Basin Water Use
Average Year Data
Scotts Valley Groundwater Basin

Crop	Unit ET of Applied Water (acre-feet/acre)	Unit Applied Water (acre-feet/acre)					
		Surface		Mixed	Ground		Total
ALFALFA	2.8	70%	4.00		70%	4.00	
ALFALFA - X							
ALMONDS	2.4	80%	3.00		80%	3.00	
CORN	1.6	73%	2.19		78%	2.05	
EUCALYPTUS							
GRAIN	0.3	70%	0.43		70%	0.43	
GRAPES	0.5	90%	0.56		90%	0.56	
MEADOW PASTURE							
MEADOW PASTURE - X							
OLIVES - CITRUS							
OTHER DECIDUOUS	2.2	80%	2.75		80%	2.75	
OTHER FIELD							
OTHER TRUCK	1.5	78%	1.92		78%	1.92	
PASTURE	3.1	70%	4.43		76%	4.08	
PASTURE - X							
PEARS	2.2	75%	2.93		80%	2.75	
PISTACHIOS	2.5	90%	2.78		90%	2.78	
RICE	2.7	60%	4.50		60%	4.50	
STRAWBERRIES	1.5	70%	2.14		70%	2.14	
WALNUTS	2.3	76%	3.03		80%	2.88	
Total Irrigated Crop Acreage							

Crop	Irrigated Acreage (Acres)				ET of Applied Water (Acre-feet)				Applied Water (Acre-feet)			
	Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total
ALFALFA												
ALFALFA - X												
ALMONDS												
CORN												
EUCALYPTUS												
GRAIN												
GRAPES			41.0	41.0	0.0		21.0	21.0	0.0		23.0	23.0
MEADOW PASTURE												
MEADOW PASTURE - X												
OLIVES - CITRUS												
OTHER DECIDUOUS			11.0	11.0	0.0		24.0	24.0	0.0		30.0	30.0
OTHER FIELD												
OTHER TRUCK												
PASTURE			74.0	74.0	0.0		229.0	229.0	0.0		302.0	302.0
PASTURE - X												
PEARS			680.0	680.0	0.0		1,496.0	1,496.0	0.0		1,870.0	1,870.0
PISTACHIOS			5.0	5.0	0.0		13.0	13.0	0.0		14.0	14.0
RICE												
STRAWBERRIES												
WALNUTS			45.0	45.0	0.0		104.0	104.0	0.0		130.0	130.0
Total Irrigated Crop Acreage	**0.0**		**856.0**	**856.0**	**0.0**		**1,887.0**	**1,887.0**	**0.0**		**2,369.0**	**2,369.0**

Agricultural Water Demand by Groundwater Basin Water Use
Average Year Data
Middle Creek Groundwater Basin

Crop	Unit ET of Applied Water (acre-feet/acre)	Unit Applied Water (acre-feet/acre)								Irrigated Acreage (Acres)				ET of Applied Water (Acre-feet)				Applied Water (Acre-feet)			
		Surface		Mixed		Ground		Total		Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total
ALFALFA	2.8	70%	4.00			70%	4.00														
ALFALFA - X																					
ALMONDS	2.4	80%	3.00			80%	3.00														
CORN	1.6	73%	2.19			78%	2.05														
EUCALYPTUS																					
GRAIN	0.3	70%	0.43			70%	0.43														
GRAPES	0.5	90%	0.56			90%	0.56														
MEADOW PASTURE																					
MEADOW PASTURE - X																					
OLIVES - CITRUS																					
OTHER DECIDUOUS	2.2	80%	2.75			80%	2.75														
OTHER FIELD																					
OTHER TRUCK	1.5	78%	1.92			78%	1.92														
PASTURE	3.1	70%	4.43			76%	4.08					18.0	18.0	0.0		56.0	56.0	0.0		73.0	73.0
PASTURE - X																					
PEARS	2.2	75%	2.93			80%	2.75														
PISTACHIOS	2.5	90%	2.78			90%	2.78														
RICE	2.7	60%	4.50			60%	4.50														
STRAWBERRIES	1.5	70%	2.14			70%	2.14														
WALNUTS	2.3	76%	3.03			80%	2.88														
Total Irrigated Crop Acreage										**0.0**		**18.0**	**18.0**	**0.0**		**56.0**	**56.0**	**0.0**		**73.0**	**73.0**

Agricultural Water Demand by Groundwater Basin Water Use
Average Year Data
Lower Lake Groundwater Basin

Crop	Unit ET of Applied Water (acre-feet/acre)	Unit Applied Water (acre-feet/acre)								Irrigated Acreage (Acres)				ET of Applied Water (Acre-feet)				Applied Water (Acre-feet)			
		Surface		Mixed		Ground		Total		Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total
ALFALFA	2.8	70%	4.00			70%	4.00														
ALFALFA - X																					
ALMONDS	2.4	80%	3.00			80%	3.00														
CORN	1.6	73%	2.19			78%	2.05														
EUCALYPTUS																					
GRAIN	0.3	70%	0.43			70%	0.43														
GRAPES	0.5	90%	0.56			90%	0.56					31.0	31.0	0.0		16.0	16.0	0.0		17.0	17.0
MEADOW PASTURE																					
MEADOW PASTURE - X																					
OLIVES - CITRUS																					
OTHER DECIDUOUS	2.2	80%	2.75			80%	2.75														
OTHER FIELD																					
OTHER TRUCK	1.5	78%	1.92			78%	1.92														
PASTURE	3.1	70%	4.43			76%	4.08														
PASTURE - X																					
PEARS	2.2	75%	2.93			80%	2.75														
PISTACHIOS	2.5	90%	2.78			90%	2.78														
RICE	2.7	60%	4.50			60%	4.50														
STRAWBERRIES	1.5	70%	2.14			70%	2.14														
WALNUTS	2.3	76%	3.03			80%	2.88														
Total Irrigated Crop Acreage										**0.0**		**31.0**	**31.0**	**0.0**		**16.0**	**16.0**	**0.0**		**17.0**	**17.0**

Agricultural Water Demand by Groundwater Basin Water Use
Average Year Data
Long Valley Groundwater Basin

