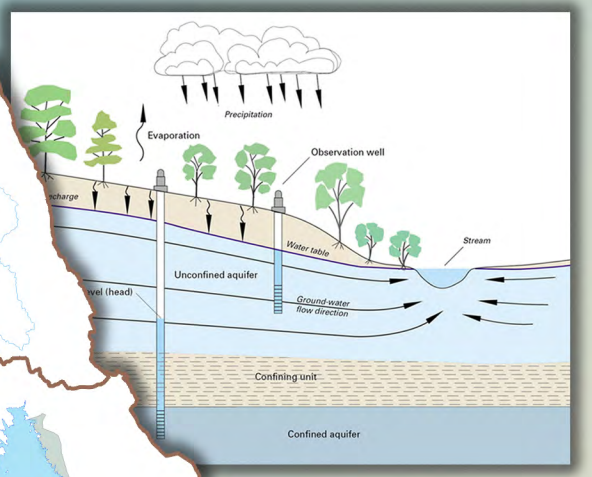
Napa County Groundwater Monitoring Plan 2013



January, 2013

LUHDORFF & SCALMANINI
CONSULTING ENGINEERS

Napa County

Groundwater Monitoring Plan 2013

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EXECUTIVE SUMMARY

Groundwater and surface water are highly important natural resources in Napa County. Long-term, systematic monitoring programs are essential to provide data that allow for improved evaluation of water resources conditions and to facilitate effective water resources planning. In 2009, Napa County embarked on a countywide project referred to as the "Comprehensive Groundwater Monitoring Program, Data Review, and Policy Recommendations for Napa County's Groundwater Resources" (Comprehensive Groundwater Monitoring Program), to meet identified action items in the 2008 General Plan update. The program emphasizes developing a sound understanding of groundwater conditions and implementing an expanded groundwater monitoring and data management program as a foundation for future coordinated, integrated water resources planning and dissemination of water resources information.

The purpose of this *Napa County Groundwater Monitoring Plan 2012* (Plan) is to formalize and augment current groundwater monitoring efforts [levels and quality] to better understand the groundwater resources of Napa County, aid in making the County eligible for public funds administered by the California Department of Water Resources (DWR), and regularly evaluate trends to identify changes in levels and /or quality and factors related to those changes that warrant further examination to ensure sustainable water resources. The Plan is considered a living document that will be updated based upon the data collected and County/community needs. It is envisioned that groundwater conditions and recommended modifications to the countywide groundwater monitoring program would be reported triennially or as needed.

Recent studies by Napa County have found that there are many areas in the county where further efforts to establish or refine groundwater monitoring, using existing or new monitoring facilities, will improve the understanding of groundwater resource conditions and availability. This Plan summarizes groundwater monitoring priorities and recommendations for addressing these priorities. This Plan also summarizes the overarching groundwater level and quality monitoring objectives defined by the County and the Groundwater Resources Advisory Committee (GRAC).

Existing groundwater level and quality monitoring sites are described and recommendations are made for additional monitoring locations of interest to fill data gaps. As additional monitoring sites are considered, or existing monitoring facilities are further evaluated, the groundwater level and quality monitoring objectives will be used to evaluate the suitability of the existing or proposed facilities to ensure that the data being (or planned to be) collected can address these objectives.

The recommended monitoring sites can be addressed in several ways, including:

1) Investigating the potential to restart monitoring where historical records are available but monitoring was discontinued;
2) identifying existing wells of suitable construction that might be volunteered for inclusion through County and GRAC education and outreach efforts (this may include wells that are already being monitored for groundwater quality); and
3) Constructing new dedicated monitoring wells if suitable existing wells either do not exist in the area of interest or are otherwise not available.

This Plan includes recommendations for 18 areas of interest for focused education and outreach efforts to identify existing wells suitable for meeting the monitoring objectives. Additionally, this Plan describes six groundwater monitoring sites located along the main Napa Valley Floor from the City of Napa north to St. Helena adjacent to the Napa River system. These recommended sites would provide the necessary information to further characterize in greater detail the interrelationship between groundwater and surface water resources.

1 INTRODUCTION

1.1 Purpose

Groundwater and surface water are highly important natural resources in Napa County. Collectively, the County and other municipalities, water districts, commercial and industrial operations, the agricultural community, and the general public, are stewards of the available water resources. Currently, municipal and private stakeholders are actively engaged in assessing the reliability of current and future demands and supplies. Important sources of water include both groundwater and surface water of good quality and quantity, to meet future urban, rural, and agricultural water demands. Similar to other areas in California, businesses and residents of Napa County face many water-related challenges including:

- Increased competition for current and future available supplies;
- Preserving the quality and availability of local and imported water supplies;
- Sustaining groundwater recharge capacity and supplies;
- Meeting challenges arising during drought conditions;
- Avoiding environmental effects due to water use; and
- Changes in long-term availability due to global warming and/or climate change.

To address these challenges, long-term, systematic monitoring programs are essential to provide data that allow for improved evaluation of water resources conditions and to facilitate effective water resources planning. Establishment of a groundwater and surface water monitoring network results in the collection of data necessary to distinguish long-term trends from short-term fluctuations, anticipate unintended consequences due to current and historical land uses, identify emerging issues, and design appropriate water resources planning and management strategies. In 2009, Napa County embarked on a countywide project referred to as the "Comprehensive Groundwater Monitoring Program, Data Review, and Policy Recommendations for Napa County's Groundwater Resources" (Comprehensive Groundwater Monitoring Program), to meet identified action items in the 2008 General Plan update. The program emphasizes developing a sound understanding of groundwater conditions and implementing an expanded groundwater monitoring and data management program as a foundation for future coordinated, integrated water resources planning and dissemination of water resources information.

The purpose of this *Napa County Groundwater Monitoring Plan 2012* (Plan) is to formalize and augment current groundwater monitoring efforts [levels and quality] to better understand the groundwater resources of Napa County, aid in making the County eligible for public funds administered by the California Department of Water Resources (DWR), and regularly evaluate trends to identify changes in levels and /or quality and factors related to those changes that warrant further examination to ensure sustainable water resources. The Plan is considered a living document that will be updated based upon the data collected and County/community needs. It is envisioned that groundwater conditions and recommended modifications to the countywide groundwater monitoring program would be reported triennially or as needed.

1.2 Organization of the Plan

This Plan formalizes recommendations provided in the County's Comprehensive Groundwater Monitoring Program by outlining steps to augment countywide groundwater level and quality monitoring. Recent studies by Napa County have found that there are many areas in the county where further efforts to establish or refine groundwater monitoring, using existing or new monitoring facilities, will improve the understanding of groundwater resource conditions and availability. This Plan summarizes groundwater monitoring priorities and recommendations for addressing these priorities. This Plan also summarizes the overarching groundwater level and quality monitoring objectives defined by the County and the GRAC. These objectives provide the framework necessary to ensure that the data collected from the countywide monitoring facilities can address these objectives.

On June 28, 2011, the County Board of Supervisors adopted a resolution establishing a Groundwater Resources Advisory Committee (GRAC). Two of the tasks assigned to the GRAC include: 1) assisting with the synthesis of the existing groundwater information and identifying critical data needs; and 2) providing input on the furtherance of the ongoing countywide groundwater monitoring program. During preparation of this Plan, input from this committee is being coordinated to optimize additional groundwater monitoring locations that serve to meet the objectives of the County's Comprehensive Groundwater Monitoring Program and the California Statewide Groundwater Elevation Monitoring (CASGEM) program. As explained in the next section, the CASGEM program is a subset of the countywide groundwater monitoring program.

This Plan includes the following sections:

Section 2: Hydrogeology of Napa County

- DWR Basins/Subbasins and County Subareas
- Summary of Geology and Groundwater Resources
- Overview of Recent Groundwater Studies and Programs
- Presentation of Groundwater Monitoring Priorities
    - Groundwater Level Monitoring
    - Groundwater Quality Monitoring
- Summary of Recommendations from Recent County Studies

Section 3: Groundwater Resources Goals and Monitoring Objectives

- Napa County Water Resources Goals and Policies
- Groundwater Level Monitoring Objectives
- Groundwater Quality Monitoring Objectives
- Funding and Collaboration for Groundwater Monitoring

Section 4: Groundwater Monitoring Network Design and Development

- **Groundwater Level Monitoring** - Monitoring Network (including existing groundwater level monitoring wells, recommendations to expand the monitoring well network, frequency of monitoring, and field methods)

- **Groundwater Quality Monitoring** - Monitoring Network (including existing groundwater quality monitoring wells, recommendations to expand the monitoring well network, frequency of monitoring, field methods, and parameters of interest)

Section 5: Groundwater Data Management

- Data Management Overview
- Data Management System (DMS)
- Data Use and Disclosure

Section 6: Reporting and Assessment

- Annual Update and Review of Monitoring Plan and Well Network
- Annual CASGEM Reporting
- Triennial Countywide Reporting

2 HYDROGEOLOGY OF NAPA COUNTY

This section summarizes the countywide geologic and hydrologic setting, and includes information about DWR groundwater basin/subbasin delineations and a description of the Napa County groundwater monitoring subareas. The studies that form the basis of the understanding of County hydrogeology are referenced, including the work for the Updated Conceptualization and Characterization of Hydrogeologic Conditions (LSCE and MBK, 2013 in progress).

2.1 DWR Basins/Subbasins and County Subareas

DWR has identified the major groundwater basins and subbasins in and around Napa County; these include the Napa-Sonoma Valley (which in Napa County includes the Napa Valley and Napa-Sonoma Lowlands Subbasins), Berryessa Valley, Pope Valley, and a small part of the Suisun-Fairfield Valley Groundwater Basins (**Figure 2-1**). These basins and subbasins are generally defined based on boundaries to groundwater flow and the presence of water-bearing geologic units. These groundwater basins defined by DWR are not confined within county boundaries, and DWR-designated "basin" or "subbasin" designations do not cover all of Napa County.

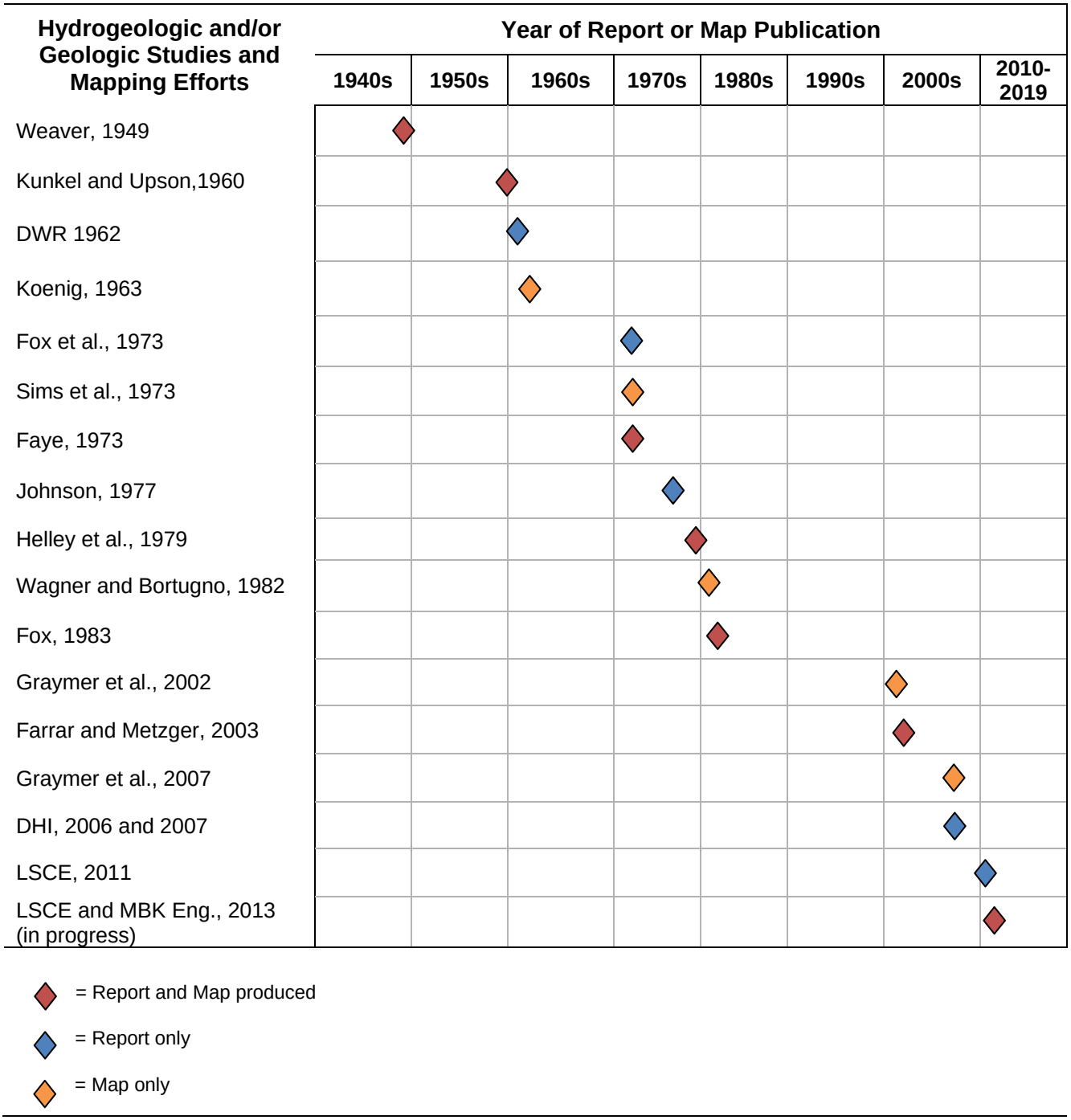
Groundwater conditions outside of the DWR-designated areas are also very important in Napa County. An example of such an area is the Milliken-Sarco-Tulucay (MST) area, a locally identified groundwater deficient area. For purposes of local planning, understanding, and studies, the County has been subdivided into a series of groundwater subareas (**Figure 2-2**). These subareas were delineated based on the main watersheds, groundwater basins, and the County's environmental resource planning areas. These subareas include the Knoxville, Livermore Ranch, Pope Valley, Berryessa, Angwin, Central Interior Valleys, Eastern Mountains, Southern Interior Valleys, Jameson/American Canyon, Napa River Marshes, Carneros, Western Mountains Subareas and five Napa Valley Floor Subareas (Calistoga, St. Helena, Yountville, Napa, and MST).

2.2 Summary of Geology and Groundwater Resources

2.2.1 Previous Studies

Previous hydrogeologic studies of Napa County and also mapping efforts are divisible into geologic studies and groundwater studies. The more significant studies and mapping efforts are mentioned in this section. **Table 2-1** shows the chronological sequence of these efforts that span more than six decades. Weaver (1949) presented geologic maps which covered the southern portion of the county and provided a listing of older geologic studies. Kunkel and Upson (1960) examined the groundwater and geology of the northern portion of the Napa Valley. DWR (Bulletin 99, 1962) presented a reconnaissance report on the geology and water resources of the eastern area of the County; Koenig (1963) compiled a regional geologic map which encompasses Napa County. Fox and others (1973) and Sims and others (1973) presented more detailed geologic mapping of Napa County. Faye (1973) reported on the groundwater of the northern Napa Valley. Johnson (1977) examined the groundwater hydrology of the MST area.

Table 2-1
Summary and Chronology of Hydrogeologic and Geologic Studies and Mapping Efforts in Napa County



Helley and others (1979) summarized the flatland deposits of the San Francisco Bay Region, including those in Napa County. Fox (1983) examined the tectonic setting of Cenozoic rocks, including Napa County. Farrar and Metzger (2003) continued the study of groundwater conditions in the MST area.

Wagner and Bortugno (1982) compiled and revised the regional geologic map of Koenig (1963). Graymer and others (2002) presented detailed geologic mapping of the southern and portions of the eastern areas of the County, while Graymer and others (2007) compiled geologic mapping of the rest of Napa County.

In 2005 to 2007, DHI Water & Environment (DHI) contributed to the 2005 *Napa County Baseline Data Report* (DHI, 2006a and Jones & Stokes et al., 2005) which was part of the County's General Plan update (Napa County, 2008). A groundwater model was developed by DHI in conjunction with the Napa Valley and Lake Berryessa Surface Water models to simulate existing groundwater and surface water conditions on a regional basis primarily in the North Napa Valley and the MST and Carneros Subareas (DHI, 2006b). A 2007 technical memorandum, *Modeling Analysis in Support of Vineyard Development Scenarios Evaluation* (DHI, 2007), was prepared to document the groundwater model update which was used to evaluate various vineyard development scenarios.

Additional geologic maps, groundwater studies, and reports are listed in the references of the Groundwater Report (LSCE, 2011). As recommended in the Groundwater Report and described below, additional work has been conducted to update the conceptualization and characterization of hydrogeologic conditions particularly for the Napa Valley Floor (LSCE and MBK, 2013 in progress).

2.2.2 Summary of Geology and Water Resources

The geology of Napa County can be divided into three broad geologic units based on their ages and geologic nature. These units are: 1) Mesozoic Basement Rocks (pre-65 million years (my)), which underlie all of Napa County, but are primarily exposed in the Eastern County area and the Western Mountains Subarea, 2) Older Cenozoic Volcanic and Sedimentary Deposits (65 my to 2.5 my), including Tertiary Sonoma Volcanics (Miocene and Pliocene; 10 my to 2.5 my) which are found throughout the county, especially in the mountains surrounding Napa Valley, and 3) Younger Cenozoic Volcanic and Sedimentary Deposits (post 2.6 my to present), including the Quaternary alluvium of the Valley Floor. The two primary water-bearing units in the county are the tuffaceous member of the Sonoma Volcanics and the Quaternary alluvium.

Outside of the Napa Valley Floor, percolation of surface water appears to be the primary source of recharge. The rate of recharge within areas such as the MST Subarea has been shown to be significantly higher where streams and tributaries cross highly permeable outcrops (e.g., the tuffaceous member of the Sonoma Volcanics or shallow alluvium). Direct infiltration of precipitation is a major component of recharge in the main Napa Valley. Recharge throughout much of the county is generally limited by underlying shallow bedrock of low permeability. An additional component of groundwater recharge that is less understood is deep percolation through fractured rock and fault zones. This type of recharge can be very difficult to quantify due to the highly variable size and distribution of faults, fractures, and joints in a given area.

Groundwater Occurrence and Quality in the Sonoma Volcanics

Groundwater occurs in the Sonoma Volcanics in Napa County and yields water to wells. Well yields are highly variable from less than 10 to several hundred gallons per minute (gpm). The most common yields are between 10 to 100 gpm. Faye (1973) reported well-test information which showed an average yield of 32 gpm and an average specific capacity of 0.6 gallons per minute per foot of drawdown. From the available well log data, the Tertiary marine sedimentary rocks are poor groundwater producers either for a lack of water or poor water quality (high salinity). At great depths, groundwater quality in the Tertiary marine sedimentary rocks is generally poor due to elevated chloride concentrations.

According to Kunkel and Upson (1960), groundwater in the Sonoma Volcanics is generally of good quality except in three areas. The first area with poor groundwater quality, the Tulucay Creek drainage basin, east of the City of Napa, contains groundwater with elevated iron, sulfate, and boron. The Suscol area, south of the City of Napa, is the second area where some wells exhibit poor quality groundwater due to elevated chloride concentrations, possibly from leakage from salty water in the Napa River, alluvial material above, or the existence of zones of unusually saline connate water deep within the Sonoma Volcanics. The third area of poor groundwater quality, the Calistoga area in the northern end of the Napa Valley, contains isolated wells with elevated chloride, boron, and some trace metal concentrations.