Crop	Unit ET of Applied Water (acre-feet/acre)	Unit Applied Water (acre-feet/acre)								Irrigated Acreage (Acres)				ET of Applied Water (Acre-feet)				Applied Water (Acre-feet)			
		Surface		Mixed		Ground		Total		Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total
ALFALFA	2.8	70%	4.00			70%	4.00														
ALFALFA - X																					
ALMONDS	2.4	80%	3.00			80%	3.00														
CORN	1.6	73%	2.19			78%	2.05														
EUCALYPTUS																					
GRAIN	0.3	70%	0.43			70%	0.43														
GRAPES	0.5	90%	0.56			90%	0.56														
MEADOW PASTURE																					
MEADOW PASTURE - X																					
OLIVES - CITRUS																					
OTHER DECIDUOUS	2.2	80%	2.75			80%	2.75														
OTHER FIELD																					
OTHER TRUCK	1.5	78%	1.92			78%	1.92														
PASTURE	3.1	70%	4.43			76%	4.08														
PASTURE - X																					
PEARS	2.2	75%	2.93			80%	2.75														
PISTACHIOS	2.5	90%	2.78			90%	2.78														
RICE	2.7	60%	4.50			60%	4.50														
FLOWERS	1.5	70%	2.14			70%	2.14					117.0	117.0	0.0		176.0	176.0	0.0		250.0	250.0
WALNUTS	2.3	76%	3.03			80%	2.88					1.0	1.0	0.0		2.0	2.0	0.0		3.0	3.0
Total Irrigated Crop Acreage										**0.0**		**118.0**	**118.0**	**0.0**		**178.0**	**178.0**	**0.0**		**253.0**	**253.0**

Agricultural Water Demand by Groundwater Basin Water Use
Average Year Data
Big Valley Groundwater Basin

Crop	Unit ET of Applied Water (acre-feet/acre)	Unit Applied Water (acre-feet/acre)								Irrigated Acreage (Acres)				ET of Applied Water (Acre-feet)				Applied Water (Acre-feet)			
		Surface		Mixed		Ground		Total		Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total
ALFALFA	2.8	70%	4.00			70%	4.00														
ALFALFA - X																					
ALMONDS	2.4	80%	3.00			80%	3.00														
CORN	1.6	73%	2.19			78%	2.05					8.0	8.0	0.0		13.0	13.0	0.0		16.0	16.0
EUCALYPTUS																					
GRAIN	0.3	70%	0.43			70%	0.43					39.0	39.0	0.0		12.0	12.0	0.0		17.0	17.0
GRAPES	0.5	90%	0.56			90%	0.56			3.0		3,456.0	3,459.0	2.0		1,728.0	1,730.0	2.0		1,935.0	1,937.0
MEADOW PASTURE																					
MEADOW PASTURE - X																					
OLIVES - CITRUS																					
OTHER DECIDUOUS	2.2	80%	2.75			80%	2.75					12.0	12.0	0.0		26.0	26.0	0.0		33.0	33.0
OTHER FIELD																					
OTHER TRUCK	1.5	78%	1.92			78%	1.92					19.0	19.0	0.0		29.0	29.0	0.0		36.0	36.0
PASTURE	3.1	70%	4.43			76%	4.08			20.0		254.0	274.0	62.0		787.0	849.0	89.0		1,036.0	1,125.0
PASTURE - X																					
PEARS	2.2	75%	2.93			80%	2.75					2,151.0	2,151.0	0.0		4,732.0	4,732.0	0.0		5,915.0	5,915.0
PISTACHIOS	2.5	90%	2.78			90%	2.78														
RICE	2.7	60%	4.50			60%	4.50														
FLOWERS	1.5	70%	2.14			70%	2.14					6.0	6.0	0.0		9.0	9.0	0.0		13.0	13.0
WALNUTS	2.3	76%	3.03			80%	2.88					820.0	820.0	0.0		1,886.0	1,886.0	0.0		2,362.0	2,362.0
Total Irrigated Crop Acreage										**23.0**		**6,765.0**	**6,788.0**	**64.0**		**9,222.0**	**9,286.0**	**91.0**		**11,363.0**	**11,454.0**

Agricultural Water Demand by Groundwater Basin Water Use
Average Year Data
High Valley Groundwater Basin

Crop	Unit ET of Applied Water (acre-feet/acre)	Unit Applied Water (acre-feet/acre)								Irrigated Acreage (Acres)				ET of Applied Water (Acre-feet)				Applied Water (Acre-feet)			
		Surface		Mixed		Ground		Total		Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total
ALFALFA	2.8	70%	4.00			70%	4.00														
ALFALFA - X																					
ALMONDS	2.4	80%	3.00			80%	3.00														
CORN	1.6	73%	2.19			78%	2.05														
EUCALYPTUS																					
GRAIN	0.3	70%	0.43			70%	0.43														
GRAPES	0.5	90%	0.56			90%	0.56					64.0	64.0	0.0		32.0	32.0	0.0		36.0	36.0
MEADOW PASTURE																					
MEADOW PASTURE - X																					
OLIVES - CITRUS																					
OTHER DECIDUOUS	2.2	80%	2.75			80%	2.75														
OTHER FIELD																					
OTHER TRUCK	1.5	78%	1.92			78%	1.92														
PASTURE	3.1	70%	4.43			76%	4.08														
PASTURE - X																					
PEARS	2.2	75%	2.93			80%	2.75														
PISTACHIOS	2.5	90%	2.78			90%	2.78														
RICE	2.7	60%	4.50			60%	4.50														
FLOWERS	1.5	70%	2.14			70%	2.14														
WALNUTS	2.3	76%	3.03			80%	2.88														
Total Irrigated Crop Acreage										**0.0**		**64.0**	**64.0**	**0.0**		**32.0**	**32.0**	**0.0**		**36.0**	**36.0**

Agricultural Water Demand by Groundwater Basin Water Use
Average Year Data
Coyote Valley Groundwater Basin

Crop	Unit ET of Applied Water (acre-feet/acre)	Unit Applied Water (acre-feet/acre)				Irrigated Acreage (Acres)				ET of Applied Water (Acre-feet)				Applied Water (Acre-feet)			
		Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total
ALFALFA	2.8	70% 4.00		70% 4.00													
ALFALFA - X																	
ALMONDS	2.4	80% 3.00		80% 3.00													
CORN	1.6	73% 2.19		78% 2.05													
EUCALYPTUS																	
GRAIN	0.3	70% 0.43		70% 0.43				20.0	20.0	0.0		6.0	6.0	0.0		9.0	9.0
GRAPES	0.5	90% 0.56		90% 0.56		333.0		191.0	524.0	167.0		96.0	263.0	186.0		107.0	293.0
MEADOW PASTURE																	
MEADOW PASTURE - X																	
OLIVES - CITRUS																	
OTHER DECIDUOUS	2.2	80% 2.75		80% 2.75				3.0	3.0	0.0		7.0	7.0	0.0		8.0	8.0
OTHER FIELD																	
OTHER TRUCK	1.5	78% 1.92		78% 1.92													
PASTURE	3.1	70% 4.43		76% 4.08		726.0		134.0	860.0	2,251.0		415.0	2,666.0	3,216.0		547.0	3,763.0
PASTURE - X																	
PEARS	2.2	75% 2.93		80% 2.75													
PISTACHIOS	2.5	90% 2.78		90% 2.78													
RICE	2.7	60% 4.50		60% 4.50													
FLOWERS	1.5	70% 2.14		70% 2.14													
WALNUTS	2.3	76% 3.03		80% 2.88													
Total Irrigated Crop Acreage						**1,059.0**		**348.0**	**1,407.0**	**2,418.0**		**524.0**	**2,942.0**	**3,402.0**		**671.0**	**4,073.0**

Agricultural Water Demand by Groundwater Basin Water Use
Average Year Data
Collayomi Valley Groundwater Basin

Crop	Unit ET of Applied Water	Unit Applied Water (acre-feet/acre)				Irrigated Acreage (Acres)				ET of Applied Water (Acre-feet)				Applied Water (Acre-feet)			
	(acre-feet/acre)	Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total
ALFALFA	2.8	70% 4.00		70% 4.00													
ALFALFA - X																	
ALMONDS	2.4	80% 3.00		80% 3.00													
CORN	1.6	73% 2.19		78% 2.05													
EUCALYPTUS																	
GRAIN	0.3	70% 0.43		70% 0.43													
GRAPES	0.5	90% 0.56		90% 0.56				292.0	292.0	0.0		146.0	146.0	0.0		164.0	164.0
MEADOW PASTURE																	
MEADOW PASTURE - X																	
OLIVES - CITRUS																	
OTHER DECIDUOUS	2.2	80% 2.75		80% 2.75													
OTHER FIELD																	
OTHER TRUCK	1.5	78% 1.92		78% 1.92													
PASTURE	3.1	70% 4.43		76% 4.08		33.0		25.0	58.0	102.0		78.0	180.0	146.0		102.0	248.0
PASTURE - X																	
PEARS	2.2	75% 2.93		80% 2.75													
PISTACHIOS	2.5	90% 2.78		90% 2.78													
RICE	2.7	60% 4.50		60% 4.50													
FLOWERS	1.5	70% 2.14		70% 2.14													
WALNUTS	2.3	76% 3.03		80% 2.88													
Total Irrigated Crop Acreage						**33.0**		**317.0**	**350.0**	**102.0**		**224.0**	**326.0**	**146.0**		**266.0**	**412.0**

Agricultural Water Demand by Groundwater Basin Water Use
Average Year Data
Clear Lake Volcanics Groundwater Source Area

Crop	Unit ET of Applied Water (acre-feet/acre)	Unit Applied Water (acre-feet/acre)								Irrigated Acreage (Acres)				ET of Applied Water (Acre-feet)				Applied Water (Acre-feet)			
		Surface		Mixed		Ground		Total		Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total
ALFALFA	2.8	70%	4.00			70%	4.00														
ALFALFA - X																					
ALMONDS	2.4	80%	3.00			80%	3.00														
CORN	1.6	73%	2.19			78%	2.05														
EUCALYPTUS																					
GRAIN	0.3	70%	0.43			70%	0.43														
GRAPES	0.5	90%	0.56			90%	0.56					2,803.0	2,803.0	0.0		1,402.0	1,402.0	0.0		1,570.0	1,570.0
MEADOW PASTURE																					
MEADOW PASTURE - X																					
OLIVES - CITRUS																					
OTHER DECIDUOUS	2.2	80%	2.75			80%	2.75														
OTHER FIELD																					
OTHER TRUCK	1.5	78%	1.92			78%	1.92														
PASTURE	3.1	70%	4.43			76%	4.08			185.0		162.0	347.0	574.0		502.0	1,076.0	820.0		661.0	1,481.0
PASTURE - X																					
PEARS	2.2	75%	2.93			80%	2.75														
PISTACHIOS	2.5	90%	2.78			90%	2.78														
RICE	2.7	60%	4.50			60%	4.50														
FLOWERS	1.5	70%	2.14			70%	2.14														
WALNUTS	2.3	76%	3.03			80%	2.88					14.0	14.0	0.0		32.0	32.0	0.0		40.0	40.0
Total Irrigated Crop Acreage										**185.0**		**2,979.0**	**3,164.0**	**574.0**		**1,936.0**	**2,510.0**	**820.0**		**2,271.0**	**3,091.0**

Agricultural Water Demand by Groundwater Basin Water Use
Average Year Data
Clear Lake Cache Formation Groundwater Basin