Kunkel and Upson (1960) reported that the principal water yielding units of the Sonoma Volcanics are the tuffs, ash-type beds, and agglomerates. The lava flows were reported to be generally non-water bearing. However, it may be possible that fractured, fragmental, or weathered lava flows could yield water to wells. The hydrogeologic properties of the volcanic-sourced sedimentary deposits of the Sonoma Volcanics are complex and poorly understood.

Groundwater Occurrence in Other Units and in the Quaternary Sedimentary Deposits

Several hundred wells and test holes on record have been drilled into the exposed Huichica Formation. Well yields tend to be low to modest (< 10 gpm to tens of gpm). Only a few known wells on record are completed in the Clear Lake Volcanics near the northern County line. Three wells report high yields of 400 to 600 gpm. Much of the Clear Lake Volcanics to the south appear to be thinner, limited in extent, and in ridge-top locations where possible groundwater production appears to be less likely.

Groundwater production from Quaternary alluvium is variable, with yields ranging from <10 gpm in the East and West mountainous areas to a high of 3,000 gpm along the Napa Valley floor where the alluvium is thickest (>200 feet). According to Faye (1973), average yield of wells completed in the alluvium is 220 gpm. Many wells drilled in the alluvium within the last 30 years extend beyond the alluvium and into the underlying Cenozoic units. Kunkel and Upson (1960) report that groundwater in the alluvium is generally of good quality. The groundwater is somewhat hard and of the bicarbonate type, with small concentrations of sulfate, chloride, and total dissolved solids. A few isolated areas have increased chloride and boron concentrations.

2.3 Recent Groundwater Studies and Programs

This section summarizes the recently completed studies by Napa County and the recommendations relevant to groundwater monitoring that were developed.

2.3.1 Napa County's Comprehensive Groundwater Monitoring Program

In 2009, Napa County implemented a Comprehensive Groundwater Monitoring Program to meet identified action items in Napa County's 2008 General Plan update (Napa County, 2008). The program emphasizes developing a sound understanding of groundwater conditions and implementing an expanded groundwater monitoring and data management program as a foundation for future coordinated, integrated water resources planning and dissemination of water resources information. The program (and elements of this Plan) covers the continuation and refinement of countywide groundwater level and quality monitoring efforts (including many basins, subbasins and/or subareas throughout the county) for the purpose of understanding groundwater conditions (i.e., seasonal and long-term groundwater level trends and also quality trends) and availability. This information is critical to enable integrated water resources planning and the dissemination of water resources information to the public and state and local decision-makers. Napa County's combined efforts through the Comprehensive Groundwater Monitoring Program along with the related AB 303 Public Outreach Project on groundwater (CCP, 2010) and the efforts of the Watershed Information Center & Conservancy (WICC) of Napa County create a foundation for the County's continued efforts to increase public outreach and participation in water resources understanding, planning, and management. An informed and engaged public enables support of planned water resources projects and programs proposed by the County and others to meet the goals and objectives discussed in Section 3.

Napa County's Comprehensive Groundwater Monitoring Program involved many tasks that led to the preparation of five technical memorandums and a report on *Napa County Groundwater Conditions and Groundwater Monitoring Recommendations* (Groundwater Report) (LSCE, 2011a). This report and the other related documents can be found at: http://www.countyofnapa.org/bos/grac/. The report documents existing knowledge of countywide groundwater conditions and establishes a framework for the monitoring and reporting of groundwater levels and groundwater quality on a periodic basis. The report also summarizes priorities for groundwater level and quality monitoring for each of the county subareas.

2.3.2 Napa County Statewide Groundwater Elevation Monitoring (CASGEM)

This section describes the new DWR California Statewide Groundwater Elevation Monitoring (CASGEM) program. The wells included by the County in the CASGEM program are a *subset* of the overall network of wells monitored in Napa County.

In November 2009, Senate Bill SBX7 – 6 mandated that the groundwater elevations in all basins and subbasins in California be regularly and systematically monitored with the goal of demonstrating seasonal and long-term trends in groundwater elevations. In accordance with the mandate, DWR developed the CASGEM program. DWR is facilitating the statewide program which began with the opportunity for local entities to apply to DWR to assume the function of regularly and systematically collecting and reporting groundwater level data for the above purpose. These entities are referred to as Monitoring Entities. The legislature added a key aspect

to SBX7 – 6 which was to make certain elements of the groundwater level information available to the public.

Wells designated for inclusion in the CASGEM program are for purposes of measuring groundwater levels on a semi-annual or more frequent basis that are representative of groundwater conditions in the state's groundwater basins and subbasins.

On December 29, 2010, the County applied to DWR to become the local countywide Monitoring Entity responsible for designating wells as appropriate for monitoring and reporting groundwater elevations for purposes of the CASGEM program.

The wells selected by the County for this program may be a *subset* of the overall wells monitored and need not be inclusive of the County's entire monitoring network. Thus, the County's participation in the CASGEM program complements other pre-existing groundwater monitoring that has been ongoing in Napa County for sometime (the overall historical monitoring record began in 1918). The end goals of the CASGEM program from the state's perspective is to support the understanding, managing, and sustaining of groundwater resources throughout California.

Following confirmation, the County, as the Monitoring Entity, proceeded to identify a *subset* of monitored wells to be included in the CASGEM network and to prepare a CASGEM Network Plan as required by DWR (LSCE, 2011b). At the time the County's CASGEM Network Plan was submitted to DWR, fourteen wells were included in the program. As of June 2012, the number of CASGEM wells had increased to nineteen.

2.3.3 Updated Conceptualization and Characterization of Hydrogeologic Conditions

In 2012, activities were implemented to update the characterization and conceptualization of hydrogeologic conditions (LSCE and MBK Engineers, 2013 in progress). Work to date is summarized below for three tasks, including: 1) the updated Napa Valley geologic conceptualization, 2) linking well construction information to groundwater level monitoring data, and 3) groundwater recharge characterization and estimates.

An important aspect of the work to update the hydrogeologic conceptualization is providing a refined understanding of the mechanisms through which water moves in response to the hydrologic cycle, particularly in the aquifer system underlying the main Napa Valley Floor. This involves many complex pathways and also considers many different time scales. As discussed further below, a key County General Plan goal (Napa County, 2008) is to " Conserve, enhance and manage water resources on a sustainable basis to attempt to ensure that sufficient amounts of water will be available for the uses allowed by this General Plan, for the natural environment, and for future generations." The groundwater monitoring program described in this Plan is instrumental to accomplishing this goal. The groundwater monitoring data (especially levels) are important for understanding the quantity of water flowing into and from a groundwater basin. Construction of a water budget, also known as a water balance, is a tool scientists can employ to assess the quantity of groundwater in storage. This tool is also used to observe how the quantity of groundwater in storage may vary over time. This tool relies upon a defined accounting unit of volume, for example a groundwater basin or other hydrologic unit of analysis. Measurements of

water flowing into and out of the defined unit are used to determine the change in water storage. In the simplest form, the equation for this is:

Inflows – Outflows = Change in Storage

Typical Inflows and Outflows are summarized below (DWR, 2003):

Inflows

- Natural recharge from precipitation;
- Seepage from surface water channels;
- Intentional recharge via ponds, ditches, and injection wells;
- Net recharge of applied water for agricultural and other irrigation uses;
- Unintentional recharge from leaky conveyance pipelines; and
- Subsurface inflows from outside basin boundaries.

Outflows

- Groundwater extraction by wells;
- Groundwater discharge to surface water bodies and springs;
- Evapotranspiration; and
- Subsurface outflow across basin or subbasin boundaries.

Information relating to each of the above inflow and outflow data components provides the best approximation of the change in storage. A simple way of estimating the change in storage in a basin is through the determination of the average change in groundwater elevations over the groundwater basin for a period of time. This change in water levels is then multiplied by the area overlying the basin and also the average specific yield (in the case of an unconfined aquifer system, or storativity in the case of a confined aquifer system). The change in groundwater levels is best determined over a specific study period that considers different water year types (wet, normal, dry, multiple dry years), but it is common for shorter time periods (e.g., one year's spring to spring groundwater elevations) to be used. This simplistic approach to calculating a change in storage does not provide an indication of the total volume of groundwater storage or the storage available for use. Rather, this computation provides a "snapshot" perspective of short-term trends. The quick calculation should only be considered as an indicator; a more complete groundwater balance evaluation is much preferred (e.g., groundwater flow model). For example, if stresses on the aquifer system induce additional surface water infiltration, the change in groundwater storage may not be apparent (DWR, 2003).

Updated Napa Valley Geologic Conceptualization

Published hydrogeologic studies of Napa County have been largely based on pre-1970 water well drillers' reports and focused on the higher yielding Quaternary alluvium deposits of Napa Valley (Kunkel and Upson, 1960; Faye, 1973). Most previous hydrogeologic cross sections have been constructed in the southern portion of the valley near and to the east of the City of Napa (Kunkel and Upson, 1960; Sweetkind and Taylor, 2010; Farrar and Metzger 2003). The northern valley has been characterized by alluvium thickness maps (Faye, 1973) with little attention paid to the older deposits and Sonoma Volcanics.

As part of this investigation, a series of eight cross valley geologic sections were constructed utilizing water well drillers' reports extending up to 2011 (**Figure 2-3**). Cross-section locations were chosen based on perceived geologic relationships and the availability of sufficient well control. About 1,300 water well drillers' reports were reviewed and located on topographic base maps; 191 of these were selected for use in the cross sections. Geologic correlations seen on the cross-sections were then extended between sections by available well control and surficial geologic maps. From the geologic cross-sections and correlations of other water well drillers' reports, the Quaternary alluvium was separated from underlying units, and an isopach (contours of equal thickness) map was constructed.

The alluvium is divided into three facies on the map based on lithologic character. From the area just north of the City of Napa and southward, the alluvium is characterized as the basin fill facies consisting of thin sand and gravels with some thicker channel deposits interbedded with thicker beds of silt and clays of floodplain, marshland and possibly, estuary deposits in the Suscol area. This area is not well defined because of lack of well control. North of this area, the Napa Valley alluvium is subdivided into two facies: the fluvial facies and the alluvial plain facies. A narrow band of the fluvial facies consists of thick-bedded sand and gravel channels with interbedded floodplain silts and clays. The total thickness is up to 300 feet near Yountville and thins southward. The fluvial facies remains thick (up to 200 feet) northward to near Rutherford, and then thins to a thickness of 100 feet or less near the St. Helena area. The area between Rutherford and Oak Knoll Avenue is where the highest well yields are reported. Outside of the fluvial facies towards the valley sides occur the alluvial plain facies of thin sand and gravel beds of tributary streams interbedded with thicker, alluvial fan flood-flow sandy gravelly clays. These deposits appear to thin from a thickness of over 100 feet near the fluvial facies, with which they interfinger, to zero thickness near the valley sides. The alluvial plain facies deposits appear to be modest to low water yielding in pre-1970 wells, but more recently constructed wells extend into deeper units.

Beneath the alluvium is a complex sequence of Tertiary sedimentary deposits (Huichica Formation) and igneous deposits of the Sonoma Volcanics. These units are strongly deformed by folding and faulting and have complex stratigraphic relationships. From the geologic cross-sections, lateral correlations, and surficial map relationships, a structure contour map (elevations) of the top of these units and the subcrop[1] pattern were developed (LSCE and MBK Engineers, 2013 in progress). From north of the City of Napa and southward, these deposits are dominated by fine-grained basin fill with few sand and gravels of floodplain, estuary origin. North towards Yountville, sedimentary deposits of the Huichica Formation appear to overlie Sonoma Volcanics andesites and tuffs. Sonoma Volcanics and the older Mesozoic Great Valley sequence are exposed in a structural uplift area in the small hills in the Yountville area.

Further north, a Sonoma Volcanics andesite flow breccia appears to transition into a sedimentary conglomerate along the center of the valley. This unit is encountered in deep, high yielding wells also completed in the overlying alluvium fluvial facies, but it is not clear if this unit also is high yielding. Overlying the conglomerate/breccia on the east is the sedimentary Huichica Formation of sandstones and mudstones (?). To the west of the unit occur older Sonoma Volcanics andesites, tuffs in the south, and younger (?) Sonoma Volcanics tuffs interbedded with Huichica Formation (?) sedimentary deposits of sand and gravels and clays. All of the Tertiary

[1] Occurrence of strata in contact with the undersurface of a stratigraphic unit, which in this case includes the strata beneath the alluvium.

units beneath the Napa Valley Floor appear to be low to moderately water yielding with poor aquifer characteristics.

Linking Well Construction Information to Groundwater Monitoring Data

As part of the updated hydrogeologic characterization, existing monitoring well construction data from all available public sources were reviewed to determine the distribution of aquifer-specific monitoring data in Napa Valley. This effort addresses recommendations of the Comprehensive Groundwater Management Program to identify and fill data gaps that will allow for analysis of groundwater occurrence and flow as a more robust understanding of the extent of groundwater resources in the county is developed. A major component of this work has been to identify construction information for previously monitored wells in Napa Valley.

Groundwater level monitoring needs identified through the Comprehensive Groundwater Management Program include improved spatial distribution of groundwater level monitoring, additional characterization of subsurface geologic conditions in county subareas to identify aquifer characteristics, further examination of well construction information to define which portion of the aquifer system is represented by water levels measured in the currently monitored wells (and in many cases to link construction information to the monitored wells), and improve the understanding of surface water/groundwater interactions and relationships.

To address these needs, the Data Management System (DMS) created as part of the Comprehensive Groundwater Management Program was used along with a set of over 6,000 well drillers' reports for wells drilled in the county through 2011. Location and other data about wells where water level data have been collected within the Napa Valley Floor were extracted from the Napa DMS by a query that returned 938 wells. Four hundred sixty-eight of those are wells constructed for monitoring regulated soil and groundwater contamination sites. Of the remaining 470 wells, nine have a record of destruction or abandonment in the DMS. Many more of the 470 non-regulated monitoring wells are likely duplicate entries accumulated in the DMS as a result of records compiled from multiple monitoring entities.

Well construction information for these wells was identified by comparing data about the wells available in the Napa DMS with the actual drillers' reports that contain the well driller's record of subsurface lithology encountered during the drilling process. Information in the Napa DMS was compared in sequence for each well and included the township/range/section, parcel number, well address, type of well, intended use, and date of well completion. The range of data collected at each well relative to the recorded well completion date on the Well Completion Report was also referenced as a secondary indicator when more than one well was found with a given address or parcel. Records compiled by Kunkel and Upson (1960), who performed an extensive survey of wells drilled in Napa Valley through approximately 1952, were also referenced in cases where the earliest measurements or date of well completion were prior to 1960, which predates most drillers' reports from Napa County that were provided by DWR. Due to slight variations in location information recorded by various monitoring entities over time, multiple point locations have sometimes been assigned for a single well. The Napa DMS and direct communications with Napa County staff were used to identify duplicate well records. The DMS was used to compare metadata, including well depth, borehole depth, and construction date to avoid over representation of sites where water levels have been or are being recorded.

This process identified 42 duplicate well entries for sites where water levels have been or are currently monitored by Napa County, DWR, and USGS.

Monitored wells with at least 5 years of monitoring data and that are also relatively close to the mainstem Napa River were identified to address the need for improved monitoring of groundwater/surface water interactions in Napa Valley. That process identified 101 wells located within a one-quarter mile radius of the Napa River, with 38 wells which were not associated with regulated soil and groundwater contamination sites. A total of 180 wells were found within a one-half mile radius of the Napa River, with 89 of those not associated with regulated sites. Although the regulated sites most often have aquifer-specific shallow monitoring wells completed in the alluvial aquifer system, their spatial distribution is skewed to coincide with the developed population centers in the valley.

All monitored wells with at least 5 years of data were then compared by location with existing surface water gauges along the Napa River to evaluate the potential for pairing measurements of river stage with groundwater levels to assess surface water/groundwater interactions. Ultimately, six sites spanning from the City of Napa north to St. Helena were identified for future monitoring focus (see additional discussion of these sites in Section 4).

Groundwater Recharge Characterization and Estimates

Another important feature of the current hydrogeologic investigation is the development of improved characterization of groundwater recharge in the areas of greatest groundwater development, with an emphasis on Napa Valley. Understanding the volume of and mechanisms driving groundwater recharge in the county will be essential in determining where and how much groundwater can be produced without incurring negative impacts (LSCE, 2011a). Currently, evaluation of recharge mechanisms and volumes within Napa County has been limited to the Napa Valley (Faye, 1973) and the MST Subarea (Johnson, 1977; Farrar and Metzger, 2003).

The high permeability of the alluvial sediments in the Napa Valley permits precipitation and surface water to readily infiltrate and recharge groundwater throughout the majority of the valley. These high permeability soils combined with the large volume of water that flows through the Napa River create the potential for significant recharge to occur under the hydrologic circumstances and hydraulic gradient that allow for recharge from the river to groundwater to occur.

For the current project, mass balance and streamflow infiltration methods are being used to estimate regional and local recharge. Streamflow infiltration can be characterized by comparing the elevation of surface water to the shallowest adjacent groundwater. Detailed remotely sensed elevation data of the mainstem Napa River and several major tributaries have been obtained for this purpose. These LiDAR data provide sub-meter precision elevation data and have been sampled at 3 foot intervals along each watercourse. These data are paired with previously collected groundwater level data and estimates of areas of greatest recharge potential to estimate the potential for recharge to groundwater.

In addition, mass balance recharge estimates have been developed for the Napa River watershed and major tributary watersheds using a range of available data (LSCE and MBK Engineers, 2013 in progress). Available records for streamflow, precipitation, land use, and vegetative cover throughout these watersheds have been used to develop spatially-distributed estimates of annual

hydrologic inputs and outputs in order to solve for the volume of groundwater recharge. Key components of this work include quantifying the distribution of precipitation across the land surface, quantifying the amount of water that returns to the atmosphere by evapotranspiration, and quantifying the hydraulic properties of soil and alluvial materials through which water must infiltrate to reach groundwater. Estimates developed through the mass balance approach have been evaluated using a sensitivity analysis to determine the degree to which any individual or set of inputs affects the recharge estimate.

2.3.4 Groundwater Monitoring Priorities

Priorities for addressing groundwater level and quality monitoring are presented below. These are based on the analysis of existing groundwater data and conditions described in the Groundwater Report (LSCE, 2011a). Preliminary prioritizations presented in the Groundwater Report are provided in Appendix A. The recommendations from the Groundwater Report have been slightly updated with input received from the GRAC.

Groundwater Level Monitoring

Currently, groundwater level measurements are recorded at a total of 87 sites (measurements began in 1920 for one Napa County monitoring well that is still being monitored). **Table 2-2** and **Figure 2-4** summarize the currently conducted monitoring in each subarea. Also shown in **Table 2-2** are the preliminary ranking and priorities for improving or expanding groundwater level monitoring in each of the designated subareas. Six subareas (including the NVF-Calistoga, NVF-MST, NVF-Napa, NVF-St. Helena, NVF-Yountville, and Carneros Subareas) are given a relatively higher priority. This relative prioritization is based on such factors as data scarcity, the need to improve the spatial distribution of the currently collected data, current population and groundwater utilization relative to other parts of the county, and /or the need to improve understanding of groundwater/surface water interactions. Some factors are given greater consideration in areas that currently use more groundwater than other areas. In mountainous areas where less groundwater development has occurred, where geologic conditions are complicated by basement rocks that are complexly deformed by folding and faulting and are well lithified, and overall there is considerable variability (LSCE, 2011a), future monitoring needs could be considered in coordination with potential or planned development in localized areas. Overall, groundwater level monitoring priorities are to identify seasonal and long-term trends and develop the data that facilitate better understanding of groundwater conditions, including response to such factors as climate change and to identify opportunities for enhanced groundwater recharge and storage.

Groundwater level monitoring needs include improved spatial distribution of groundwater level monitoring, additional characterization of subsurface geologic conditions in each subarea to identify aquifer characteristics, further examination of well construction information to define which portion of the aquifer system is represented by water levels measured in the currently monitored wells, and improve the understanding of surface water – groundwater relationships.

Table 2-2
Groundwater Level Monitoring Sites, Napa County
(Current[1] and Future)

Subarea	No. Sites with Current Groundwater Level Data	Future Groundwater Level Monitoring		Monitoring Needs
		Relative Priority	Action (Expand/ Refine)	
Napa Valley Floor-Calistoga	**6**	**H**	E	**SP, SW**
Napa Valley Floor-MST	**29**	**H**	R	**SP, SW**
Napa Valley Floor-Napa	**18**	**H**	R	**SP, SW**
Napa Valley Floor-St. Helena	**12**	**H**	E	**SP, SW**
Napa Valley Floor-Yountville	**9**	**H**	E	**SP, SW**
Carneros	**5**	**H**	E	**B**
Jameson/American Canyon	1	M	E	B
Napa River Marshes	1	M	E	SP, SW
Angwin	0	M	E	B
Berryessa	3	L	E	B
Central Interior Valleys	1	L	E	B
Eastern Mountains	0	L	E	B
Knoxville	1	L	E	B
Livermore Ranch	0	L	E	B
Pope Valley[2]	1	L	E	B
Southern Interior Valleys	0	L	E	B
Western Mountains	0	L	E	B
Total	**87**			

[1] "Current" refers to monitored sites with wells measured for levels and/or any water quality parameter with a period of record extending to 2011 or later. “Future” refers to recommended monitoring locations.
[2] The relative priority for Pope Valley was changed from “high” in the Groundwater Report to “low” in the Plan based on input from the GRAC on the current population and groundwater use in this subarea.

L = Low Priority; add groundwater level monitoring based on areas of planned future groundwater development

M = Medium Priority; add groundwater level monitoring

H = High Priority; add groundwater level monitoring

E = Expand current monitoring network; possible alternatives for additional monitoring wells include 1) wells historically monitored by DWR/USGS/Others, preferably with well construction information; 2) existing water supply wells (e.g., private/commercial) with well construction information; 3) new dedicated monitoring wells coordinated with recent geologic investigations that are or will be conducted)

R = Refine current monitoring network (link well construction information to all monitored wells, as possible)

Monitoring Needs:
SP = Improve horizontal and/or vertical spatial distribution of data, including for the purpose of identifying such factors as climate change and to identify opportunities for enhanced groundwater recharge and storage;
SW =identify appropriate monitoring site to evaluate surface water -groundwater recharge/discharge mechanisms;
B = Basic data needed to accomplish groundwater level monitoring objectives

Groundwater Quality Monitoring

The current groundwater quality monitoring network consists of 177 monitoring sites (**Table 2-3 and Figure 2-5**). Of these sites, some of the wells, but not all, have well construction information. Current groundwater quality monitoring sites are fairly well distributed throughout the Napa Valley Floor Subarea but are generally sparse elsewhere in the county. Recommended improvements to the groundwater quality monitoring program, and priority timelines for improvements, are summarized in **Table 2-3** and discussed further in the Groundwater Report (LSCE, 2011a).

Table 2-3 includes a ranking and prioritization for improving or expanding groundwater quality monitoring in each of the designated subareas. Three subareas (including NVF-MST, Carneros, and Jameson/American Canyon Subareas) are given a relatively higher priority. This relative prioritization is based on such factors as data scarcity, the need to improve the spatial distribution of the currently collected data, current population and groundwater utilization relative to other parts of the county, and/or the need to improve understanding of groundwater/surface water interactions. Some factors are given greater consideration in areas that currently use more groundwater than other areas. Seven subareas, including Berryessa, Central Interior Valleys, Knoxville, Livermore Ranch, Pope Valley, Southern Interior Valleys, and Western Mountains, are assigned lower priorities for groundwater quality monitoring due to the likely lower levels of projected land and groundwater use. The seven remaining subareas are designated as medium priorities for groundwater quality monitoring. Many of these areas have current monitoring programs, so the emphasis in these areas is to further examine land use with respect to monitoring locations and the units(s) of the aquifer system represented by this monitoring. For example, the Eastern Mountains Subarea appears to include 25 current groundwater quality monitoring sites. However, the source of this data is largely GeoTracker GAMA, which includes California Department of Public Health (DPH) data for community water supply wells. Consequently, these wells are assigned imprecise locations by DPH such that the well locations are accurate to plus or minus one mile. Most likely, these wells are actually located in the main Napa Valley Floor.

Table 2-3 also includes key factors related to monitoring needs. Many subareas outside the Napa Valley Floor have limited spatial distribution of the current groundwater quality monitoring wells/sites. Basic data are described as a key need to accomplish the Plan's groundwater quality monitoring objectives. Importantly, expansion and/or refinement of groundwater quality monitoring conducted in all subareas should be coordinated with efforts to expand or refine groundwater level monitoring to be able to relate water quality trends to constituent transport within the aquifer system.

Table 2-3
Groundwater Quality Monitoring Sites, Napa County
(Current[1] and Future)

Subarea	No. Sites with Current Groundwater Quality Data	Future Groundwater Quality Monitoring		Monitoring Needs
		Relative Priority	Action (Expand/ Refine)	
Napa Valley Floor-Calistoga	20	M	R	SP,C
Napa Valley Floor-MST	**16**	**H**	R	**SP,C**
Napa Valley Floor-Napa	21	M	R	SP,C
Napa Valley Floor-St. Helena	31	M	R	SP,C
Napa Valley Floor-Yountville	14	M	R	SP,C
Carneros	**9**	**H**	R	**SP,C**
Jameson/American Canyon	**3**	**H**	E	**B,SP,C**
Napa River Marshes	6	M	E	B,SP,C
Angwin	4	M	E	B,C
Berryessa	6	L	E	B,C
Central Interior Valleys	6	L	R	B,SP,C
Eastern Mountains	25	M	E/R	B,C
Knoxville	0	L	E	B,C
Livermore Ranch	0	L	E	B,C
Pope Valley[2]	6	L	E	B,C
Southern Interior Valleys	1	L	E	B,C
Western Mountains	10	L	R	B,C
Total	**177**			

[1] "Current" refers to monitored sites with wells measured for levels and/or any water quality parameter with a period of record extending to 2008 or later. “Future” refers to recommended monitoring locations.
[2] The relative priority for Pope Valley was changed from “high” in the Groundwater Report to “low” in the Plan based on input from the GRAC on the current population and groundwater use in this subarea. Similarly, some subareas previously in a “medium” category were changed to a relatively low ranking.

L = Low Priority; add groundwater quality and also level monitoring based on areas of planned future groundwater development

M = Medium Priority; add groundwater quality and also level monitoring

H = High Priority; add groundwater quality and also level monitoring

E = Expand current monitoring network; possible alternatives for additional monitoring wells include 1) wells historically monitored by DWR/USGS/Others, preferably with well construction information and as the well may be available for monitoring; 2) existing water supply wells (e.g., private/commercial) with well construction information; 3) new dedicated monitoring wells (coordinate with potential geologic investigations that may be conducted in selected areas)

R = Refine current monitoring network (link well construction information to all monitored wells, as possible)

Monitoring Needs: SP = Improve horizontal and/or vertical spatial distribution of data; B = Basic data needed to accomplish groundwater level monitoring objectives; C = Coordinate with groundwater level monitoring

Note: Some sites with current groundwater quality data are approximately located and currently may not be counted in the correct subarea. Also, additional sites with current groundwater quality beyond this tabulation exist but the locations are currently unavailable and unable to be counted at this time.

2.3.5 Recommendations from Recent County Studies

Groundwater Level Monitoring Recommendations from the Groundwater Report

Below are recommendations from the 2011 Groundwater Report (LSCE, 2011a) in order to implement the expansion and improvement of countywide groundwater level monitoring activities by the County and others.

1. Replace water level monitoring wells that are completed in more than one aquifer with wells completed in (or representative of) a single aquifer (a phased approach is recommended for this effort that considers the historical record for existing wells in the network).
2. Continue groundwater level monitoring on at least a semi-annual basis; increase the spatial and vertical distribution of wells for monthly water level measurements (e.g., in key areas) to allow more comprehensive evaluation of groundwater conditions and stream-aquifer relationships.
3. Perform GPS surveys with higher accuracy instrumentation, as may be needed, to establish updated reference point elevation data.
4. Communicate County groundwater level monitoring objectives to private and commercial landowners and invite voluntary participation in the ongoing program (i.e., access to suitable wells with construction information located in areas of interest to meet subarea-specific monitoring objectives).

Groundwater Quality Monitoring Recommendations from the Groundwater Report

Below are recommendations from the 2011 Groundwater Report (LSCE, 2011a) in order to implement the expansion and improvement of countywide groundwater quality monitoring activities.

1. Implement efforts to expand and/or refine the groundwater quality monitoring program such that more wells can be “qualified” with well construction information.
2. Review the historically monitored wells to determine whether some of these may be suited to the objectives of gathering basic data and/or expanding groundwater quality monitoring in the various county subareas.
3. Coordinate expansion of the groundwater quality monitoring program with the expansion/refinement of subarea groundwater level monitoring.
4. Communicate County groundwater quality monitoring objectives to private and commercial landowners and invite voluntary participation in the ongoing program (i.e., access to suitable wells with construction information located in areas of interest to meet subarea-specific monitoring objectives).
5. As feasible, replace monitoring wells that are completed in more than one zone or aquifer with wells completed in a single unit that meets regional and subarea-specific groundwater quality monitoring objectives.

Summary of Overall Groundwater Monitoring Program Recommendations from the 2011 Groundwater Report

1. County establish its role as lead agency for ongoing groundwater monitoring program coordination and database oversight and management.
2. Establish plan for pertinent County departments to coordinate data collection, storage, and analysis efforts.
3. Identify potential collaborators (including local, federal, and state agency representatives) and interested stakeholders for the ongoing program.
4. Annually update the DMS (e.g., groundwater levels and quality and other water-related data), assess network and findings, and make changes to the program where necessary.
5. Discuss monitoring parameters of special interest with collaborators.
6. Review groundwater data annually and revise or make recommendations to revise data collection accordingly, pending changes to network wells and/or specific program objectives.
7. Identify locations for construction of dedicated monitoring wells for water level and/or quality monitoring (e.g., county subareas where more subsurface information is required to better quantify groundwater availability and quality, recharge areas where aquifer-specific monitoring is lacking, surface water-groundwater interaction, etc.).
8. Replace (over time) wells in the monitoring network that have no well construction information (or are perforated in more than one zone) to improve the understanding of aquifer-specific conditions.
9. Coordinate efforts being conducted for water supply investigation work (e.g., test hole construction) with opportunities for constructing zone-specific dedicated monitoring facilities for countywide water level and/or water quality monitoring.
10. Communicate program results to cooperating entities.
11. Provide an overview of program objectives, benefits and results to the general public via web information and other communication vehicles.
12. Seek funding to support program continuation, including DMS, data evaluation, and implementation of priority recommendations.
13. Explore the need to develop guidelines for testing private wells to evaluate potential water quality issues.

Napa County CASGEM Plan Recommendations

The County's 2011 CASGEM program (LSCE, 2011b) reported that the County plans to include at least one additional monitoring well in the Pope Valley and Berryessa Valley Groundwater Basins as well as additional wells in other subareas (including the NVF-Calistoga, NVF-MST, NVF-Napa, NVF-St. Helena, NVF-Yountville, and Carneros Subareas) over the coming years. Additional wells in these subareas are of interest for (LSCE, 2011a):

- Improving horizontal and/or vertical spatial distribution of data;
- Identifying appropriate monitoring sites to evaluate surface water-groundwater interaction; and

- Establishing additional basic data needed to accomplish groundwater level monitoring objectives.

Summary of Recommendations

Groundwater Level Monitoring

Per the priorities discussed in this section, additional groundwater level monitoring wells are recommended in the following subareas:

- NVF-MST
- NVF-Napa
- NVF-St. Helena
- NVF-Yountville
- NVF-Calistoga
- Carneros
- Pope Valley (CASGEM)
- Berryessa Valley (CASGEM)

Additional monitoring in the subareas in the Napa Valley Floor would be especially to improve the horizontal and spatial distribution of groundwater level data to better understand groundwater conditions, including response to such factors as climate change and to identify opportunities for enhanced groundwater recharge and storage.

Additional groundwater level monitoring is needed to further evaluate surface water-groundwater interaction and recharge/discharge mechanisms. It is especially recommended that dedicated shallow monitoring wells be constructed at appropriate locations, particularly along the main stem of the Napa River, for this purpose.

Groundwater Quality Monitoring

Per the priorities discussed in this section, additional groundwater quality monitoring wells are recommended in the following subareas:

- NVF-MST
- Carneros
- Jameson/American Canyon

Additional wells in these subareas are to improve horizontal and/or vertical spatial distribution of data and also to establish baseline groundwater quality conditions. Groundwater level monitoring would also occur at any wells added for groundwater quality monitoring in order to evaluate trends in and/or movement of the monitored constituents.

Further examination of the suitability of existing wells for groundwater monitoring (including their location and construction and relevance to meet County and/or CASGEM monitoring objectives) is necessary to determine if any existing wells would be suitable for ongoing evaluation of groundwater conditions. If existing private wells are considered, approval from the property owners to voluntarily participate in the County's groundwater monitoring program would be sought. Additional wells may be added to provide better spatial and/or vertical

distribution of monitored locations within the subareas and to enhance the understanding of localized groundwater conditions and availability.

Section 4 outlines steps to optimize additional groundwater monitoring locations that serve to meet the objectives of the County's Comprehensive Groundwater Monitoring Program and the CASGEM monitoring program.

3 GROUNDWATER RESOURCES GOALS AND MONITORING OBJECTIVES

3.1 Napa County Water Resources Goals and Policies

The County's General Plan (2008, amended June 23, 2009) recognizes, "water is one of the most complex issues related to land use planning, development, and conservation; it is governed and affected by hundreds of federal, state, regional, and local mandates pertaining to pollution, land use, mineral resources, flood protection, soil erosion, reclamation, etc. Every year, the state legislature considers hundreds of bills relating to water issues, and in Napa County, more than two dozen agencies have some say in decisions and regulations affecting water quality and water use."

As part of the General Plan update in 2008, and within the Conservation Element, six goals are set forth relating to the County's water resources, including surface water and groundwater. Complementing these goals are twenty-eight policies and ten water resources action items (one of which is "reserved" for later description). The County's six water resources goals are included below (the entire group of water resources goals, policies, and action items is included in LSCE, 2011a).

> **Goal CON-8:** Reduce or eliminate groundwater and surface water contamination from known sources (e.g., underground tanks, chemical spills, landfills, livestock grazing, and other dispersed sources such as septic systems).
>
> **Goal CON-9:** Control urban and rural storm water runoff and related non-point source pollutants, reducing to acceptable levels pollutant discharges from land-based activities throughout the county.
>
> **Goal CON-10:** Conserve, enhance and manage water resources on a sustainable basis to attempt to ensure that sufficient amounts of water will be available for the uses allowed by this General Plan, for the natural environment, and for future generations.
>
> **Goal CON-11:** Prioritize the use of available groundwater for agricultural and rural residential uses rather than for urbanized areas and ensure that land use decisions recognize the long-term availability and value of water resources in Napa County.
>
> **Goal CON-12:** Proactively collect information about the status of the County's surface and groundwater resources to provide for improved forecasting of future supplies and effective management of the resources in each of the County's watersheds.
>
> **Goal CON-13:** Promote the development of additional water resources to improve water supply reliability and sustainability in Napa County, including imported water supplies and recycled water projects.

Addressing the six water resources goals above, the County has produced specific General Plan Action Items related to the focus and objective of this Plan. Those action items include:

Action Item CON WR-1: Develop basin-level watershed management plans for each of the three major watersheds in Napa County (Napa River, Putah Creek, and Suisun Creek). Support each basin-level plan with focused sub-basin (drainage-level) or evaluation area-level implementation strategies, specifically adapted and scaled to address identified water resource problems and restoration opportunities. Plan development and implementation shall utilize a flexible watershed approach to manage surface water and groundwater quality and quantity. The watershed planning process should be an iterative, holistic, and collaborative approach, identifying specific drainage areas or watersheds, eliciting stakeholder involvement, and developing management actions supported by sound science that can be effectively implemented. [Implements Policies 42 and 44]

Action Item CON WR-4: Implement a countywide watershed monitoring program to assess the health of the County's watersheds and track the effectiveness of management activities and related restoration efforts. Information from the monitoring program should be used to inform the development of basin-level watershed management plans as well as focused sub-basin (drainage-level) implementation strategies intended to address targeted water resource problems and facilitate restoration opportunities. Over time, the monitoring data will be used to develop overall watershed health indicators and as a basis of employing adaptive watershed management planning. [Implements Policies 42, 44, 47, 49, 63, and 64]

Action Item CON WR-6: Establish and disseminate standards for well pump testing and reporting and include as a condition of discretionary projects that well owners provide to the County upon request information regarding the locations, depths, yields, drilling and well construction logs, soil data, water levels and general mineral quality of any new wells. [Implements Policy 52 and 55]

Action Item CON WR-7: The County, in cooperation with local municipalities and districts, shall perform surface water and groundwater resources studies and analyses and work toward the development and implementation of an integrated water resources management plan (IRWMP) that covers the entirety of Napa County and addresses local and state water resource goals, including the identification of surface water protection and restoration projects, establishment of countywide groundwater management objectives and programs for the purpose of meeting those objectives, funding, and implementation. [Implements Policy 42, 44, 61 and 63]

Action Item CON WR-8: The County shall monitor groundwater and interrelated surface water resources, using County-owned monitoring wells and stream and precipitation gauges, data obtained from private property owners on a voluntary basis, data obtained via conditions of approval associated with discretionary projects, data from the State Department of Water Resources, other agencies and organizations. Monitoring data shall be used to determine baseline water quality conditions, track groundwater levels, and identify where problems may exist. Where there is a demonstrated need for additional management actions to address groundwater problems, the County shall work collaboratively with property owners and other stakeholders to prepare a plan for managing groundwater supplies pursuant to State Water Code Sections 10750-10755.4 or other applicable legal authorities. [Implements Policy 57, 63 and 64]

Action Item CON WR-9.5: The County shall work with the SWRCB, DWR, DPH, CalEPA, and applicable County and City agencies to seek and secure funding sources for the County to develop and expand its groundwater monitoring and assessment and undertake community-based planning efforts aimed at developing necessary management programs and enhancements.

3.2 Overarching Groundwater Monitoring Objectives

The following Plan subsections describe a number of water level and quality objectives to be accomplished with the current and refined countywide groundwater level and quality monitoring program. The overarching groundwater monitoring objectives are linked to the County's General Plan goals and action items presented above and also to hydrogeologic conditions and issues of interest, including (but not limited to):

- Monitoring trends in groundwater levels and storage (e.g., groundwater balance) to assess and ensure long-term groundwater availability and reliability;
- Monitoring of groundwater-surface water interactions to ensure sufficient amounts of water are available to the natural environment and for future generations;
- Monitoring in significant recharge areas to assess factors (natural and human-influenced) that may affect groundwater recharge (including climate change) and also aid the identification of opportunities to enhance groundwater recharge and storage;
- Monitoring to establish baseline conditions in areas of potential saline water intrusion;
- Monitoring of general water quality to establish baseline conditions, trends, and protect and preserve water quality.
- Identify where data gaps occur in the key subareas and provide infill, replacement, and/or project-specific monitoring (e.g., such as may occur for planned projects or expansion of existing projects) as needed; and
- Coordinate with other entities on the collection, utilization, and incorporation of groundwater level data in the countywide DMS.