Crop	Unit ET of Applied Water (acre-feet/acre)	Unit Applied Water (acre-feet/acre)								Irrigated Acreage (Acres)				ET of Applied Water (Acre-feet)				Applied Water (Acre-feet)			
		Surface		Mixed		Ground		Total		Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total
		%		%		%		%													
ALFALFA	2.8	70%	4.00			70%	4.00														
ALFALFA - X																					
ALMONDS	2.4	80%	3.00			80%	3.00														
CORN	1.6	73%	2.19			78%	2.05														
EUCALYPTUS																					
GRAIN	0.3	70%	0.43			70%	0.43														
GRAPES	0.5	90%	0.56			90%	0.56			26.0		127.0	153.0	13.0		64.0	77.0	15.0		71.0	86.0
MEADOW PASTURE																					
MEADOW PASTURE - X																					
OLIVES - CITRUS																					
OTHER DECIDUOUS	2.2	80%	2.75			80%	2.75														
OTHER FIELD																					
OTHER TRUCK	1.5	78%	1.92			78%	1.92														
PASTURE	3.1	70%	4.43			76%	4.08														
PASTURE - X																					
PEARS	2.2	75%	2.93			80%	2.75														
PISTACHIOS	2.5	90%	2.78			90%	2.78														
RICE	2.7	60%	4.50			60%	4.50														
FLOWERS	1.5	70%	2.14			70%	2.14														
WALNUTS	2.3	76%	3.03			80%	2.88					5.0	5.0	0.0		12.0	12.0	0.0		14.0	14.0
Total Irrigated Crop Acreage										**26.0**		**132.0**	**158.0**	**13.0**		**76.0**	**89.0**	**15.0**		**85.0**	**100.0**

Agricultural Water Demand by Groundwater Basin Water Use
Average Year Data
Burns Valley Groundwater Basin

Crop	Unit ET of Applied Water (acre-feet/acre)	Unit Applied Water (acre-feet/acre)								Irrigated Acreage (Acres)				ET of Applied Water (Acre-feet)				Applied Water (Acre-feet)			
		Surface		Mixed		Ground		Total		Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total	Surface	Mixed	Ground	Total
ALFALFA	2.8	70%	4.00			70%	4.00														
ALFALFA - X																					
ALMONDS	2.4	80%	3.00			80%	3.00														
CORN	1.6	73%	2.19			78%	2.05														
EUCALYPTUS																					
GRAIN	0.3	70%	0.43			70%	0.43														
GRAPES	0.5	90%	0.56			90%	0.56			162.0			162.0	81.0		0.0	81.0	91.0		0.0	91.0
MEADOW PASTURE																					
MEADOW PASTURE - X																					
OLIVES - CITRUS																					
OTHER DECIDUOUS	2.2	80%	2.75			80%	2.75														
OTHER FIELD																					
OTHER TRUCK	1.5	78%	1.92			78%	1.92														
PASTURE	3.1	70%	4.43			76%	4.08														
PASTURE - X																					
PEARS	2.2	75%	2.93			80%	2.75														
PISTACHIOS	2.5	90%	2.78			90%	2.78														
RICE	2.7	60%	4.50			60%	4.50														
FLOWERS	1.5	70%	2.14			70%	2.14														
WALNUTS	2.3	76%	3.03			80%	2.88					5.0	5.0	0.0		12.0	12.0	0.0		14.0	14.0
Total Irrigated Crop Acreage										**162.0**		**5.0**	**167.0**	**81.0**		**12.0**	**93.0**	**91.0**		**14.0**	**105.0**

Appendix C

Meeting Summaries

Contents

December 7, 2005 Public Meeting

Clear Lake Volcanics Groundwater Source Area

Memorandum

To: *Tom Smythe*

From: *J. Ayres*

Date: *6 January 2006*

Subject: *Lake County Groundwater Management Plan Basin Management Objective Meeting for the Clear Lake Volcanics Groundwater Source Area*

On December 7th, 2005, CDM facilitated a public meeting with stakeholders from the Clear Lake Volcanics Groundwater Source Area. This memorandum summarizes major discussions held during the meeting.

Attendees:

Name	Organization	Phone	Email
Tom Smythe	Lake Co DPW	707-263-2341	Tom_s@co.lake.ca.us
John Ayres	CDM	916-567-9900	ayresjw@cdm.com
Ben Swann	CDM	916-567-9900	swannbm@cdm.com
Franz Waltenspuhl	B.I. Mutual Water Company	707-279-2244	wildcats@jps.net

Ben Swann introduced the meeting's goals, facilitated introduction of meeting attendees, and reviewed the agenda.

Agenda Item 1 - GMP Purpose and Objectives

Ben Swann discussed the purpose and funding of the Lake County Groundwater Management Plan (GMP). Ben presented a preliminary list of plan objectives. The preliminary objectives were:

- Minimize the long-term drawdown of groundwater levels
- Protect groundwater quality
- Minimize changes to surface water flows and quality that directly affect groundwater levels or quality
- Minimize the effect of groundwater pumping on surface water flows and quality
- Facilitate groundwater replenishment and cooperative management projects

Agenda Item 2 - GMP Elements

Ben Swann discussed the required and voluntary elements of a groundwater management plan. Required elements are indicated by Senate Bill 1938, and voluntary elements are indicated by Assembly Bill 3030.

Agenda Item 3 - GMP Study Area

John Ayres discussed the GMP study area. The study area consists of groundwater basins as defined in Bulletin 118-2003 (DWR), and groundwater source areas (specifically the Clear Lake Volcanics).

Agenda Item 4 - Overview of Groundwater Basins Existing Information

John Ayres discussed the information available for the Clear Lake Volcanics Groundwater Source Area information on the area was developed from:

- The Department of Water Resources (DWR) groundwater level monitoring grid
- Geologic maps
- DWR Bulletin 118 and studies

John reported that for the Clear Lake Volcanics, there were outstanding data needs for groundwater levels, quality and other aquifer properties. Mr. Ayres discussed anecdotal groundwater quality information derived for Department of Health Services data, which indicated in the area, iron and manganese levels may exceed maximum contaminant thresholds. Mr. Ayres indicated that due to the hard rock nature of the groundwater source area, land subsidence due to water extraction was unlikely to occur. Meeting participants provided the following additional groundwater information:

- Groundwater levels in the well for B.I. Mutual have remained constant at a depth to water of 21 feet for the last 3 years.
- There is concern about the effect on groundwater supplies in the Clear Lake Volcanics groundwater source area by the development of areas into vineyards

Agenda Item 5 - BMO Development Process

Ben Swann discussed the BMO Development process, which is focused on local participation and is flexible over time. Qualitative BMOs are locally-developed guidelines that describe water level, quality and subsidence objectives or goals within the basin. Qualitative BMO examples provided at the meeting include:

- Prevent long-term declines in groundwater levels
- Maintain groundwater levels to assure an adequate and affordable irrigation and domestic water supply

- Develop an understanding of groundwater within the basin
- Maintain a sustainable water supply now and into the future
- Increase groundwater level monitoring
- Prevent geothermal groundwater intrusion
- Reduce nitrate concentrations
- Increase groundwater quality monitoring

Meeting participants indicated that increasing monitoring and understanding of water quality should be an objective. Potential additional objectives could be:

- Increase monitoring and understanding of groundwater levels, groundwater quality, land subsidence, and connections between these elements

Agenda Item 6 - Next Steps

Ben Swann discussed the next steps of the GMP process.