3.2.1 Groundwater Level Monitoring Objectives

The focus of the countywide groundwater level monitoring program includes the following objectives:

- Expand groundwater level monitoring in priority County subareas to improve the understanding of the occurrence and movement of groundwater; monitor local and regional groundwater levels including seasonal and long-term trends; and identify vertical hydraulic head differences in the aquifer system and aquifer-specific groundwater conditions, especially in areas where short- and long-term development of groundwater resources are planned (this includes additional monitoring of the Tertiary formation aquifer in the area between the NVF-MST Subarea and the northeastern part of the NVF-Napa Subarea to determine whether groundwater water conditions in the NVF-MST are affecting other areas (see Section 9 in LSCE and MBK Engineers, 2013 in progress));

- Detect the occurrence of, and factors attributable to, natural (e.g., direct infiltration of precipitation, surface water seepage to groundwater, groundwater discharge to

streams) or induced factors (e.g., pumping, purposeful recharge operations) that affect groundwater levels and trends;

- Identify appropriate monitoring sites to further evaluate surface water-groundwater interaction and recharge/discharge mechanisms, including whether groundwater utilization is affecting surface water flows;

- Establish a monitoring network to aid in the assessment of changes in groundwater storage; and

Generate data to better estimate groundwater basin conditions and assess local current and future water supply availability and reliability; update analyses as additional data become available.

Based on the analysis of existing groundwater data and conditions described in the Groundwater Report (LSCE, 2011a) and with input received from the GRAC, the key objectives for future groundwater level monitoring for each subarea are summarized in Appendix A.

3.2.2 Groundwater Quality Monitoring Objectives

The primary objectives of the countywide groundwater quality monitoring program include:

- Evaluate groundwater quality conditions in the various county subareas and identify differences in water quality spatially between areas and vertically in the aquifer system within a subarea;

- Detect the occurrence of and factors attributable to natural (e.g., general minerals and trace metals) or other constituents of concern;

- Establish baseline conditions in areas of potential saltwater intrusion, including the extent and natural occurrence and/or causes of saltwater beneath the Carneros, Jameson/American Canyon and Napa River Marshes Subareas;

- Assess the changes and trends in groundwater quality; and

- Identify the natural and human factors that affect changes in water quality.

Based on the analysis of existing groundwater data and conditions described in the Groundwater Report (LSCE, 2011a) and with input received from the GRAC, the key objectives for future groundwater quality monitoring for each subarea are summarized in Appendix A.

3.3 Collaboration and Funding for Groundwater Monitoring

As described above, the County wishes to promote interagency collaboration and coordination on the collection, utilization, and incorporation of groundwater monitoring data into the DMS and to achieve countywide groundwater resources goals and monitoring objectives. As also noted above, the County has an existing Action Item (CON WR-9.5) that sets forth its interest in

working with the SWRCB, DWR, DPH, CalEPA, and applicable County and City agencies to seek and secure funding sources for the County to develop and expand its groundwater monitoring and assessment, and undertake community-based planning efforts aimed at developing necessary management programs and enhancements.

The Groundwater Management Act adopted in 2002 (SB 1938) amended and expanded AB 3030 groundwater management plans. As discussed in the technical memorandum prepared for the County on *Groundwater Planning Considerations and Review of Napa County Groundwater Ordinance and Permit Process* (LSCE, 2011), the California Water Code requires public agencies seeking priority for state funds administered through DWR (e.g., Local Groundwater Assistance (LGA) grant program) for the construction of groundwater projects or groundwater quality projects to prepare and implement a groundwater management plan with certain required components (Water Code Section 10753.7). Previously, all plans were voluntary, and there were no required plan components. The requirements now include establishing basin management objectives, preparing a plan to involve other local agencies in the basin in a cooperative planning effort, and more comprehensive monitoring programs (including groundwater levels and quality; surface water flows and quality; and inelastic land surface subsidence for basins where it is identified as a potential concern) to assess changes in basin conditions and "generate information that promotes efficient and effective groundwater management" (Water Code Section 10753.7).

As described above, on November 6, 2009, SBx7-6 (e.g., the CASGEM program) was enacted. This revised Water Code Section 10920 et seq. and established a groundwater monitoring program designed to monitor and report groundwater elevations in all or part of a basin or subbasin. These new requirements also limit counties and various entities' (Water Code Section 10927.(a)-(d), inclusive) ability to receive state grants or loans in the event that DWR is required to perform groundwater monitoring functions pursuant to Water Code 10933.7 (DWR, 2012). The goal of the LGA grant program is to improve groundwater resource management and the knowledge of various groundwater basins throughout the state by funding projects that will provide long-term benefit to the management of groundwater (DWR, 2012). A comprehensive groundwater monitoring program is an integral part of this goal. As such, this Plan would greatly improve the County's ability to apply for state and possibly federal funds in the future.

4 GROUNDWATER MONITORING NETWORK DESIGN AND DEVELOPMENT

This section describes the existing well monitoring network and well qualification efforts concurrently being conducted to attempt to link well construction information to wells with historical groundwater level and/or groundwater quality monitoring records. This section will also discuss data gaps identified as a result of the well qualification efforts and the monitoring wells needed to achieve the groundwater monitoring objectives described in Section 3. The means by which the monitoring network gaps might be addressed include:

1) Investigating the potential to restart monitoring where historical records are available but monitoring was discontinued;
2) Identification of existing wells of suitable construction that might be volunteered for inclusion through County and GRAC education and outreach efforts; and
3) Construction of new dedicated monitoring wells if suitable existing wells either do not exist in the area of interest or are otherwise not available.

This section includes monitoring protocols to meet program objectives (i.e., including developing a program capable of tracking changes in groundwater level and quality conditions and groundwater/surface water interrelationships). In support of the County's General Plan Goal CON-12 and Action Item CON WR-7 (see Section 3), the monitoring protocols are designed to generate information that promotes efficient and effective groundwater management.

This section also includes recommendations for filling spatial/vertical groundwater monitoring data gaps. Finally, this section includes recommended monitoring frequencies for groundwater levels and quality and recommended groundwater quality monitoring parameters.

4.1 Groundwater Level Monitoring

This section describes existing groundwater level monitoring and recommended locations for wells for groundwater level monitoring to fill data gaps. As additional monitoring facilities are considered, or existing facilities are further evaluated, the objectives provided in **Section 3** will be used evaluate the suitability of the existing or proposed facilities to ensure that the data being (or planned to be) collected can address these objectives.

4.1.1 Monitoring Network

Existing Groundwater Level Monitoring Wells

Figure 4-1 illustrates the distribution of current groundwater level monitoring locations, which is primarily located in the Napa Valley Floor-Napa and MST Subareas. Very little groundwater level monitoring is currently conducted elsewhere in Napa County outside these two subareas. A few scattered locations of groundwater level monitoring occur in the Berryessa, Pope Valley, the southern portion of the Central Interior Valleys, Jameson/American Canyon, and in the NVF-Calistoga, NVF-St. Helena, and NVF-Yountville Subareas. Groundwater level monitoring is not currently conducted in the Carneros, Livermore Ranch, Angwin, Southern Interior Valleys, and Western Mountains Subareas. **Table 4-1** summarizes the number of wells in each subarea that are currently monitored for groundwater levels (a detailed list is included in **Appendix A)**.

Groundwater level measurements have been recorded at a total of 87 sites since 2011. Of these sites where groundwater levels are measured, some type of well construction information (depth and/or perforated interval(s)) is readily available for 67 sites (41 non-regulated sites and 26 regulated sites). Most current groundwater level monitoring occurs on a semi-annual frequency.

Recommendations to Expand Monitoring Well Network

As presented above in **Table 2-2**, and summarized in Section 2, a preliminary ranking and priorities for improving or expanding groundwater level monitoring were prepared for each county subarea. Six subareas are given a relatively higher priority for improving the groundwater level monitoring network based on factors of current population and groundwater utilization relative to other parts of the county, and/or the need to improve understanding of groundwater/surface water interactions. Some factors are given greater consideration in areas that currently use more groundwater than other areas. These areas include:

- NVF-Calistoga,
- NVF-St. Helena,
- NVF-Yountville,
- NVF- MST,
- NVF-Napa, and
- Carneros Subareas

The monitoring network gaps in these six subareas might be addressed by:

1) Investigating the potential to restart monitoring where historical records are available but monitoring was discontinued;
2) Identifying existing wells of suitable construction that might be volunteered for inclusion through County and GRAC education and outreach efforts (this may include wells that are already being monitored for groundwater quality); and
3) Constructing new dedicated monitoring wells if suitable existing wells either do not exist in the area of interest or are otherwise not available.

Monitoring in other subareas with relatively medium to lower priorities is suggested to be addressed with volunteered wells.

The Napa County CASGEM Network Plan submitted to DWR in September 2011 (LSCE, 2011) also describes the County's intent to include at least one additional monitoring well in the Pope Valley and Berryessa Valley Groundwater Basins, as noted above.

The County will conduct additional public outreach to inform more private well owners of the value of understanding the groundwater resources in the County and to encourage their voluntary participation in the Comprehensive Groundwater Monitoring Program and/or CASGEM program. The County anticipates additional wells to be included in the CASGEM program over the coming years. Wells will be included based upon input from the County's GRAC and in concert with their work to meet the objectives of the County's Comprehensive Groundwater Monitoring Program and the CASGEM program.

For each county subarea, **Table 4-1** shows the existing monitoring sites, provides recommendations for the number and location of additional monitoring areas, and describes the key groundwater level monitoring objectives to be addressed. Altogether, it is recommended that approximately six groundwater/surface water monitoring sites for purposes of evaluating groundwater/surface water interactions and about 18 other areas of interest (AOIs) be added to the network (**Figure 4-1**).

Table 4-1
Groundwater Level Monitoring Sites, Napa County
(Current[1] and Recommended Additional Sites)

Subarea	No. Sites with Current Ground-water Level Data	Future GW Level Monitoring (Relative Priority)		Monitoring Needs	Recommend Addn'l Sites[2] (Number of Areas of Interest; Additional Volunteered Sites)	Proposed Areas of Interest for Monitoring	Key Monitoring Objectives[3]
Napa Valley Floor-Calistoga	**6**	**H**	**E**	**SP, SW**	**2 AOIs; V**	**14, 15**	**Conditions, Trends, Wtr Budget, SW**
Napa Valley Floor-MST	**29**	**H**	**R**	**SP, SW**	**V**		**Conditions, Trends, Wtr Budget, SW**
Napa Valley Floor-Napa	**18**	**H**	**R**	**SP, SW**	**2 SW; 4 AOIs; V**	**5, 6, 7, 8**	**Conditions, Trends, Wtr Budget, SW**
Napa Valley Floor-St. Helena[4]	**12**	**H**	**E**	**SP, SW**	**2 SW; 3AOIs; V**	**11, 12, 13**	**Conditions, Trends, Wtr Budget, SW**
Napa Valley Floor-Yountville	**9**	**H**	**E**	**SP, SW**	**2 SW; 2 AOIs; V**	**9, 10**	**Conditions, Trends, Wtr Budget, SW**
Carneros	**5**	**H**	**E**	**B**	**1 AOI; V**	**4**	**Conditions, Trends, Wtr Budget, Saltwater**
Jameson/American Canyon	1	M	E	B	3 AOIs; V	1, 18	Conditions, Trends, Wtr Budget, Saltwater
Napa River Marshes	1	M	E	SP, SW	1 AOI; V	2, 3	Conditions, Trends, Wtr Budget, Saltwater
Angwin	0	M	E	B	1 AOI; V	16	Conditions, Trends, Wtr Budget
Berryessa	3	L	E	B	V		Conditions, Trends (includ. CASGEM)
Central Interior Valleys	1	L	E	B	V		Conditions, Trends
Eastern Mountains	0	L	E	B	V		Conditions, Trends
Knoxville	1	L	E	B	V		Conditions, Trends
Livermore Ranch	0	L	E	B	V		Conditions, Trends
Pope Valley	1	L	E	B	1 AOI; V	17	Conditions, Trends (includ. CASGEM)
Southern Interior Valleys	0	L	E	B	V		Conditions, Trends
Western Mountains	0	L	E	B	V		Conditions, Trends
Total	**87**				**6 SW; 18 AOIs; V**		

[1] "Current" refers to monitored sites with wells measured for levels and/or any water quality parameter with a period of record extending to 2011 or later. "Future" refers to recommended monitoring locations.
[2] The numbers shown in this column refer to the number of areas of interest for additional monitoring. SW in this column refers to recommended sites for groundwater/surface water monitoring. "V" refers to additional water

supply wells (private or other) that may be volunteered for participation in the County program. "AOI" refers to the Area of Interest for monitoring; see Figure 4-1 for AOI locations.
[3] The Groundwater Level Monitoring Objectives shown in this column are "shorthand" descriptors for the objectives explained in Section 3.
[4] The wells shown in the Recommended Additional Sites column include one or more of the City of St. Helena's wells.

L = Low Priority; add groundwater level monitoring based on areas of planned future groundwater development

M = Medium Priority; add groundwater level monitoring

H = High Priority; add groundwater level monitoring

E = Expand current monitoring network; possible alternatives for additional monitoring wells include 1) wells historically monitored by DWR/USGS/Others, preferably with well construction information and as the well may be available for monitoring; 2) existing water supply wells (e.g., private/commercial) with well construction information; 3) new dedicated monitoring wells (coordinate with potential geologic investigations that may be conducted in selected areas)

R = Refine current monitoring network (link well construction information to all monitored wells, as possible)

Monitoring Needs: SP = Improve horizontal and/or vertical spatial distribution of data; SW =identify appropriate monitoring site to evaluate surface water -groundwater interrelationships; B = Basic data needed to accomplish groundwater level monitoring objectives

The six proposed groundwater monitoring sites are located along the main Napa Valley Floor from the City of Napa north to St. Helena adjacent to the Napa River system (**Figure 4-1**). These facilities are planned to be located near to existing stream gauging stations and/or near areas where stream monitoring can also be conducted. The proposed groundwater monitoring facilities are also being sited, where possible, adjacent to existing groundwater monitoring facilities (i.e., typically water supply wells constructed to greater depths in the aquifer system). The proposed monitoring wells will enable focused data collection regarding groundwater elevations and water quality to identify and characterize interactions with surface water.

Frequency of Monitoring

Historically, the County has measured the newly designated CASGEM wells semi-annually in the spring (April) and fall (October) of each year. Historical hydrographs show that these measurement periods generally correspond to the seasonal high and low groundwater elevations observed in their respective county subareas. The County will continue to measure the CASGEM wells semi-annually during similar periods.

Monthly water level monitoring is limited and does not currently provide adequate data to evaluate the effects of hydrologic events or stresses on the aquifer system. In particular, 3 wells are monitored monthly by DWR. These wells are located in the NVF-Calistoga; NVF- St. Helena, and NVF-Napa Subareas, respectively, and are also located generally near the Napa River. It is recommended that selected additional wells (existing and new) be measured monthly to evaluate hydrologic effects and particularly the wells at the six sites recommended to assess surface water and groundwater interrelationships (Napa County, 2012).

Field Methods

Napa County has documented field procedures for the collection of groundwater level measurements which were updated as part of the County's Comprehensive Groundwater Monitoring Program (LSCE, 2010b). These procedures and an example form for recording water level measurements are included in **Appendix C**). The County uses these procedures for the CASGEM program as well as continued monitoring of wells where water level data are submitted to DWR semi-annually for inclusion in DWR's Water Data Library, and the monitoring of other wells measured for County information.

4.2 Groundwater Quality Monitoring

This section describes existing groundwater quality monitoring and recommended locations for wells for groundwater quality monitoring to fill data gaps. As additional monitoring facilities are considered, or existing facilities are further evaluated, the objectives provided in Section 3 will be used to evaluate the suitability of the existing or proposed facilities to ensure that the data being (or planned to be) collected can address these objectives.

4.2.1 Monitoring Network

Existing Groundwater Quality Monitoring Wells

The current groundwater quality monitoring network consists of 177 sites (**Table 4-2; see detailed list in Appendix B**). Current groundwater quality monitoring sites are fairly well distributed throughout the Napa Valley Floor Subarea (**Figure 4-2).** Recommended improvements to the groundwater quality monitoring program, and priority timelines for improvements are discussed below.

Recommendations

As presented above in **Table 2-2**, and summarized in Section 2, a preliminary ranking and priorities for improving or expanding groundwater quality monitoring were prepared for each of the county subareas. Three subareas are given a relatively higher priority for improving the groundwater quality monitoring network based on the lack of spatially distributed groundwater quality monitoring. Although other areas also lack baseline groundwater quality data, these areas are given a relatively higher priority due to interest in better understanding naturally occurring metals (MST) and naturally occurring elevated salinity levels (e.g., Jameson/American Canyon and Napa River Marshes).These areas include:

- NVF-MST;
- Carneros; and
- Jameson/American Canyon Subareas.

Seven subareas, including Berryessa, Central Interior Valleys, Knoxville, Livermore Ranch, Pope Valley, Southern Interior Valleys and Western Mountains, are assigned relatively lower priorities for groundwater quality monitoring due to lower levels of land and groundwater use and/or there appear to be additionally available groundwater quality data from DPH that can be further examined for completeness and ongoing evaluation. The seven remaining subareas are

designated as medium priorities for groundwater quality monitoring. Many of these areas have current monitoring programs, so the emphasis is to periodically examine the groundwater quality data to assess changes in conditions, including any trends in constituent concentrations.

Many subareas outside the Napa Valley Floor have limited spatial distribution of the current groundwater monitoring wells (or monitoring locations). Basic data are described as a key monitoring need and expansion and/or refinement of groundwater monitoring conducted in all subareas should be coordinated with efforts to provide additional characterization of subsurface geologic conditions and well construction information. This effort was undertaken as part of the updated characterization and conceptualization of hydrogeologic conditions for linking groundwater levels to construction data. Over time, it is recommended a similar effort occur for water quality data. Initial efforts to link water quality data to representation of the aquifer system could focus on the MST, Carneros, and Jameson/American Canyon Subareas. This will allow for the evaluation of groundwater conditions specific to an aquifer rather than composite information which limits the ability to fully understand groundwater conditions in the County and in individual subareas.

The monitoring network gaps in the three subareas given a relatively higher priority might be addressed by:

1) Investigating the potential to restart monitoring where historical records are available but monitoring was discontinued;
2) Identifying existing wells of suitable construction that might be volunteered for inclusion through County and GRAC education and outreach efforts; and
3) Constructing new dedicated monitoring wells if suitable existing wells either do not exist in the area of interest or are otherwise not available (this is not likely to be necessary for groundwater quality monitoring purposes only; the six recommended sites with dedicated wells constructed for groundwater level monitoring to evaluate groundwater/surface water interactions could also be added to the groundwater quality monitoring network).

Groundwater quality monitoring is recommended in the 18 AOIs discussed above for groundwater level monitoring. This addresses specific groundwater quality monitoring needs for the relatively higher priority subareas, as well as broader assessment of groundwater quality conditions and trends in other subareas.

Monitoring in other subareas with relatively medium to lower priorities is suggested to be addressed with volunteered wells.

For each county subarea, **Table 4-2** shows the existing monitoring sites, provides recommendations for the number and location of additional monitoring sites, and describes the key groundwater quality monitoring objectives to be addressed.

Table 4-2
Groundwater Quality Monitoring Sites, Napa County
(Current[1] and Recommended Additional Monitoring Sites)

Subarea	No. Sites with Current GW Quality Data	Future GW Quality Monitoring (Relative Priority)		Monitoring Needs	Recommend Addn'l Sites[2] (Number of Areas of Interest; Additional Volunteered Sites)	Proposed Areas of Interest for Monitoring	Key Monitoring Objectives[3]
Napa Valley Floor-Calistoga	20	M	R	SP,C	2 AOIs; V	14, 15	Conditions, Trends, Nat'l Constituents
Napa Valley Floor-MST	**16**	**H**	**R**	**SP,C**	**V**		Conditions Trends, Nat'l Constituents
Napa Valley Floor-Napa	21	M	R	SP,C	2 SW; 4 AOIs; V	5, 6, 7, 8	Conditions, Trends, Nat'l Constituents
Napa Valley Floor-St. Helena	31	M	R	SP,C	2 SW; 3 AOIs; V	11, 12, 13	Conditions, Trends, Nat'l Constituents
Napa Valley Floor-Yountville	14	M	R	SP,C	2 SW; 2 AOIs; V	9, 10	Conditions, Trends, Nat'l Constituents
Carneros	**9**	**H**	**R**	**SP,C**	**1 AOI; V**	**4**	Conditions, Trends, Nat'l Constituents, Saltwater
Jameson/American Canyon	**3**	**H**	**E**	**B,SP,C**	**3 AOIs; V**	**1, 18**	Conditions, Trends, Nat'l Constituents, Saltwater
Napa River Marshes	6	M	E	B,SP,C	1 AOI; V	2, 3	Conditions, Trends, Nat'l Constituents. Saltwater
Angwin	4	M	E	B,C	1 AOI; V	16	Conditions, Trends, Nat'l Constituents
Berryessa	6	L	E	B,C	V		Conditions, Trends, Nat'l Constituents

Subarea	No. Sites with Current GW Quality Data	Future GW Quality Monitoring (Relative Priority)		Monitoring Needs	Recommend Addn'l Sites[2] (Number of Areas of Interest; Additional Volunteered Sites)	Proposed Areas of Interest for Monitoring	Key Monitoring Objectives[3]
Central Interior Valleys	6	L	R	B,SP,C	V		Conditions, Trends, Nat'l Constituents
Eastern Mountains	25	M	E	B,C	V		Conditions, Trends, Nat'l Constituents
Knoxville	0	L	E	B,C	V		Conditions, Trends, Nat'l Constituents
Livermore Ranch	0	L	E	B,C	V		Conditions, Trends, Nat'l Constituents
Pope Valley	6	L	E	B,C	1 AOI; V	17	Conditions, Trends, Nat'l Constituents
Southern Interior Valleys	0	L	E	B,C	V		Conditions, Trends, Nat'l Constituents
Western Mountains	10	L	R	B,C	V		Conditions, Trends, Nat'l Constituents
Total	**177**				**6 SW; 18 AOIs; V**		

[1] "Current" refers to monitored sites with wells measured for levels and/or any water quality parameter with a period of record extending to 2008 or later. "Future" refers to recommended monitoring locations.
[2]The numbers shown in this column refer to the number of areas of interest for additional monitoring. SW in this column refers to recommended sites for groundwater/surface water monitoring "V" refers to additional water supply wells (private or other) that may be volunteered for participation in the County program (these volunteered wells for groundwater quality monitoring would be coordinated with those volunteered for groundwater level monitoring). "AOI" refers to Areas of Interest for groundwater monitoring; see Figure 4-2 for AOI locations for groundwater quality monitoring.
[3] The Groundwater Level Monitoring Objectives shown in this column are "shorthand" descriptors for the objectives explained in Section 3.

L = Low Priority; add groundwater quality and also level monitoring based on areas of planned future groundwater development

M = Medium Priority; add groundwater quality and also level monitoring

H = High Priority; add groundwater quality and also level monitoring

E = Expand current monitoring network; possible alternatives for additional monitoring wells include 1) wells historically monitored by DWR/USGS/Others, preferably with well construction information and as the well may be available for monitoring; 2) existing water supply wells (e.g., private/commercial) with well construction information; 3) new dedicated monitoring wells (coordinate with potential geologic investigations that may be conducted in selected areas)

R = Refine current monitoring network (link well construction information to all monitored wells, as possible)

Monitoring Needs: SP = Improve horizontal and/or vertical spatial distribution of data; B = Basic data needed to accomplish groundwater level monitoring objectives; C = Coordinate with groundwater level monitoring

Note: Some sites with current groundwater quality data are approximately located and currently may not be counted in the correct subarea. Also, additional sites with current groundwater quality beyond this tabulation

exist but the locations are currently unavailable and unable to be counted at this time.

Frequency of Monitoring

With the exception of GeoTracker regulated facility sites in the county, current groundwater quality monitoring for TDS and/or EC typically occurs on a less frequent than annual basis. Nitrate monitoring on an annual or more frequent basis has occurred more often than monitoring for TDS, EC, and chloride (LSCE, 2010a, 2010b, and 2011).

It is recommended that wells added to the monitoring network for groundwater quality monitoring are sampled initially for general minerals and drinking water metals. These wells would include the six sites recommended for the purpose of evaluating groundwater/surface water interactions and also about 18 other sites in AOIs for groundwater quality monitoring as shown in **Table 4-2** and described above. It is also recommended that groundwater quality samples for similar parameters be collected the following year to affirm baseline conditions. It is recommended that groundwater quality monitoring occur on a triennial basis for general minerals and drinking water metals at the six sites recommended for groundwater/surface water evaluation. Following the baseline sampling and the one-year confirmation sampling, a 5-year frequency is recommended for the other 18 AOIs and where wells are volunteered for inclusion for monitoring in other subareas. A subset of analytes is recommended in intervening years (see further discussion below).

Field Methods

The methods and procedures used by DWR (1994) and USGS (http://water.usgs.gov/owq/FieldManual/) are detailed and extensive and are often used by counties and consultants as guidelines for the collection of water level measurements and water quality samples.

Prior to sampling a monitoring well, the static water level is measured. An electric sounder is used to measure the depth to groundwater from a specified reference point (usually the top of the well casing). Wellhead reference points are typically marked to provide consistency between measurements. Measurements are recorded to the nearest 0.01 foot. The static water level in conjunction with well construction information is used to calculate the volume of water in the well. This information is used to determine the minimum volume of water to be purged prior to sample collection.

Dedicated monitoring wells are typically purged and sampled using a portable submersible sampling pump. A discharge hose is attached to the top of the pump assembly through which purge water is discharged. Smaller-diameter tubing for sample collection is also attached to the top of the pump assembly. Discharge and sample collection tubings are attached to a manifold and are isolated from each other by a check valve.

Private water wells (domestic or agricultural), and also municipal and industrial wells, most often can be sampled using installed pumping equipment. Often these wells are routinely used for their intended purpose so the purging duration may be adjusted accordingly. Samples collected from existing supply wells should be collected near the wellhead (i.e., prior to any type of water storage tank).

Monitoring wells are purged of at least three well casing volumes and until indicator parameters have stabilized prior to sample retrieval. Stabilization is defined as three consecutive readings at 5-minute intervals where parameters do not vary by more than 5 percent. Purged groundwater is disposed of by spreading it on the ground at a reasonable distance from the sampled well to avoid the potential for purge water to enter the well casing again during the purging process.

The following indicator parameters (or field parameters) are typically monitored during the well purging:

- temperature (°C)
- pH (standard pH-units)
- electrical conductivity (µS/cm)
- dissolved oxygen (percent saturation)
- oxygen reduction potential (mV)
- turbidity (NTU)

Visual (color, occurrence of solids), olfactory (odor) and other observations (e.g., wellhead conditions, well access, ground conditions, and weather) are noted as appropriate.

After completion of purging activities, groundwater quality samples are often filtered in the field to remove turbidity and collected in laboratory-supplied bottles with or without preservative (depending on analyses to be conducted) with or without headspace. Filtering may also be conducted by the laboratory, in which case preservatives are added at the laboratory. Bottles are labeled with laboratory-supplied labels, immediately placed on ice, and kept in a dark ice chest (at 4 °C) until delivered to the laboratory. Samples are delivered to a laboratory certified through the State of California (Department of Public Health Environmental Laboratory Accreditation Program) with the proper chain-of-custody documentation within the required holding time. A chain-of-custody form is used to record sample identification numbers, type of samples (matrix), date and time of sample collection, and analytical tests requested. In addition, times, dates, and individuals who had possession of the samples are documented to record sample custody.

A field sheet is used to document equipment calibration, water level measurements, well purging activities, and the measurement of indicator parameters; an example is provided in **Appendix D**.

Quality Assurance Procedures

Quality assurance (QA) is an overall management plan used to guarantee the integrity of data collected by the monitoring program. This includes the discussed guidelines for groundwater level measurements, purging protocol, and sample handling and recordation. Quality control (QC) is a component of QA that includes analytical measurements used to evaluate the quality of the data. A brief discussion of field QC is followed by a discussion of laboratory QC requirements.

Field Quality Control

"Blind" duplicate field samples are collected to monitor the precision of the field sampling process and to assess laboratory performance. Blind duplicates are collected from at least 5 percent (1 in 20) of the total number of sample locations. The true identity of the duplicate sample is not noted on the chain-of-custody form, rather a unique identifier is provided. The identities of the blind duplicate samples are recorded in the field sheet, but the sampling locations of the blind field duplicates will not be revealed to the laboratory. "Field blanks" may also be employed to assure that the field procedures are not introducing any bias or contamination to the samples. The sample water for these is usually provided by the laboratory.

Lab Quality Control

Quality assurance and quality control samples (e.g., spiked samples, blank samples, duplicates) are employed by the laboratory to document the laboratory performance. Results of this testing are provided with each laboratory report.

Review of Laboratory Data Reports

Data validation includes a data completeness check of each laboratory analytical report. Specifically, this review includes:

- Review of data package completeness (ensuring that required QC and analytical results are provided);
- Review of the required reporting summary forms to determine if the QC requirements were met and to determine the effect of exceeded QC requirements on the precision, accuracy, and sensitivity of the data;
- Review of the overall data package to determine if contractual requirements were met; and
- Review of additional QA/QC parameters to determine technical usability of the data.

In addition, the data validation includes a comprehensive review of the following QA/QC parameters:

- Holding times (to assess potential for degradation that will affect accuracy);
- Blanks (to assess potential laboratory contamination);
- Matrix spikes/matrix spike duplicates and laboratory control samples (to assess accuracy of the methods and precision of the method relative to the specific sample matrix);
- Internal standards (to assess method accuracy and sensitivity);
- Compound reporting limits and method detection limits; and
- Field duplicate relative percent differences.

Parameters of Interest

The recommended water quality monitoring parameters are described below.

Baseline

During the initial groundwater sampling campaign (i.e., when "new" wells are added to the groundwater quality monitoring network), samples will be laboratory analyzed for general minerals and drinking water metals.

- General Minerals: Specific conductance (or electrical conductivity, EC), total dissolved solids, pH, sodium (Na), potassium (K), magnesium (Mg), calcium (Ca), chloride (Cl), sulfate (SO_4), nitrate (NO_3), fluoride (F), alkalinity series (total, carbonate (CO_3), bicarbonate (HCO_3), hydroxide (OH)), and hardness;
- Drinking Water Metals: silver (Ag), aluminum (Al), arsenic (As) (total and dissolved), boron (B), barium (Ba), beryllium (Be), cadmium (Cd), chromium (Cr) (total and dissolved), Hexavalent Cr, copper (Cu), iron (Fe), mercury (Hg), manganese (Mn), nickel (Ni), lead (Pb), antimony (Sb), selenium (Se), thallium (Tl), vanadium (V), and zinc (Zn).

Affirm Baseline

During the second year of a monitoring well's inclusion in the groundwater quality monitoring network, samples will again be collected and analyzed for general minerals and drinking water metals to affirm the findings of the baseline sampling event.

Annual

It is recommended that samples be collected annually for analysis of field parameters and laboratory analyses for at least TDS, nitrate, and chloride. Additional analyses may be appropriate in selected subareas. The groundwater quality sampling locations/AOIs listed in **Table 4-2** are also locations where groundwater levels would be measured at least semi-annually. Therefore, it is recommended that groundwater quality sampling be coordinated with the spring water level measurements.

Triennial and/or Every Five Years

It is recommended that samples be collected triennially from the wells in the groundwater quality monitoring network for the six sites recommended for groundwater/surface water evaluation. A 5-year frequency is recommended for the other 18 AOIs, including the main NVF, Carneros, Jameson/American Canyon, and Napa River Marshes Subareas and also where wells are volunteered for inclusion in other subareas, and analyzed for general minerals and drinking water metals.

Special Studies or Areas of Interest

Some county subareas may have naturally occurring compounds or human-influenced compounds that are of special interest. Special studies may be appropriate to determine the presence, concentration, persistence and potential effects of such compounds, particularly when site-specific factors may potentially affect groundwater quality (e.g., mining areas, wastewater disposal, recycled water use, etc.).

5 Groundwater Data Management

This section describes how groundwater data obtained by the County will be managed, used, and shared. Specifically, this section discusses the types of data to be collected, the County's Data Management System (DMS), and which data may be shared with the State (e.g., DWR or other entities) and/or reported to the public.

5.1 Data Management Overview

An overview of the County's data management approach is provided in **Figure 5-1.** Data will be collected from a variety of sources and programs. The groundwater monitoring program includes public and volunteered wells[2] and also permit-required monitoring. Therefore, it is important that guidelines are established to ensure that data are managed according to the well owner's permission and/or as it relates to applicable permit conditions.

5.2 Data Management System (DMS)

The Napa County DMS has been constructed to incorporate existing and new data about groundwater resources in Napa County (LSCE, 2010a). The data incorporated in the DMS will be used on an ongoing basis by the County to evaluate countywide groundwater supply and quality conditions and functions as a secure central data storage location.

In order to ensure security and user flexibility, the database was designed using Microsoft Access 2000 and the .mdb database format. Access has the capacity to store historical and future data, up to a total of 2 GB of data, and the DMS can be transitioned to an enterprise database software system as necessary.

5.3 Data Use and Disclosure

In this section, the County's use and disclosure of collected data are described. A tiered participation approach in the volunteer groundwater monitoring program will be followed which allows property owners to choose their level of participation, including what data can be shared versus what data are to be kept confidential as required by State law (Water Code §13751, §13752). Well owners that volunteer their well for inclusion in the County's program would receive the groundwater information collected from their well. This may be provided on an annual basis and/or in periodic reports produced by the County.

5.3.1 Protected Data

The DMS contains certain protected information that will not be made publicly available. For example, drillers' reports and the specific well construction information contained therein are confidential. This data will be held as confidential unless permission is received from the well owner.

[2] As described in Section 4, the County has identified areas of interest where additional groundwater level and/or quality monitoring will help address data gaps. The County will be seeking well owners interested in volunteering their wells for inclusion in this program. All groundwater level and/or quality monitoring will be done by the County or representatives on behalf of the County (i.e., the monitoring is at no cost to participants and participants will receive information about groundwater beneath their property.

5.3.2 Data Sharing and Disclosure

The County is planning to implement an education and outreach program that includes communication to the public about opportunities to volunteer to have their well monitored as part of the County's groundwater monitoring program. The County is providing a tiered participation program as described below.

Napa County Program

Property owners interested in participating in the County program but who wish to keep their information confidential may elect to not have their well data (e.g., groundwater levels) reported to DWR's Water Data Library or as part of the CASGEM program. This means the County would only use the collected groundwater data (levels and/or quality) for public education and information but would display the data in publically distributed reports which ensure the owner's privacy.

Water Data Library

DWR maintains groundwater information in a database called the Water Data Library (WDL). Napa County reports groundwater level elevation data to DWR for inclusion in the WDL. Although well location information is included in the WDL, well construction information is not reported. This level of participation will be offered to property owner's volunteering their well for the County groundwater monitoring program. This will authorize the County to release water level information, but State mandated protected information will continue to be held as confidential.

CASGEM Program

Property owners interested in participating in the County's groundwater monitoring program and who are willing to provide the information required by the CASGEM program could also become participants in that program . Particularly, owners would recognize that if the County elects to include their well in the CASGEM program, the construction information for their well would be available online on DWR's site.

5.3.3 Reporting of Data

The County has historically routinely reported groundwater level data to DWR for inclusion in the WDL. Beginning in 2012, the County is also now reporting a subset of the groundwater level data collected by the County to DWR as part of the CASGEM program.
Any maps prepared from data in the DMS should represent well locations with large symbols. Names and addresses of well owners would be kept confidential. Additional information related to reporting is contained in **Section 6**.

5.3.4 Data from Other Sources

In addition to the groundwater level and quality data directly collected by the County, other groundwater data are available for the County to download and include in the evaluation of countywide groundwater conditions. Several different public agencies collect and maintain

groundwater data, including DWR, the USGS, the California Department of Public Health (DPH; GeoTracker-GAMA), and the State Water Resources Control Board (SWRCB; GeoTracker) (LSCE, 2010a). These sources can be accessed through the SWRCB website that summarizes the current data and databases available on the web at www.waterboards.ca.gov/resources/data_databases/. These programs and publicly available databases are continually evolving to expand and merge to create a more useful and powerful network of information. During the development of the County DMS, these data sources were combined with Napa County's own records in order to populate the Napa County DMS (LSCE, 2010a).

For gathering data that is collected by external agencies, a timeframe of about 2 to 3 years is a reasonable span between obtaining updates. This can be a sizeable effort to integrate multiple datasets, and planning should be done to avoid inconsistencies, gaps or duplications of data over a historical record.

6. REPORTING

To facilitate community understanding of Napa County groundwater and surface water systems, the reports prescribed in this section will be published in a manner that gives full and easy access to the public.

6.1 Annual Groundwater Monitoring Progress and Data Report

It is recommended that an Annual Groundwater Monitoring Progress and Data Report be prepared that includes a review of the groundwater monitoring program and network. Based on the data gathered from the current monitoring year, review of the historical record, water level and quality trend analyses, and consideration of issues of interest to the County and collaborating entities, the program may be adjusted as needed to accomplish the countywide groundwater resources goals and monitoring objectives. The Annual Progress Report will consider the stated goals and objectives of the groundwater monitoring program and include recommended modifications to the program and network, as needed.

It is recommended that the Progress Report also include a summary of the groundwater level and quality data collected by Napa County staff, including attachments containing tables that summarize the data and figures showing the measurement locations (this dataset and any accompanying discussion are not intended to be as comprehensive as the dataset and evaluation of groundwater level and quality conditions described below for Triennial Countywide Reporting).

6.2 Annual CASGEM Reporting

It is recommended that the County prepare an annual report summarizing the results and findings of the countywide CASGEM program. Each annual report will describe any changes to the current monitoring network and program, including recommended additions to the CASGEM program network.

6.3 Triennial Countywide Reporting on Groundwater Conditions

It is also recommended that the County prepare on a regular basis, approximately triennially, a report on countywide groundwater level and quality conditions and any other monitoring network modifications per the recommendations in this Plan which are for the purpose of meeting the County's groundwater level and quality monitoring objectives.

It is recommended that the Triennial Groundwater Conditions Report be prepared that includes the following:

- A summary of the groundwater level and quality data collected in Napa County by Napa County staff and other entities, including attachments containing tables that summarize the data and provide a reference to applicable water quality standards; figures showing the measurement locations;
- Figures illustrating groundwater level trends at locations throughout the County, especially in high priority subareas;

- Figures showing contours of equal groundwater elevation for the 1) Napa Valley Floor subareas (including Calistoga, St. Helena, Yountville, and Napa Subareas); 2) MST Subarea; and 3) other subareas as the groundwater level monitoring program evolves;
- Figures illustrating groundwater quality trends at locations throughout the County, especially in high priority subareas (time series plots would include TDS, nitrate and chloride and other selected constituents, depending on specific interests in individual subareas;
- A summary of coordinated efforts with other local, state and federal agencies pertaining to County and Regional groundwater conditions and reporting. Examples include summaries pertaining to interagency collaboration on Integrated Regional Water Management Planning and Implementation, Urban Water Management Plan updates, and Basin Plan updates.