December 7, 2005 Public Meeting

Big Valley Groundwater Basin

Memorandum

To: *Tom Smythe*

From: *J. Ayres*

Date: *6 January 2006*

Subject: *Lake County Groundwater Management Plan Basin Management Objective Meeting for the Big Valley Groundwater Basin*

On December 7th, 2005, CDM facilitated a public meeting with stakeholders from Big Valley Groundwater Basin. This memorandum summarizes major discussions held during the meeting.

Attendees:

Name	Organization	Phone	Email
Tom Smythe	Lake Co DPW	707-263-2341	Tom_s@co.lake.ca.us
John Ayres	CDM	916-567-9900	ayresjw@cdm.com
Ben Swann	CDM	916-567-9900	swannbm@cdm.com
Ray Mostin	Big Valley Groundwater Basin Chair	707-279-8205	EM1932@earthlink.net
Richard H. Smith	BVGB Vice Chair	707-279-4791	
Paul Lauenroth	BVGB		
Bob Lossius	Lake County DPW	707-263-2341	Bob_L@co.lake.ca.us
William S. Barquist	BVGWMC	707-279-0323	wmbarquist@yahoo.com
Terrie Stark	Resident	707-262-0929	
Tim Stark	Resident	707-262-0929	

Ben Swann introduced the meeting's goals, facilitated introduction of meeting attendees, and reviewed the agenda.

Agenda Item 1 - GMP Purpose and Objectives

Ben Swann discussed the purpose and funding of the Lake County Groundwater Management Plan (GMP). Ben presented a preliminary list of plan objectives. The preliminary objectives were:

- Minimize the long-term drawdown of groundwater levels
- Protect groundwater quality

- Minimize changes to surface water flows and quality that directly affect groundwater levels or quality
- Minimize the effect of groundwater pumping on surface water flows and quality
- Facilitate groundwater replenishment and cooperative management projects

Agenda Item 2 - GMP Elements

Ben Swann discussed the required and voluntary elements of a groundwater management plan. Required elements are indicated by Senate Bill 1938, and voluntary elements are indicated by Assembly Bill 3030.

Agenda Item 3 - GMP Study Area

John Ayres discussed the GMP study area. The study area consists of groundwater basins as defined in Bulletin 118-2003 (DWR), and groundwater source areas (specifically the Clear Lake Volcanics).

Agenda Item 4 - Overview of Groundwater Basin Existing Information

John Ayres discussed the information available for the Big Valley Groundwater Basin. Information on the groundwater basins was developed from:

- The Department of Water Resources (DWR) groundwater level monitoring grid
- Geologic maps
- DWR Bulletin 118 and studies
- Adobe Creek Conjunctive Use Project Initial Study
- Big Valley Groundwater Recharge Investigation
- Big Valley Groundwater Recharge Investigation Update

Mr. Ayres reported that for the Big Valley Groundwater basin, spring groundwater levels are consistent, however summer groundwater levels experience larger declines in a few areas including near Finley and northwest of Kelseyville. There were high reported levels of magnesium, calcium, bicarbonate, sodium, chloride, sulfate, nitrate and boron. Geothermal water is a significant groundwater issue in Big Valley. Geothermal water is typically found near faults and at the basin's boundary, and may be intruding in areas where freshwater recharge is less than extraction. Subsidence of approximately 12 to 16 inches was observed during the 1976-1977 and 1987-1992 droughts. Meeting participants provided the following additional groundwater information:

- Some wells have high temperature water when pumped
- There are concerns that the lower aquifer with lower quality water may be connected to the upper aquifer with higher quality water
- Some wells may be acting as conduits for geothermal water
- Subsidence was observed to be 6-8 inches in 1976 and 6-8 inches in 1989

Agenda Item 5 - BMO Development Process

Ben Swann discussed the BMO Development process, which is focused on local participation and is flexible over time. Qualitative BMOs are locally-developed guidelines that describe water level, quality and subsidence objectives or goals within the basin. Qualitative BMO examples provided at the meeting include:

- Prevent long-term declines in groundwater levels
- Maintain groundwater levels to assure an adequate and affordable irrigation water supply
- Develop an understanding of groundwater within the basin
- Maintain a sustainable water supply now and into the future
- Increase groundwater level monitoring
- Prevent geothermal groundwater intrusion
- Reduce nitrate concentrations
- Increase groundwater quality monitoring
- Prevent inelastic land subsidence
- Increase subsidence monitoring

Meeting participants indicated that BMOs should be developed from the existing Big Valley AB3030 plan. Potential objectives derived from the existing AB3030 plan are:

- Maintain high groundwater levels to prevent geothermal water intrusion
- Determine and maintain a safe yield of groundwater for use within the basin
- Identify and monitor the relationship between basin groundwater extraction and impacts on groundwater supplies within and adjacent to the basin.

- Develop data and information that identify impacts on groundwater in adjacent areas that might be affected by groundwater use
- Establish mitigation measures to offset identified adverse impacts of groundwater extraction
- Establish quantitative limitation on groundwater extractions for particular areas and establish criteria for well spacing and operations to limit adverse impacts of groundwater extraction on basin wells, if needed
- The recharge area for the volcanic ash aquifer located north of Wight Way should be protected
- The creek beds of Adobe Creek , Kelsey Creek and Manning Creek must be protected to maintain and managed to optimize their recharge capabilities
- Continue to operate the Kelsey Creek Detention Structure to maximize groundwater recharge, allow creek bedload movement, minimize operating costs, and maintain passage for the Clear Lake Hitch
- Consideration should be given to expanding the monitoring program to include wells that provide a more accurate assessment of groundwater levels, including wells that provide an increased area of coverage

Agenda Item 6 - Next Steps

Ben Swann discussed the next steps of the GMP process.