As for the Annual Progress Report, it is recommended that the groundwater monitoring program and network be regularly reviewed and modifications to the groundwater monitoring network and program also included in the Triennial Report.

Interagency coordination is important for the ongoing program. Specifically, the local participants will benefit from efforts made toward systematic data collection and analyses and maintaining the DMS in a standardized format. The Triennial Report will include recommendations relevant to interagency data coordination, as needed.

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FIGURES

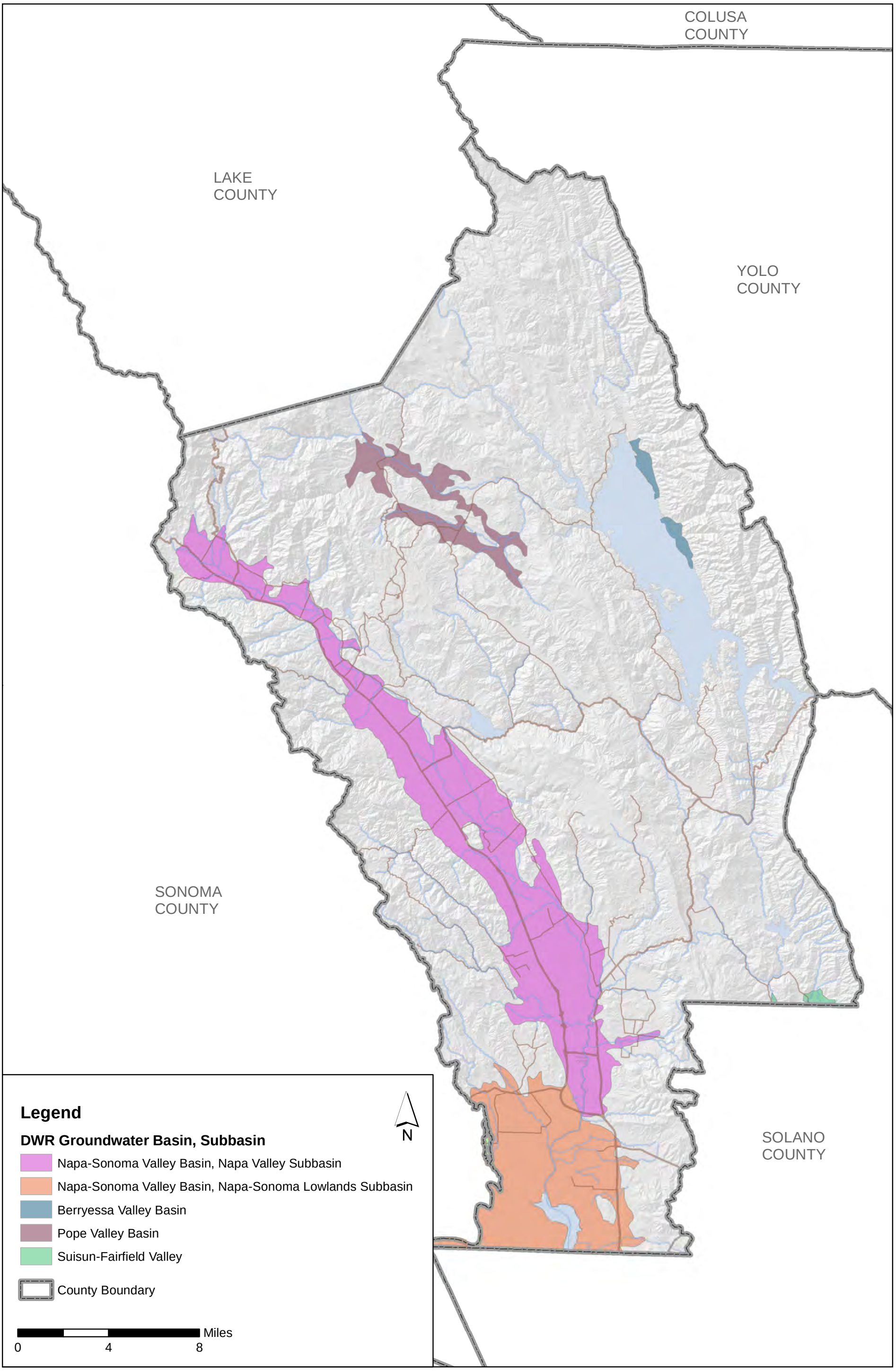

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Figure 2-1
Napa County Groundwater Basins
Napa County, CA

COLUSA COUNTY

LAKE COUNTY

YOLO COUNTY

SONOMA COUNTY

SOLANO COUNTY

Knoxville

Livermore Ranch

Pope Valley

Berryessa

Angwin

Central Interior Valleys

Napa Valley Floor Calistoga

Eastern Mountains

Napa Valley Floor St. Helena

Western Mountains

Napa Valley Floor Yountville

Napa Valley Floor MST

Napa Valley Floor Napa

Southern Interior Valleys

Carneros

Jameson/ American Canyon

Napa River Marshes

Legend

Subarea Boundary

County Boundary

N

Miles

0 4 8

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Figure 2-2
Napa County Subareas
Napa County, CA

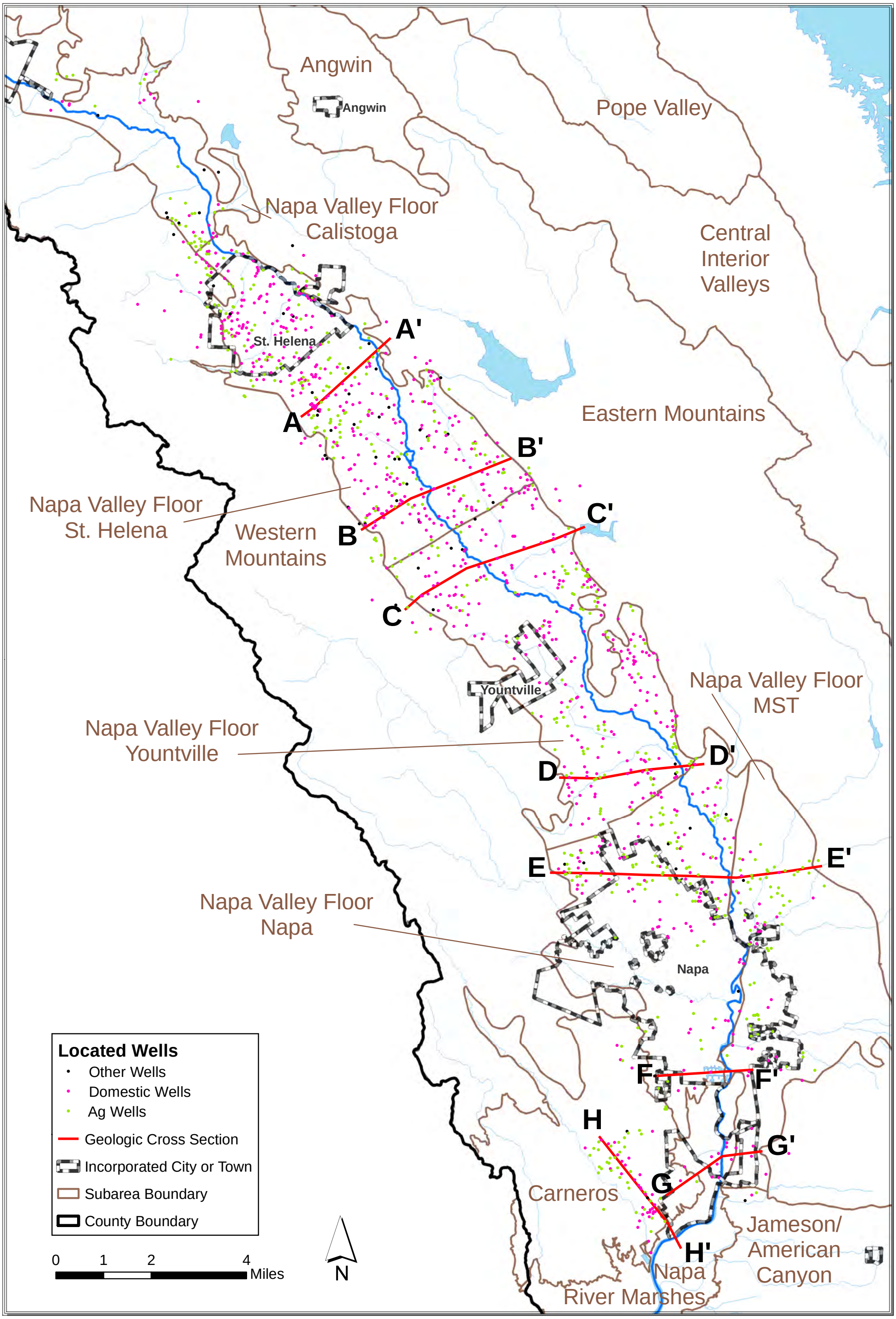

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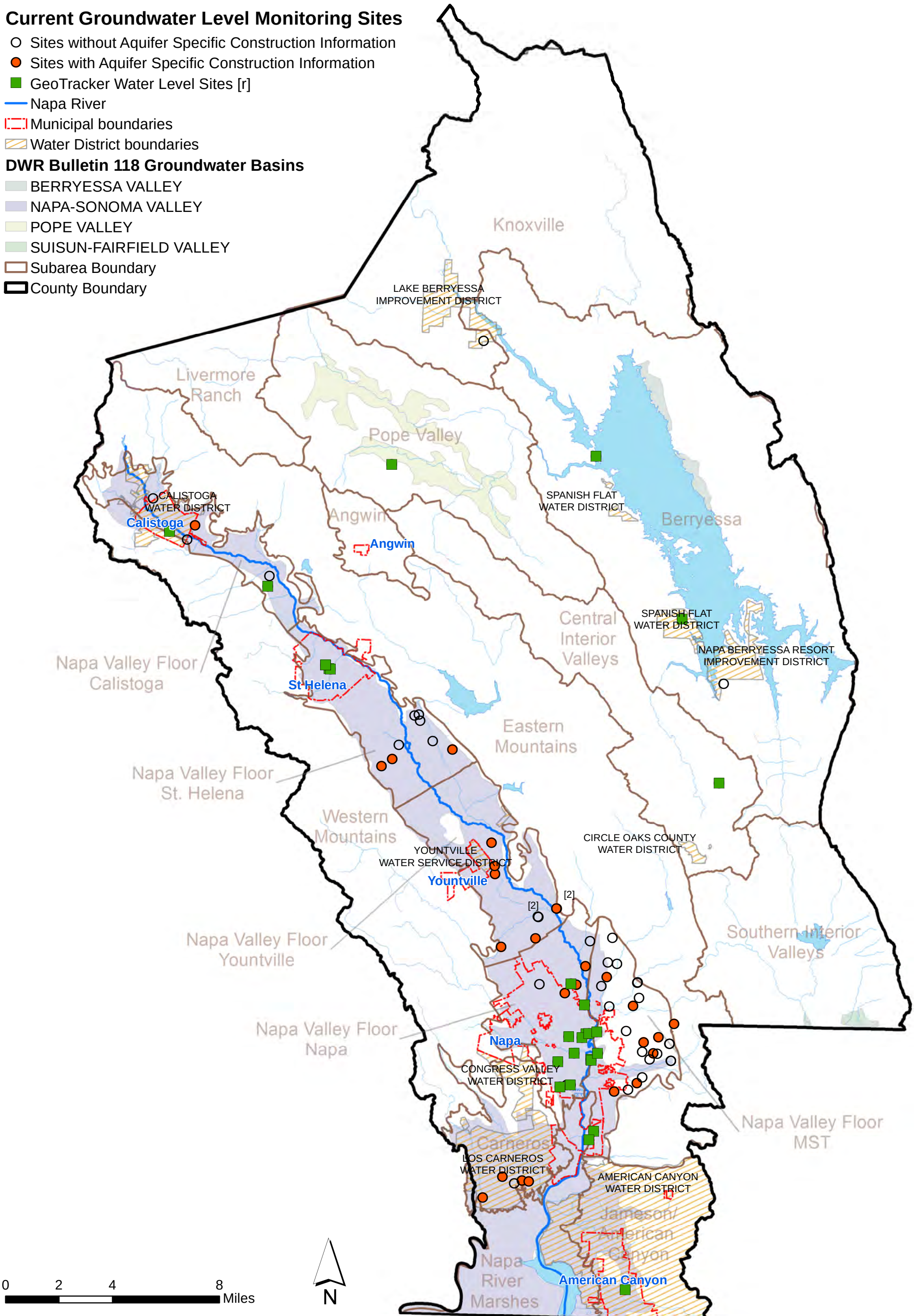
Figure 2-3
Geologic Cross Section Location Map

Current Groundwater Level Monitoring Sites

- Sites without Aquifer Specific Construction Information
- Sites with Aquifer Specific Construction Information
- GeoTracker Water Level Sites [r]
- Napa River
- Municipal boundaries
- Water District boundaries

DWR Bulletin 118 Groundwater Basins

- BERRYESSA VALLEY
- NAPA-SONOMA VALLEY
- POPE VALLEY
- SUISUN-FAIRFIELD VALLEY
- Subarea Boundary
- County Boundary



[r]: Regulated contaminant clean-up sites

[#]: Indicates the number of sites at a location where multiple sites are obscured by map scale.

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Figure 2-4
Current Groundwater Level Monitoring Sites in Napa County

Current Groundwater Quality Monitoring Sites

- Current DPH and DWR sites
- Current GeoTracker Groundwater Quality Sites
- Napa River
- Municipal boundaries
- Water District boundaries

DWR Bulletin 118 Groundwater Basins

- BERRYESSA VALLEY
- NAPA-SONOMA VALLEY
- POPE VALLEY
- SUISUN-FAIRFIELD VALLEY
- Subarea Boundary
- County Boundary

Knoxville
LAKE BERRYESSA IMPROVEMENT DISTRICT
Livermore Ranch
Pope Valley
CALISTOGA WATER DISTRICT
Calistoga
Angwin
Angwin
SPANISH FLAT WATER DISTRICT
Berryessa
Central Interior Valleys
SPANISH FLAT WATER DISTRICT
NAPA BERRYESSA RESORT IMPROVEMENT DISTRICT
Napa Valley Floor Calistoga
St Helena
Eastern Mountains
Napa Valley Floor St. Helena
Western Mountains
CIRCLE OAKS COUNTY WATER DISTRICT
YOUNTVILLE WATER SERVICE DISTRICT
Yountville
Napa Valley Floor Yountville
Southern Interior Valleys
Napa Valley Floor Napa
Napa
CONGRESS VALLEY WATER DISTRICT
Napa Valley Floor MST
Carneros
LOS CARNEROS WATER DISTRICT
AMERICAN CANYON WATER DISTRICT
Jameson/ American Canyon
Napa River Marshes
American Canyon

0 2 4 8 Miles

N

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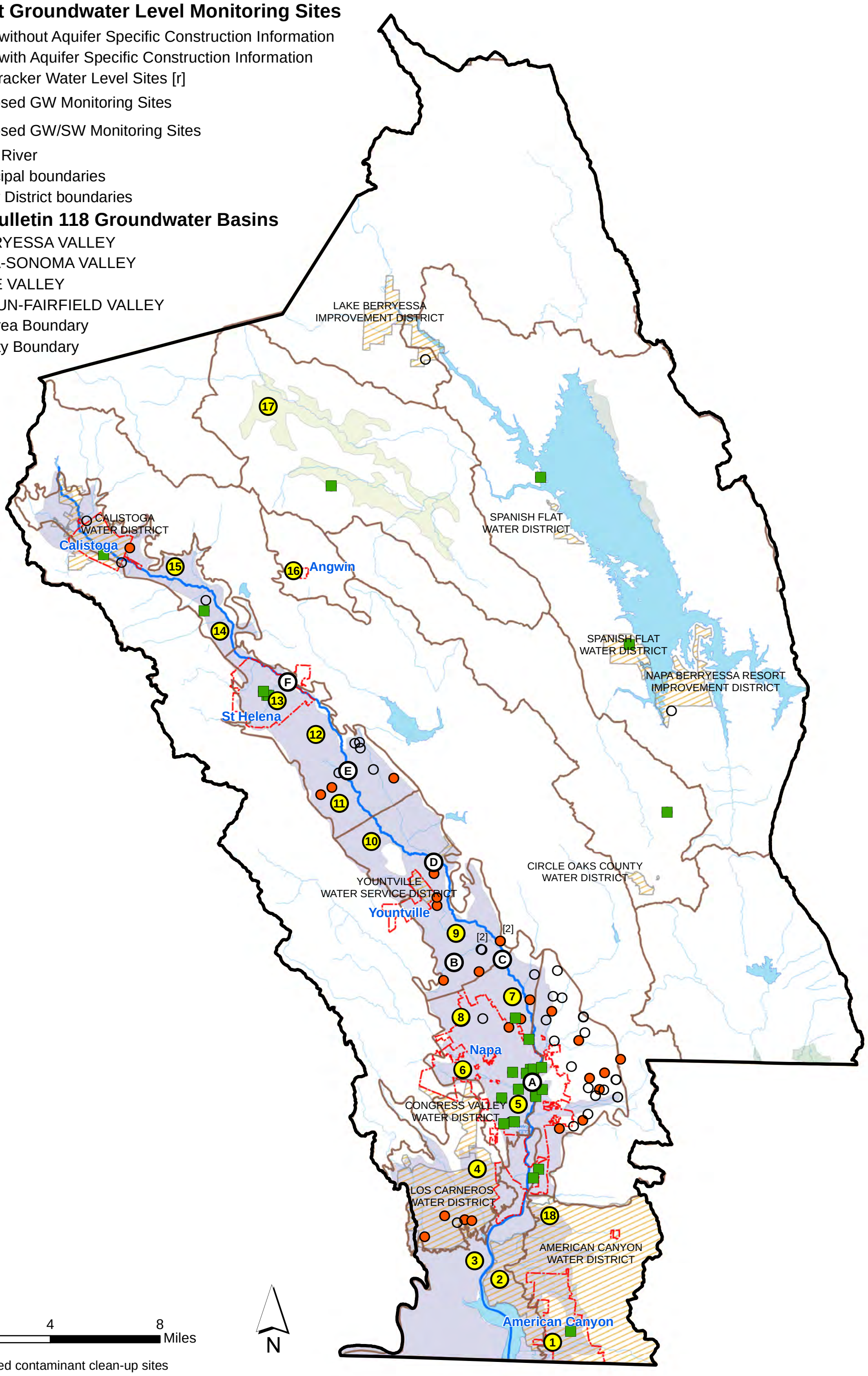
Figure 2-5
Current Groundwater Quality Monitoring Sites in Napa County

Current Groundwater Level Monitoring Sites

- Sites without Aquifer Specific Construction Information
- Sites with Aquifer Specific Construction Information
- GeoTracker Water Level Sites [r]
- Proposed GW Monitoring Sites
- Proposed GW/SW Monitoring Sites
- Napa River
- Municipal boundaries
- Water District boundaries

DWR Bulletin 118 Groundwater Basins

- BERRYESSA VALLEY
- NAPA-SONOMA VALLEY
- POPE VALLEY
- SUISUN-FAIRFIELD VALLEY
- Subarea Boundary
- County Boundary



[r]: Regulated contaminant clean-up sites

[#]: Indicates the number of sites at a location where multiple sites are obscured by map scale.

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Figure 4-1
Current and Proposed Groundwater Level Monitoring Sites in Napa County

Current Groundwater Quality Monitoring Sites

- Current DPH and DWR sites
- Current GeoTracker Groundwater Quality Sites
- Napa River
- Municipal boundaries
- Water District boundaries

DWR Bulletin 118 Groundwater Basins

- BERRYESSA VALLEY
- NAPA-SONOMA VALLEY
- POPE VALLEY
- SUISUN-FAIRFIELD VALLEY
- Subarea Boundary
- County Boundary

LAKE BERRYESSA IMPROVEMENT DISTRICT
CALISTOGA WATER DISTRICT
Calistoga
Angwin
SPANISH FLAT WATER DISTRICT
SPANISH FLAT WATER DISTRICT
NAPA BERRYESSA RESORT IMPROVEMENT DISTRICT
St Helena
YOUNTVILLE WATER SERVICE DISTRICT
Yountville
CIRCLE OAKS COUNTY WATER DISTRICT
Napa
CONGRESS VALLEY WATER DISTRICT
LOS CARNEROS WATER DISTRICT
AMERICAN CANYON WATER DISTRICT
American Canyon

17 15 16 14 F 13 12 E 11 10 D 9 B C 7 8 6 A 5 4 18 3 2 1

0 2 4 8 Miles

N

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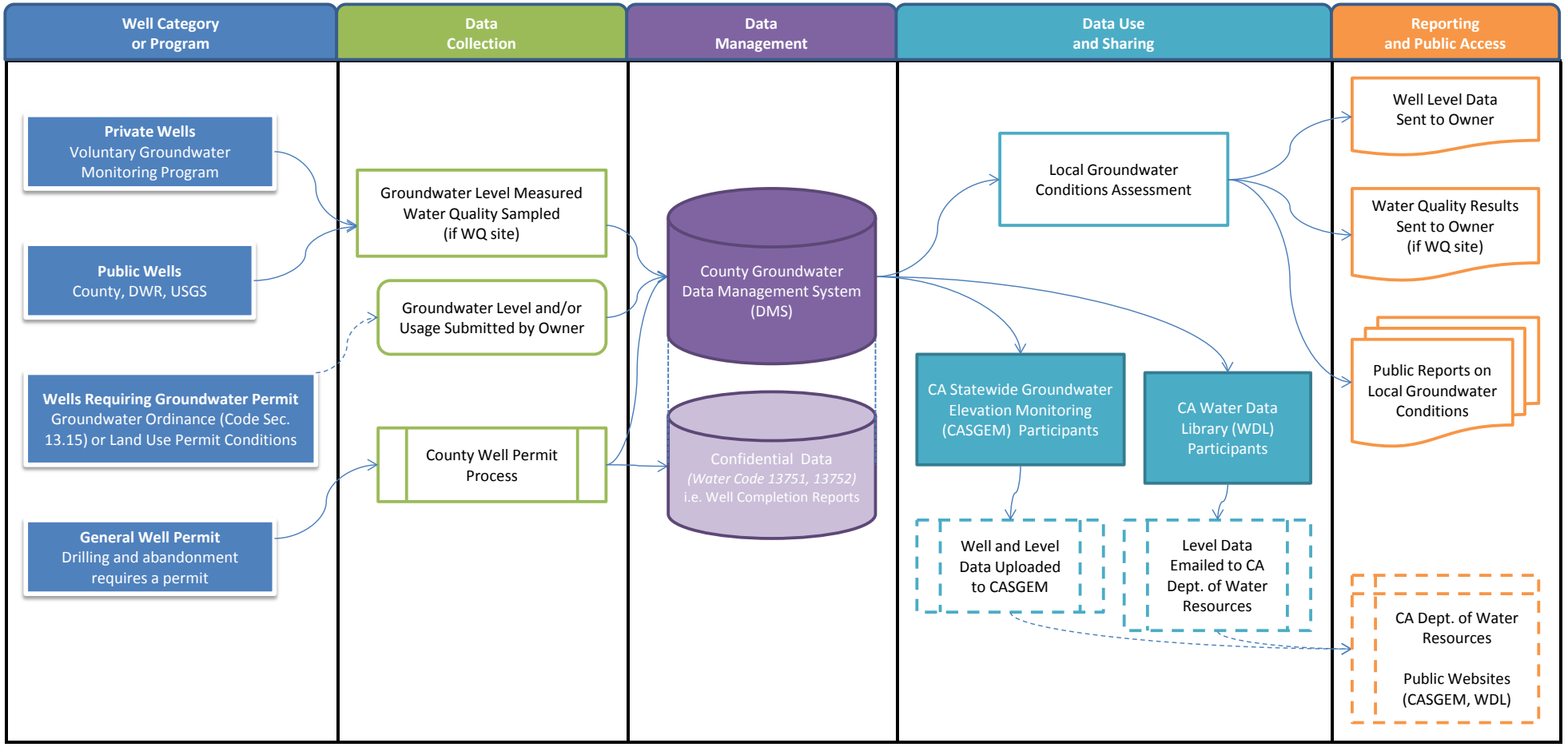
LUHDORFF & SCALMANINI CONSULTING ENGINEERS

Figure 4-2
Current and Proposed Groundwater Quality Monitoring Sites in Napa County

Figure 5-1 Groundwater Data Collection, Management, Use, and Reporting



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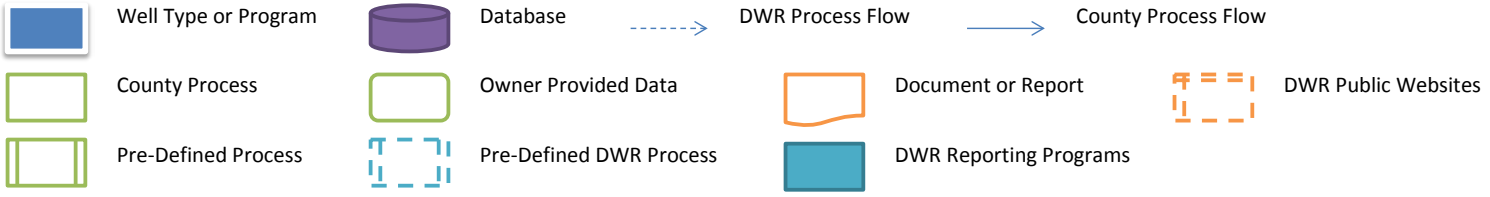

APPENDIX A

Summaries of 2011 and 2013 Groundwater Report Findings and Future Groundwater Level and Quality Monitoring Objectives

Summaries of 2011 and 2013 Groundwater Report Findings and Objectives
Groundwater Level Monitoring Sites, Napa County

Subarea	No. Sites with Current GW Level Data (LSCE and MBK Eng. 2013)	Future Groundwater Level Monitoring		Monitoring Needs	Findings on GW Level Conditions (LSCE, 2011a)	General Comments re Monitoring Needs	Improve understanding of occurrence and movement	Factors affecting levels & trends	Fill Data Gaps	Develop/refine GW budget (include recharge)	Further evaluate sw/gw potential exchange	Potential for saltwater intrusion
		Relative Priority (2011 Prelim)	Action (Expand/ Refine)									
Napa Valley Floor-Calistoga	**6**	**H**	E	**SP, SW**	*Water levels are generally stable and depths to gw are shallow; 156 wells provide data, about 3/4 of the wells have limited records.*	**Need to optimize current monitoring locations to ensure that the existing monitoring locations are adequately distributed throughout the subarea in aquifers of interest.**	**X**	**X**	**X**	**X**	**X**	
Napa Valley Floor-MST	**29**	**H**	R	**SP, SW**	*Wells with records show long term declining water levels; some have a repeating pattern of declining then stabilizing and never recovering, while others have a recent steady continuous decline; 286 wells provide data, half with limited records and more than half measured recently.*	**Need to optimize current monitoring locations to ensure the northern, central, and southern areas of MST have representative distribution of MWs in aquifers of interest. Would provide essential data to assess how existing gw development regulations are effective in managing gw resources in this area.**	**X**	**X**	**X**	**X**	**X**	
Napa Valley Floor-Napa	**18**	**H**	R	**SP, SW**	*Water levels are generally stable except toward the east where declines of 20 feet have been observed close to the northern MST; 273 wells provide data, most with limited records.*	**Need to optimize current monitoring locations to ensure that the existing monitoring locations are adequately distributed throughout the subarea in aquifers of interest.**	**X**	**X**	**X**	**X**	**X**	

Summaries of 2011 and 2013 Groundwater Report Findings and Objectives
Groundwater Level Monitoring Sites, Napa County

Subarea	No. Sites with Current GW Level Data (LSCE and MBK Eng. 2013)	Future Groundwater Level Monitoring		Monitoring Needs	Findings on GW Level Conditions (LSCE, 2011a)	General Comments re Monitoring Needs	Improve understanding of occurrence and movement	Factors affecting levels & trends	Fill Data Gaps	Develop/refine GW budget (include recharge)	Further evaluate sw/gw potential exchange	Potential for saltwater intrusion
		Relative Priority (2011 Prelim)	Action (Expand/ Refine)									
Napa Valley Floor-St. Helena	**12**	**H**	E	**SP, SW**	*Water levels are generally stable and depths to water are shallow; 70 wells provide data, most wells have good records.*	**Need to optimize current monitoring locations to ensure that the existing monitoring locations are adequately distributed throughout the subarea in aquifers of interest.**	**X**	**X**	**X**	**X**	**X**	
Napa Valley Floor-Yountville	**9**	**H**	E	**SP, SW**	*Water levels are generally stable with seasonal fluctuations; fewer wells have data (31 wells) compared to the rest of the Valley Floor, and fewer wells have good records or recent data.*	**Need to optimize current monitoring locations to ensure that the existing monitoring locations are adequately distributed throughout the subarea in aquifers of interest.**	**X**	**X**	**X**	**X**	**X**	
Carneros	**5**	**H**	E	**B**	*No current groundwater level data, but a good record exists for 7 wells with data between 1962 and 1978.*	**Very limited historical data and no current data. Additional data collection is recommended to investigate groundwater conditions under existing development conditions and for any planned additional use of groundwater resources.**	**X**	**X**	**X**	**X**		**X**
Jameson/American Canyon	1	M	E	B	*Limited groundwater level data; all recent data are from regulated facility monitoring wells.*	**Very limited data for the most part, however, short term development of groundwater resources are not anticipated on a significant scale.**	X	X	X	X		X

Summaries of 2011 and 2013 Groundwater Report Findings and Objectives Groundwater Level Monitoring Sites, Napa County

Subarea	No. Sites with Current GW Level Data (LSCE and MBK Eng. 2013)	Future Groundwater Level Monitoring		Monitoring Needs	Findings on GW Level Conditions (LSCE, 2011a)	General Comments re Monitoring Needs	Improve understanding of occurrence and movement	Factors affecting levels & trends	Fill Data Gaps	Develop/refine GW budget (include recharge)	Further evaluate sw/gw potential exchange	Potential for saltwater intrusion
		Relative Priority (2011 Prelim)	Action (Expand/ Refine)									
Napa River Marshes	1	M	E	SP, SW	*Limited groundwater level data; all data are from regulated facility monitoring wells; no historical data pre-2000.*	Very limited data for the most part, however, short term development of groundwater resources are not anticipated on a significant scale.	X	X	X	X		X
Angwin	0	M	E	B	*No current groundwater level data; 10 wells are from one regulated facility site with data over three years; no historical data pre-2002.*	No data; short term development of gw resources are not anticipated on a significant scale.	X	X	X	X		
Berryessa	3	M	E	B	*Limited record and spatial distribution; most wells with data are monitoring wells on three different regulated facilities; no historic data pre-2002.*	Very limited data for the most part, however, short term development of groundwater resources are not anticipated on a significant scale.	X	X	X			
Central Interior Valleys	1	M	E	B	*Limited data; all data from three regulated facilities' monitoring wells; no historical data pre-2002.*	Very limited data for the most part, however, short term development of groundwater resources are not anticipated on a significant scale.	X	X	X			
Eastern Mountains	0	M	E	B	*Limited data and spatial distribution; one well near the MST shows recent declines similar to those found in the MST.*	No data; short term development of gw resources are not anticipated on a significant scale.	X	X	X			

Summaries of 2011 and 2013 Groundwater Report Findings and Objectives Groundwater Level Monitoring Sites, Napa County

Subarea	No. Sites with Current GW Level Data (LSCE and MBK Eng. 2013)	Future Groundwater Level Monitoring		Monitoring Needs	Findings on GW Level Conditions (LSCE, 2011a)	General Comments re Monitoring Needs	Improve understanding of occurrence and movement	Factors affecting levels & trends	Fill Data Gaps	Develop/refine GW budget (include recharge)	Further evaluate sw/gw potential exchange	Potential for saltwater intrusion
		Relative Priority (2011 Prelim)	Action (Expand/ Refine)									
Knoxville	1	M	E	B	*Limited record and spatial distribution; no historic groundwater level data and a very short period of record.*	Very limited data for the most part, however, short term development of groundwater resources are not anticipated on a significant scale.	X	X	X			
Livermore Ranch	0	L	E	B	*No data.*	No data; short term development of gw resources are not anticipated on a significant scale.	X	X	X			
Pope Valley	1	H	E	B	*Limited groundwater level data; all data are from two regulated facilities' monitoring wells; no historical data pre-2002.*	Very limited existing data. Additional data collection is recommended to investigate groundwater conditions for planned use of groundwater resources.	X	X	X			
Southern Interior Valleys	0	L	E	B	*No data.*	No data; short term development of gw resources are not anticipated on a significant scale.	X	X	X			
Western Mountains	0	L	E	B	*No data.*	No data; short term development of gw resources are not anticipated on a significant scale.	X	X	X			
Total	**87**											

Groundwater Level Notes

[1] "Current" refers to monitored sites with wells measured for levels and/or any water quality parameter with a period of record extending to 2011 or later.“Future” refers to recommended monitoring locations.

L = Low Priority; add groundwater level monitoring based on areas of planned future groundwater development

M = Medium Priority; add groundwater level monitoring

H = High Priority; add groundwater level monitoring

E = Expand current monitoring network; possible alternatives for additional monitoring wells include 1) wells historically monitored by DWR/USGS/Others, preferably with well construction information; 2) existing water supply wells (e.g., private/commercial) with well construction information; 3) new dedicated monitoring wells coordinated with recent geologic investigations that are or will be conducted)

R = Refine current monitoring network (link well construction information to all monitored wells, as possible)

Monitoring Needs:
SP = Improve horizontal and/or vertical spatial distribution of data;
SW =identify appropriate monitoring site to evaluate surface water -groundwater recharge/discharge mechanisms;
B = Basic data needed to accomplish groundwater level monitoring objectives

Summaries of 2011 Groundwater Report Findings and Objectives for Groundwater Quality Monitoring Sites, Napa County

Subarea	No. Sites with Current GW Quality Data	Future Groundwater Quality Monitoring		Monitoring Needs	Findings GW Quality Conditions (LSCE, 2011a)	Constits. of Concern	Baseline conditions &spatial differences	Fill Data Gaps	Occurrence & factors related to natural or other constituents	Baseline conditions in areas of potential saltwater intrusion	Assess changes, trends, factors contrib. to change	Other
		Relative Priority (2011 Preilm)	Action (Expand/ Refine)									
Napa Valley Floor-Calistoga	20	M	R	SP,C	*Limited data record, minimal historical record*	*As, B*	X	X	X		X	
Napa Valley Floor-MST	**16**	**H**	R	**SP,C**	*Very limited long-term records*	*As, B, Fe, Mn, Na*	**X**	**X**	**X**		**X**	
Napa Valley Floor-Napa	21	M	R	SP,C	*Generally good water quality; most wells have limited data records and very little historical data*	*Na, As, NO3*	X	X	X		X	
Napa Valley Floor-St. Helena	31	M	R	SP,C	*Generally good water quality; most wells have limited data records and very little historical data*	*As, NO3*	X	X	X		X	
Napa Valley Floor-Yountville	14	M	R	SP,C	*Generally good water quality; most wells have limited data records and very little historical data*	*As, NO3*	X	X	X		X	
Carneros	**9**	**H**	R	**SP,C**	*Limited data record; minimal historic and recent records; poor water quality common; possible increasing recent trend seen in EC, chloride, and TDS*	*Cl, EC, TDS*	**X**	**X**	**X**	**X**	**X**	
Jameson/American Canyon	**3**	**H**	E	**B,SP,C**	*No recent data post-1998; generally poor water quality from a very limited data set; increasing chloride and EC levels*	*Cl, EC, Na, NO3, TDS*	**X**	**X**	**X**	**X**	**X**	

Summaries of 2011 Groundwater Report Findings and Objectives for Groundwater Quality Monitoring Sites, Napa County

Subarea	No. Sites with Current GW Quality Data	Future Groundwater Quality Monitoring		Monitoring Needs	Findings GW Quality Conditions (LSCE, 2011a)	Constits. of Concern	Baseline conditions &spatial differences	Fill Data Gaps	Occurrence & factors related to natural or other constituents	Baseline conditions in areas of potential saltwater intrusion	Assess changes, trends, factors contrib. to change	Other
		Relative Priority (2011 Preilm)	Action (Expand/ Refine)									
Napa River Marshes	6	M	E	B,SP,C	*Very limited long-term records; one well with historic data; generally poor water quality*	*Cl, EC, Na, NO3, TDS*	X	X	X	X	X	
Angwin	4	M	E	B,C	*No historic records; all measurements from two sites (ten wells total); generally good water quality*	*Fe, Mn*	X	X	X		X	
Berryessa	6	M	E	B,C	*Poor coverage for majority of constituents; no long-term records*	*EC, TDS*	X	X	X		X	
Central Interior Valleys	6	M	R	B,SP,C	*No historic records pre-2001; poor coverage for majority of constituents; no long-term data*	*TDS*	X	X	X		X	
Eastern Mountains	25	M	E	B,C	*Limited historic records; poor spatial distribution; generally good water quality*	*Fe, Mn*	X	X	X		X	
Knoxville	0	M	E	B,C	*Limited to one site with five monitoring wells; generally poor quality and no long-term records*	*B, Cl, EC, Na, TDS*	X	X	X		X	
Livermore Ranch	0	L	E	B,C	*No groundwater quality data available*	*unknown*	X	X	X		X	
Pope Valley	6	L	E	B,C	*No historic records; all measurements from two sites (seven wells total); generally good water quality from constituents with data*	*Fe, Mn*	X	X	X		X	

Summaries of 2011 Groundwater Report Findings and Objectives for Groundwater Quality Monitoring Sites, Napa County

Subarea	No. Sites with Current GW Quality Data	Future Groundwater Quality Monitoring		Monitoring Needs	Findings GW Quality Conditions (LSCE, 2011a)	Constits. of Concern	Baseline conditions &spatial differences	Fill Data Gaps	Occurrence & factors related to natural or other constituents	Baseline conditions in areas of potential saltwater intrusion	Assess changes, trends, factors contrib. to change	Other
		Relative Priority (2011 Preilm)	Action (Expand/ Refine)									
Southern Interior Valleys	0	L	E	B,C	*No historic records; poor spatial coverage (only three wells with data); generally good quality*	*As, Na*	X	X	X		X	
Western Mountains	10	L	R	B,C	*Very limited historic and current records (12 wells total); generally good quality*	*Fe, Mn*	X	X	X		X	
Total	**177**											

Groundwater Quality Notes

[1] "Current" refers to monitored sites with wells measured for levels and/or any water quality parameter with a period of record extending to 2008 or later."Future" refers to recommended monitoring locations.