December 14, 2005 Public Meeting

Scotts Valley Groundwater Basin

Memorandum

To: *Tom Smythe*

From: *J. Ayres*

Date: *6 January 2006*

Subject: *Lake County Groundwater Management Plan Basin Management Objective Meeting for the Scotts Valley Groundwater Basin*

On December 14th, 2005, CDM facilitated a public meeting with stakeholders from the Scotts Valley Groundwater Basin. This memorandum summarizes major discussions held during the meeting.

Attendees:

Name	Organization	Phone	Email
Tom Smythe	Lake Co DPW	707-263-2341	Tom_s@co.lake.ca.us
John Ayres	CDM	916-567-9900	ayresjw@cdm.com
Ben Swann	CDM	916-567-9900	swannbm@cdm.com
Stephen Holland	Private pumper	707-263-7030	blazenblake@yahoo.com
William Estrem	Private pumper	707-263-5157	westrem@jps.net

Ben Swann introduced the meeting's goals, facilitated introduction of meeting attendees, and reviewed the agenda.

Agenda Item 1 - GMP Purpose and Objectives

Ben Swann discussed the purpose and funding of the Lake County Groundwater Management Plan (GMP). Ben presented a preliminary list of plan objectives. The preliminary objectives were:

- Minimize the long-term drawdown of groundwater levels
- Protect groundwater quality
- Minimize changes to surface water flows and quality that directly affect groundwater levels or quality
- Minimize the effect of groundwater pumping on surface water flows and quality

- Facilitate groundwater replenishment and cooperative management projects

Agenda Item 2 - GMP Elements

Ben Swann discussed the required and voluntary elements of a groundwater management plan. Required elements are indicated by Senate Bill 1938, and voluntary elements are indicated by Assembly Bill 3030.

Agenda Item 3 - GMP Study Area

John Ayres discussed the GMP study area. The study area consists of groundwater basins as defined in Bulletin 118-2003 (DWR), and groundwater source areas (specifically the Clear Lake Volcanics).

Agenda Item 4 - Overview of Groundwater Basins Existing Information

John Ayres discussed the information available for the Scotts Groundwater Basin. Information on the groundwater basins was developed from:

- The Department of Water Resources (DWR) groundwater level monitoring grid
- Geologic maps
- DWR Bulletin 118 and studies
- Special Reports including the Scotts Valley Recharge and Groundwater Distribution Investigation

John reported that for the Scotts Valley Groundwater basin, there were outstanding data needs for groundwater quality and other aquifer properties. Mr. Ayres discussed anecdotal groundwater quality information derived for Department of Health Services data, which indicated high iron, aluminum, barium, and manganese levels in some areas. Mr. Ayres indicated that information regarding land subsidence was not available for Scotts Valley. Meeting participants provided the following additional groundwater information:

- A change in long term spring groundwater levels may be linked to down cutting of Scotts Creek
- Subsidence of up to 4.5 feet has occurred in Scotts Valley, but subsidence appears to have ceased. The subsidence is related to the base of groundwater wells sticking up out of the ground

Agenda Item 5 - BMO Development Process

Ben Swann discussed the BMO Development process, which is focused on local participation and is flexible over time. Qualitative BMOs are locally-developed guidelines that describe water level, quality and subsidence objectives or goals within the basin. Qualitative BMO examples provided at the meeting include:

- Prevent long-term declines in groundwater levels
- Maintain groundwater levels to assure an adequate and affordable irrigation water supply
- Develop an understanding of groundwater within the basin
- Maintain a sustainable water supply now and into the future
- Increase groundwater level monitoring
- Prevent geothermal groundwater intrusion
- Reduce nitrate concentrations
- Increase groundwater quality monitoring
- Prevent inelastic land subsidence
- Increase subsidence monitoring

Meeting participants indicated that reducing summer groundwater drawdown should be an objective. Objectives were modified to be:

- Prevent long-term declines in groundwater levels
- Maintain groundwater levels to assure an adequate and affordable irrigation and domestic water supply
- Protect and restore groundwater recharge areas
- Minimize summer to winter drawdown
- Increase groundwater level monitoring
- Monitor and or reduce nitrate, iron, and manganese concentrations
- Increase groundwater quality monitoring
- Prevent inelastic land subsidence
- Increase subsidence monitoring

Agenda Item 6 - Next Steps

Ben Swann discussed the next steps of the GMP process.

December 14, 2005 Public Meeting

Upper Lake, Middle Creek, and Gravelly Valley Groundwater Basins

Memorandum

To: *Tom Smythe*

From: *J. Ayres*

Date: *6 January 2006*

Subject: *Lake County Groundwater Management Plan Basin Management Objective Meeting for the Upper Lake, Middle Creek, and Gravelly Valley Groundwater Basins*

On December 14th, 2005, CDM facilitated a public meeting with stakeholders from the Upper Lake, Middle Creek, and Gravelly Valley Groundwater Basins. This memorandum summarizes major discussions held during the meeting.

Attendees:

Name	Organization	Phone	Email
Tom Smythe	Lake Co DPW	707-263-2341	Tom_s@co.lake.ca.us
John Ayres	CDM	916-567-9900	ayresjw@cdm.com
Ben Swann	CDM	916-567-9900	swannbm@cdm.com
Rachelle Henry	Upper Lake County Water	707-275-3232	rhenry@saber.net
Rich Simondi	Upper Lake board member	707-275-2321	
Allen Merrimon	Upper Lake board member	707-275-2070	apmerrimon@netzero.com
Cecil Prack	Private pumper		cecil@cwnet.com
Carol Prack	Private pumper		cecil@cwnet.com

Ben Swann introduced the meeting's goals, facilitated introduction of meeting attendees, and reviewed the agenda.

Agenda Item 1 - GMP Purpose and Objectives

Ben Swann discussed the purpose and funding of the Lake County Groundwater Management Plan (GMP). Ben presented a preliminary list of plan objectives. The preliminary objectives were:

- Minimize the long-term drawdown of groundwater levels
- Protect groundwater quality

- Minimize changes to surface water flows and quality that directly affect groundwater levels or quality
- Minimize the effect of groundwater pumping on surface water flows and quality
- Facilitate groundwater replenishment and cooperative management projects

Agenda Item 2 - GMP Elements

Ben Swann discussed the required and voluntary elements of a groundwater management plan. Required elements are indicated by Senate Bill 1938, and voluntary elements are indicated by Assembly Bill 3030.

Agenda Item 3 - GMP Study Area

John Ayres discussed the GMP study area. The study area consists of groundwater basins as defined in Bulletin 118-2003 (DWR), and groundwater source areas (specifically the Clear Lake Volcanics).

Agenda Item 4 - Overview of Groundwater Basins Existing Information

John Ayres discussed the information available for the Upper Lake, Middle Creek, and Gravelly Valley Groundwater Basins. Information on the groundwater basins was developed from:

- The Department of Water Resources (DWR) groundwater level monitoring grid
- Geologic maps
- DWR Bulletin 118 and studies
- Special Reports including the Upper Lake Groundwater Investigation

John reported that for the Upper Lake Groundwater basin, there were outstanding data needs for groundwater quality and other aquifer properties. He reported that there was no groundwater data for the Middle Creek and Gravelly Valley basins. John discussed anecdotal groundwater quality information derived for Department of Health Services data, which indicated in Upper Valley, iron and manganese levels may exceed maximum contaminant thresholds (mcls) in some areas. Meeting participants provided the following additional groundwater information:

- Water quality deteriorates towards the south end of the Upper Lake Basin
- There is an area of increase manganese to the south of the City of Upper lake
- Sulphur has been detected in some wells in the Upper Lake Basin

- Faults in the area may be acting as conduits for geothermal water

Agenda Item 5 - BMO Development Process

Ben Swann discussed the BMO Development process, which is focused on local participation and is flexible over time. Qualitative BMOs are locally-developed guidelines that describe water level, quality and subsidence objectives or goals within the basin. Qualitative BMO examples provided at the meeting include:

- Prevent long-term declines in groundwater levels
- Maintain groundwater levels to assure an adequate and affordable irrigation water supply
- Develop an understanding of groundwater within the basin
- Maintain a sustainable water supply now and into the future
- Increase groundwater level monitoring
- Prevent geothermal groundwater intrusion
- Reduce nitrate concentrations
- Increase groundwater quality monitoring
- Prevent inelastic land subsidence
- Increase subsidence monitoring

Meeting participants indicated that increasing monitoring and understanding of water quality, specifically iron and manganese, should be an objective. Potential additional objectives could be:

- Increase monitoring and understanding of groundwater levels, groundwater quality, land subsidence, and connections between these elements
- Monitor and understand Iron, Manganese and Nitrate water quality issues.

Agenda Item 6 - Next Steps

Ben Swann discussed the next steps of the GMP process.

December 15, 2005 Public Meeting

Collayomi Valley and Coyote Valley Groundwater Basins

Memorandum

To: *Tom Smythe*

From: *J. Ayres*

Date: *6 January 2006*

Subject: *Lake County Groundwater Management Plan Basin Management Objective Meeting for the Collayomi Valley and Coyote Valley Groundwater Basins*

On December 15th, 2005, CDM facilitated a public meeting with stakeholders from the Collayomi Valley and Coyote Valley Groundwater Basins. This memorandum summarizes major discussions held during the meeting.

Attendees:

Name	Organization	Phone	Email
Tom Smythe	Lake Co DPW	707-263-2341	Tom_s@co.lake.ca.us
John Ayres	CDM	916-567-9900	ayresjw@cdm.com
Ben Swann	CDM	916-567-9900	swannbm@cdm.com
Frank Haas	Callayomi County Water Dist	707-987-2180	ccwd@mchsi.com
Tom Miller	Retired	707-987-4878	diromiller@peoplepc.com
Monica Rosenthal	Rosenthal Vineyards	707-928-4580	davervc@pacific.net
Don Brejska	Retired	707-987-0371	
Roger Rosenthal	CCWD	707-987-2716	
Mel Aust	Hidden Valley Lake CSD	707-987-9201	maust@hiddenvalleylakecsd.com

Ben Swann introduced the meeting's goals, facilitated introduction of meeting attendees, and reviewed the agenda.

Agenda Item 1 - GMP Purpose and Objectives

Ben Swann discussed the purpose and funding of the Lake County Groundwater Management Plan (GMP). Ben presented a preliminary list of plan objectives. The preliminary objectives were:

- Minimize the long-term drawdown of groundwater levels
- Protect groundwater quality

- Minimize changes to surface water flows and quality that directly affect groundwater levels or quality
- Minimize the effect of groundwater pumping on surface water flows and quality
- Facilitate groundwater replenishment and cooperative management projects

Agenda Item 2 - GMP Elements

Ben Swann discussed the required and voluntary elements of a groundwater management plan. Required elements are indicated by Senate Bill 1938, and voluntary elements are indicated by Assembly Bill 3030.

Agenda Item 3 - GMP Study Area

John Ayres discussed the GMP study area. The study area consists of groundwater basins as defined in Bulletin 118-2003 (DWR), and groundwater source areas (specifically the Clear Lake Volcanics).

Agenda Item 4 - Overview of Groundwater Basins Existing Information

John Ayres discussed the information available for the Collayomi Valley and Coyote Valley Groundwater Basins. Information on the groundwater basins was developed from:

- The Department of Water Resources (DWR) groundwater level monitoring grid
- Geologic maps
- DWR Bulletin 118 and studies
- Special Reports including the Middletown Groundwater Recharge Enhancement Investigation (1987)

Mr. Ayres reported that for the Collayomi Valley and Coyote Valley Groundwater basins, there were outstanding data needs for groundwater quality and other aquifer properties. He discussed anecdotal groundwater quality information derived for Department of Health Services data, which indicated in Collayomi Valley, iron and manganese levels may exceed maximum contaminant thresholds (mcls) in some areas. Meeting participants provided the following additional groundwater information:

- Sulfide was detected in a water supply well in Collayomi Valley
- Chromium was detected in a water supply well in Coyote Valley
- Water in Putah Creek is adjudicated

- Wells in the south portion of Collayomi Valley run dry in the summer

Agenda Item 5 - BMO Development Process

Ben Swann discussed the BMO Development process, which is focused on local participation and is flexible over time. Qualitative BMOs are locally-developed guidelines that describe water level, quality and subsidence objectives or goals within the basin. Qualitative BMO examples provided at the meeting include:

- Prevent long-term declines in groundwater levels
- Maintain groundwater levels to assure an adequate and affordable municipal, domestic, and irrigation water supply
- Develop an understanding of groundwater within the basin
- Maintain a sustainable water supply now and into the future
- Increase groundwater level monitoring
- Prevent geothermal groundwater intrusion
- Reduce nitrate concentrations
- Increase groundwater quality monitoring
- Prevent inelastic land subsidence
- Increase subsidence monitoring

Meeting participants indicated that increasing monitoring and understanding of water quality, and well production should be objectives. Potential additional objectives could be:

- Understand well depths consistent with basin pumping or available yield
- Increase monitoring and understanding of groundwater levels, groundwater quality, land subsidence, and connections between these elements
- Monitor and understand boron, iron, manganese and chromium water quality issues.
- Understand geothermal water occurrence

Agenda Item 6 - Next Steps

Ben Swann discussed the next steps of the GMP process.

December 15, 2005 Public Meeting

High Valley, Long Valley, Cache Formation, Burns Valley, and Lower Lake Valley Groundwater Basins

Memorandum

To: *Tom Smythe*

From: *J. Ayres*

Date: *6 January 2006*

Subject: *Lake County Groundwater Management Plan Basin Management Objective Meeting for the High Valley, Long Valley, Cache Formation, Burns Valley, and Lower Lake Valley Groundwater Basins*

On December 15th, 2005, CDM facilitated a public meeting with stakeholders from the High Valley, Long Valley, Cache Formation, Burns Valley, and Lower Lake Valley Groundwater Basins. This memorandum summarizes major discussions held during the meeting.

Attendees:

Name	Organization	Phone	Email
Tom Smythe	Lake Co DPW	707-263-2341	Tom_s@co.lake.ca.us
John Ayres	CDM	916-567-9900	ayresjw@cdm.com
Ben Swann	CDM	916-567-9900	swannbm@cdm.com
Max Stevenson	Yolo Co. Flood Control	530-662-0262	mstevenson@ycfcwcd.org
Richard Kuehn	Private pumper	707-391-7984	
Clay Shannon	Private pumper	707-479-4874	clay@shannonridge.com
Chuck Lamb	CLEAN	707-998-0135	rtnc@sonic.net
Judy Barns	CLEAN	707-998-1197	bnj@kozt.com
Bob White	Clear Lake Oaks WD	707-998-4438	bobwhite@ngl.net
James Evans	Resident	707-998-9243	mimosa@copper.net
Holly Harns	CLEAN	707-998-0135	rtnc@sonic.net
Ray Brown Jr.	Elem Pomo Tribe	707-998-9411	eparay@elemnation.com
Michael Umbrello	Elem Pomo Tribe	707-998-9424	mu@sonic.net
Curt Grabham	Spring Valley Ranch	707-998-9721	patjg@xprs.net

Ben Swann introduced the meeting's goals, facilitated introduction of meeting attendees, and reviewed the agenda.

Agenda Item 1 - GMP Purpose and Objectives

Ben Swann discussed the purpose and funding of the Lake County Groundwater Management Plan (GMP). Ben presented a preliminary list of plan objectives. The preliminary objectives were:

- Minimize the long-term drawdown of groundwater levels
- Protect groundwater quality
- Minimize changes to surface water flows and quality that directly affect groundwater levels or quality
- Minimize the effect of groundwater pumping on surface water flows and quality
- Facilitate groundwater replenishment and cooperative management projects

Agenda Item 2 - GMP Elements

Ben Swann discussed the required and voluntary elements of a groundwater management plan. Required elements are indicated by Senate Bill 1938, and voluntary elements are indicated by Assembly Bill 3030.

Agenda Item 3 - GMP Study Area

John Ayres discussed the GMP study area. The study area consists of groundwater basins as defined in Bulletin 118-2003 (DWR), and groundwater source areas (specifically the Clear Lake Volcanics).

Agenda Item 4 - Overview of Groundwater Basins Existing Information

John Ayres discussed the information available for the the High Valley, Long Valley, Cache Formation, Burns Valley, and Lower Lake Valley Groundwater Basins. Information on the groundwater basins was developed from:

- The Department of Water Resources (DWR) groundwater level monitoring grid
- Geologic maps
- DWR Bulletin 118 and studies
- Academic Reports including the Stratigraphy of the Cache Formation

John reported that for the High Valley, Long Valley, Cache Formation, Burns Valley, and Lower Lake Valley Groundwater Basins, there were outstanding data needs for quality and other aquifer properties. He reported that there was no current groundwater data for the Long Valley, Cache Formation, Burns Valley, and Lower Lake Valley Groundwater Basins.

He discussed anecdotal groundwater quality information derived for Department of Health Services data, which indicated in Lower Lake, iron and manganese and aluminum levels may exceed maximum contaminant thresholds (mcls) in some areas. Meeting participants provided the following additional groundwater information:

- A quarter of the Long Valley Groundwater Basin has “Soda Water”

Agenda Item 5 - BMO Development Process

Ben Swann discussed the BMO Development process, which is focused on local participation and is flexible over time. Qualitative BMOs are locally-developed guidelines that describe water level, quality and subsidence objectives or goals within the basin. Qualitative BMO examples provided at the meeting include:

- Prevent long-term declines in groundwater levels
- Maintain groundwater levels to assure an adequate and affordable irrigation water supply
- Develop an understanding of groundwater within the basin
- Maintain a sustainable water supply now and into the future
- Increase groundwater level monitoring
- Prevent geothermal groundwater intrusion
- Reduce nitrate concentrations
- Increase groundwater quality monitoring
- Prevent inelastic land subsidence
- Increase subsidence monitoring

Meeting participants indicated that increasing monitoring and understanding of water quality, specifically iron and manganese, should be an objective. Potential additional objectives could be:

- Increase monitoring and understanding of groundwater levels, groundwater quality, land subsidence, and connections between these elements
- Monitor and understand Iron, Manganese and Nitrate water quality issues.

Agenda Item 6 - Next Steps

Ben Swann discussed the next steps of the GMP process.