L = Low Priority; add groundwater quality and also level monitoring based on areas of planned future groundwater development

M = Medium Priority; add groundwater quality and also level monitoring

H = High Priority; add groundwater quality and also level monitoring

E = Expand current monitoring network; possible alternatives for additional monitoring wells include 1) wells historically monitored by DWR/USGS/Others, preferably with well construction information and as the well may be available for monitoring; 2) existing water supply wells (e.g., private/commercial) with well construction information; 3) new dedicated monitoring wells (coordinate with potential geologic investigations that may be conducted in selected areas)

R = Refine current monitoring network (link well construction information to all monitored wells, as possible)

Monitoring Needs: SP = Improve horizontal and/or vertical spatial distribution of data; B = Basic data needed to accomplish groundwater level monitoring objectives; C = Coordinate with groundwater level monitoring

Note: Some sites with current groundwater quality data are approximately located and currently may not be counted in the correct subarea. Also, additional sites with current groundwater quality beyond this tabulation exist but the locations are currently unavailable and unable to be counted at this time.

APPENDIX B

Summaries of Current Groundwater Level and Groundwater Quality Monitoring Locations

Summary of Current Groundwater Level Monitoring Locations

	WellID	State Well Number	Year Start	Construction Date (yyyymmdd)	Well Depth (ft)	Hole Depth (ft)	Screen Interval (ft)
Napa Valley Floor-Calistoga	NapaCounty-127	009N007W25N001M	1962	19580310	149	149	unk
	NapaCounty-129	008N006W06L004M	1962	19620719	253	253	unk
	NapaCounty-128	009N006W31Q001M	1962	19620719	50	50	unk
	08N06W10Q001M	008N006W10Q001M	1949		200		unk
	T0605500250MW-1		2005		24.83		10 - 25
	T0605500272MW-1		2008				unk
Napa Valley Floor-St. Helena	NapaCounty-131	007N005W16L001M	1963	193907	221	221	7 - sections
	NapaCounty-132	007N005W14B002M	1962		265	265	25 - 265
	NapaCounty-138	007N005W16N002M	1949		321	321	unk
	07N05W09Q002M	007N005W09Q002M	1949		232		unk
	T0605500061MW-8		2005		20		6 - 20
	T0605500168MW-6		1998		18		3 - 18
	T0605500190MW-1		2001		22.5		7.5 - 22.5
	T0605500190MW-1		2002		18.59		unk
	CityofNapa-BV		2002		unk		unk
	CityofNapa-C1		2002		unk		unk
	CityofNapa-Woods1		2002		unk		unk
	CityofNapa-Woods2		2002		unk		unk
	NapaCounty-133	007N004W31M001M	1978	19720415	120	120	20 - 120

	WellID	State Well Number	Year Start	Construction Date (yyyymmdd)	Well Depth (ft)	Hole Depth (ft)	Screen Interval (ft)
Napa Valley Floor-Yountville	NapaCounty-135	006N004W19B001M	1979	19620720	125	125	unk
	NapaCounty-125	006N004W09Q001M	1979	19710823	160	163	63 - 160
	NapaCounty-126	006N004W09Q002M	1984	19711116	345	345	140 - 345
	NapaCounty-134	006N004W06L002M	1963	19550801	260	264	160 - 260
	NapaCounty-139	006N004W17R002M	1978	19770125	120	120	40 - 120
	NapaCounty-151	006N004W17Ax	2012				unk
	06N04W17A001M	006N004W17A001M	1949		250		unk
	TownofYountville-MW1			20041103	300	320	105 - 300
Napa Valley Floor-Napa	NapaCounty-76	006N004W15R003M	2000				unk
	NapaCounty-75	006N004W22R001M	1978	19710719	205	208	45 - 205
	NapaCounty-136	006N004W27N001M	1979	19620720	120	120	unk
	NapaCounty-152	006N004W28Mx	2012				unk
	06N04W27L002M	006N004W27L002M	1966	19660609	120	122	60 - 120
	05N04W15E001M	005N004W15E001M	1949		158		unk
	SL0605536682MW-1		2005		24		unk
	T0605500008MW-3		2005	20050721	15		3 - 15
	T0605500009MW1		2005	19920301	14		3 - 14
	T0605500044C-4		2002		12.63		10 - 30
	T0605500110KMW-1		2003	19900815	19.65	26	9.5 - 24.5
	T0605500124MW-1		2002		25		unk
	T0605500164EX-1		2003	2002112	37	37	10 - 35

	WellID	State Well Number	Year Start	Construction Date (yyyymmdd)	Well Depth (ft)	Hole Depth (ft)	Screen Interval (ft)
	T0605500212MW-1		2003		20	21.5	4 - 20
	T0605514064MW1		2005				unk
	T0605547200MW-1		2008				unk
	T0605575085MW-1		2009				unk
	T0605598080MW-1		2005				unk
Napa Valley Floor-MST	NapaCounty-118	005N003W07B00_My	2001			0	unk
	NapaCounty-122	006N004W26L00_M	2001			0	unk
	NapaCounty-142	006N004W25G00_M	2001			0	unk
	NapaCounty-149	005N003W08E00_M	2010				unk
	NapaCounty-18	005N004W13G004M	2000	19760714	189	210	unk
	NapaCounty-22	005N003W08E001M	2000	19680416	135	140	unk
	NapaCounty-29	005N004W01F003M	2000			0	unk
	NapaCounty-35	005N003W18D001M	2000			0	unk
	NapaCounty-4	006N004W14Q001M	2000	19890913	385	390	unk
	NapaCounty-51	006N004W25G001M	2000			0	unk
	NapaCounty-69	006N004W35G005M	2000			0	unk
	NapaCounty-72	005N003W07D003M	2000	19971007	245	245	unk
	NapaCounty-81	005N003W07F003M	2000	19880725	290	290	unk
	NapaCounty-98	006N004W36A001M	2000			0	unk
	NapaCounty-10	005N003W05M001M	1979		320		unk
	NapaCounty-148	005N003W05M00_M	2009	20090805			unk

	WellID	State Well Number	Year Start	Construction Date (yyyymmdd)	Well Depth (ft)	Hole Depth (ft)	Screen Interval (ft)
	NapaCounty-2	006N004W23J001M	1979		700		unk
	NapaCounty-20	005N003W07C003M	1978	19771208	208	208	130 - 207
	NapaCounty-56	006N004W26G001M	1978	19760828	210	210	30 - 210
	NapaCounty-95	006N004W36G001M	1979	19770110	195	340	155 - 185
	NapaCounty-137	005N004W13H001M	1979	19620716	364	364	unk
	NapaCounty-43	006N004W23Q003M	1978		310		unk
	NapaCounty-49	005N004W14J003M	1989		399		unk
	NapaCounty-74	005N003W06M001M	1999	19880818	300	300	unk
	NapaCounty-91	005N003W06B002M	1992	19860815	415	415	315 - 415
	NapaCounty-92	005N003W06A001M	1999		368	0	unk
	L10002804480DW-1		2005				unk
	T0605500138S-3		2003	20030428	30	30	4 - 15
	T0605500140MW-1		2000	19910119	24.86	26	11 - 26
Carneros	NapaCounty-150	004N004W05C001M	2011		155		unk
	NapaCounty-153	004N004W05A001M	2012	19780508	200	210	60 - 200
	NapaCounty-154	005N004W31R001M	2012	19900828	300	320	60 - 295
	NapaCounty-155	004N004W06M001M	2012	20030813	220	220	80 - 220
	04N04W05D002M	004N004W05D002M	1951		60		unk
Jameson/ American Canyon	T0605500240MW-4		2007		14.5		unk
Napa River Marshes	L10002804480DW-2		2005				unk

	WellID	State Well Number	Year Start	Construction Date (yyyymmdd)	Well Depth (ft)	Hole Depth (ft)	Screen Interval (ft)
	NBRID_MW2		2007				unk
	T0605500304MW-1		2002				unk
Berryessa	T0605591908MW-1		2006		34		unk
Central Interior Valleys	T0605500279MW1		2002				unk
Knoxville	LBRID_MW1		2006				unk
Pope Valley	T0605593602MW-1		2002				unk

Summary of Current Groundwater Quality Monitoring Locations

	WellID	SRC	SYS_NO	SITE_TYPE
Napa Valley Floor - Calistoga	2800026	DPH	TRINCHERO WINERY	
	2800030	DPH	ENVY WINES	
	2800508	DPH	CUVAISON VINEYARD	
	2800516	DPH	TUCKER ACRES MUTUAL WATER CO.	
	2800555	DPH	TWOMEY CELLARS	
	2800587	DPH	DUFFY S MYRTLEDALE RESORT	
	2800648	DPH	WINE COUNTRY INN	
	2800741	DPH	ST. HELENA PREMIUM OUTLETS	
	2800742	DPH	GOLDEN HAVEN MOTEL	
	2801004	DPH	CHATEAU MONTELENA WINERY	
	2801007	DPH	CLOS PEGASE WINERY	
	2801015	DPH	FRANK FAMILY VINEYARDS	
	2802715	DPH	NORMAN ALUMBAUGH CO., INC.	
	2810002	DPH	CALISTOGA, CITY OF	
	2810300	DPH	CSP-BALE GRIST MILL STATE PARK	
	L10001344067B-11	Geotracker	L10001344067	
	T0605500196MW-1	Geotracker	T0605500196	
	T0605500250MW-1	Geotracker	T0605500250	
	T0605500259EB1	Geotracker	T0605500259	
	T0605500272EB	Geotracker	T0605500272	
Napa Valley Floor - St. Helena	2800027	DPH	NICKEL & NICKEL WINERY	
	2800035	DPH	RIVER RANCH FARM WORKER CENTER	
	2800536	DPH	GRGICH HILLS	
	2800556	DPH	BROKEN HILL 1 LLC	
	2800562	DPH	FRANCISCAN WINERY	

	WellID	SRC	SYS_NO	SITE_TYPE
	2800589	DPH	WHITEHALL LANE WINERY	
	2800609	DPH	PHELPS VINEYARDS	
	2800749	DPH	KENT RASMUSSEN WINERY	
	2801012	DPH	ALPHA AND OMEGA WINERY	
	2801022	DPH	MILAT WINERY	
	2801026	DPH	OPUS ONE WINERY	
	2801027	DPH	PEJU PROVINCE	
	2801031	DPH	RAYMOND VINEYARD & CELLAR	
	2801037	DPH	SEQUOIA GROVE VINEYARDS	
	2801038	DPH	SILVER OAKS WINE CELLARS	
	2801045	DPH	ST. CLEMENT VINEYARDS INC.	
	2801046	DPH	ST. SUPERY WINERY	
	2801049	DPH	THE RANCH WINERY	
	2801070	DPH	BERINGER VINEYARDS	
	2801073	DPH	PROVENANCE VINEYARDS	
	2801075	DPH	CAKEBREAD CELLAR	
	2801088	DPH	V. SATTUI WINERY	
	2803886	DPH	RUTHERFORD GROVE WINERY	
	2803912	DPH	BEAULIEU VINEYARD	
	2810004	DPH	ST. HELENA, CITY OF	
	L10003472156MW-1	Geotracker	L10003472156	
	SL0605506371MW-1	Geotracker	SL0605506371	
	T0605500061EW-1	Geotracker	T0605500061	
	T0605500143MW-1	Geotracker	T0605500143	
	T0605500168EW-1	Geotracker	T0605500168	
	T0605500190MW-1	Geotracker	T0605500190	
	2800299	DPH	FAR NIENTE WINERY	

	WellID	SRC	SYS_NO	SITE_TYPE
Napa Valley Floor - Yountville	2800302	DPH	HARTWELL WINERY	
	2800557	DPH	CASTLE TROVE, INC.	
	2800736	DPH	DOMAINE CHANDON	
	2801006	DPH	CLOS DU VAL WINE CO.	
	2801010	DPH	COSENTINO WINERY	
	2801028	DPH	CARDINALE ESTATE	
	2801029	DPH	PINE RIDGE WINERY	
	2801041	DPH	SILVERADO VINEYARDS	
	2801042	DPH	SINSKEY WINERY	
	2801047	DPH	STAG S LEAP WINE CELLARS	
	2801077	DPH	CHIMNEY ROCK WINERY	
	2803911	DPH	DOMINUS ESTATE WINERY	
	2810007	DPH	TOWN OF YOUNTVILLE	
Napa Valley Floor - Napa	2800635	DPH	STRACK W.D. WATER	
	2801020	DPH	ESPINOZA WATER SYSTEM	
	SL0605536682MW-1	Geotracker	SL0605536682	
	T0605500008BC-1	Geotracker	T0605500008	
	T0605500009EW-1	Geotracker	T0605500009	
	T0605500044C-4	Geotracker	T0605500044	
	T0605500110MW-1	Geotracker	T0605500110	
	T0605500124MW-1	Geotracker	T0605500124	
	T0605500164EFF	Geotracker	T0605500164	
	T0605500165EFF	Geotracker	T0605500165	
	T0605500212MW-1	Geotracker	T0605500212	
	T0605500256MW-1	Geotracker	T0605500256	
	T0605500261MW-2	Geotracker	T0605500261	
	T0605514064MW1	Geotracker	T0605514064	

	WellID	SRC	SYS_NO	SITE_TYPE
	T0605522317DP-1	Geotracker	T0605522317	
	T06055472002285DW	Geotracker	T0605547200	
	T0605575085B-1	Geotracker	T0605575085	
	T0605591205MW-1	Geotracker	T0605591205	
	T0605597251K-1	Geotracker	T0605597251	
	T0605598080MW-1	Geotracker	T0605598080	
	05N04W15E001M	DWR	005N004W15E001M	Dom_Irr
Napa Valley Floor - MST	2800025	DPH	HAGAFEN CELLARS	
	2800548	DPH	SILVERADO PINES MOBILE HOME	
	2800554	DPH	GENE NORRIS PLAZA	
	2800564	DPH	SODA CANYON STORE	
	2800580	DPH	SYAR INDUSTRIES	
	2800717	DPH	NAPA PIPE REDEVELOPMENT PARTNERS	
	2800848	DPH	NVUSD: MT. GEORGE SCHOOL	
	2801039	DPH	SILVERADO HILL CELLARS	
	2801055	DPH	WILLIAM HILL WINERY	
	2801081	DPH	MT. GEORGE ESTATES	
	T0605500007BC-10	Geotracker	T0605500007	
	T0605500135UST-GW	Geotracker	T0605500135	
	T0605500138DM-1	Geotracker	T0605500138	
	T0605500140MW-1	Geotracker	T0605500140	
	T0605500166DW-1019	Geotracker	T0605500166	
	T10000000413MW-1	Geotracker	T10000000413	
Carneros	2800538	DPH	CARNEROS INN	
	2800847	DPH	NVUSD: CARNEROS SCHOOL	
	2801002	DPH	ETUDE WINES	

	WellID	SRC	SYS_NO	SITE_TYPE
	2801011	DPH	DOMAINE CARNEROS	
	2801089	DPH	DI ROSA ART PRESERVE	
	T0605517802MW-1	Geotracker	T0605517802	
	04N04W05C001M	DWR	004N004W05C001M	Unk_GW
	04N04W05D002M	DWR	004N004W05D002M	Dom
	04N04W04C002M	DWR	004N004W04C002M	Unk_GW
Jameson/American Canyon	T0605500012MW 1	Geotracker	T0605500012	
	T0605500077MW-1	Geotracker	T0605500077	
	T0605500240MW-4	Geotracker	T0605500240	
Napa River Marshes	2800530	DPH	MEYERS WATER CO.	
	2800531	DPH	MOORE S RESORT	
	2800592	DPH	NAPA VALLEY MARINA	
	2800811	DPH	ACACIA WINERY	
	2801080	DPH	MILTON ROAD WATER COMPANY	
	L10002804480DUP-1	Geotracker	L10002804480	
Angwin	2800527	DPH	LINDA FALLS TERRACE MUTUAL	
	2800528	DPH	LINDA VISTA MUTUAL WATER CO	
	2801936	DPH	O SHAUGHNESSY WINERY	
	2810001	DPH	HOWELL MOUNTAIN MUTUAL WATER COMPANY	
Berryessa	2800129	DPH	STERLING VINEYARDS	
	T0605500257061808	Geotracker	T0605500257	
	T0605500298MW-1	Geotracker	T0605500298	
	T0605500304	Geotracker	T0605500304	
	T0605500312EFF	Geotracker	T0605500312	
	T0605591908B-10	Geotracker	T0605591908	

	WellID	SRC	SYS_NO	SITE_TYPE
Central Interior Valleys	2800297	DPH	CATACULA LAKE WINERY	
	2800521	DPH	CIRCLE WATER DISTRICT	
	2800584	DPH	LAS POSADAS 4-H CAMP	
	2800593	DPH	R RANCH AT THE LAKE	
	T0605500279MW1	Geotracker	T0605500279	
	T0605592744MW-1	Geotracker	T0605592744	
Eastern Mountains	2800023	DPH	RUTHERFORD HILL MUTUAL WATER	
	2800024	DPH	DUCKHORN VINEYARDS	
	2800029	DPH	AUGUST BRIGGS WINERY	
	2800298	DPH	DBA SILVER ROSE CELLARS	
	2800525	DPH	LA TIERRA HEIGHTS MUTUAL	
	2800532	DPH	VAILIMA ESTATES MUTUAL WATER	
	2800561	DPH	FREEMARK ABBEY PROPERTIES	
	2800575	DPH	CALISTOGA RANCH	
	2800583	DPH	WELCOME GRANGE HALL	
	2800588	DPH	NAPA VALLEY COUNTRY CLUB	
	2800625	DPH	ST. HELENA HOSPITAL	
	2800719	DPH	MUND S MOBILE HOME PARK	
	2801009	DPH	CONN CREEK WINERY	
	2801014	DPH	RUDD WINES, INC., DBA RUDD	
	2801024	DPH	MUMM OF NAPA VALLEY	
	2801033	DPH	ROMBAUER VINEYARDS	
	2801035	DPH	ROUND HILL WINERY	
	2801043	DPH	SKYLINE PARK	
	2801056	DPH	Z D WINES	
	2801076	DPH	CAYMUS VINEYARDS	
	2801084	DPH	RUTHERFORD HILL WINERY	

	WellID	SRC	SYS_NO	SITE_TYPE
	2801086	DPH	STAGS LEAP WINERY	
	2803697	DPH	STELTZNER WINERY	
	2803879	DPH	JARVIS VINEYARD	
	2803907	DPH	MINER FAMILY WINERY	
Pope Valley	2800569	DPH	AETNA SPRINGS GOLF COURSE	
	2800970	DPH	HOWELL MTN SCHOOL	
	2810012	DPH	PACIFIC UNION COLLEGE	
	T0605593602021909	Geotracker	T0605593602	
	T10000000436MW-1	Geotracker	T10000000436	
Southern Interior Valleys	2800845	DPH	NVUSD: WOODEN VALLEY SCHOOL	
Western Mountains	2800301	DPH	LAIRD FAMILY ESTATE	
	2800613	DPH	LOKOYA REDWOODS	
	2800621	DPH	MAYACAMAS VINEYARDS	
	2801008	DPH	ARTESA VINEYARDS & WINERY	
	2801016	DPH	HESS WINERY	
	2801036	DPH	SCHRAMSBERG WINERY	
	2801054	DPH	WHITE SULPHUR SPRINGS RESORT	
	2810301	DPH	CSP-BOTHE-NAPA STATE PARK	
	2800032	DPH	TERRA VALENTINE	

APPENDIX C

Napa County Procedure for Measuring Groundwater Levels

NAPA COUNTY PROCEDURE FOR MEASURING

THE DEPTH TO WATER IN MONITORING AND PRODUCTION WELLS

Purpose

To obtain an accurate dated and timed measurement of the static depth to water in a well that can be converted into a water level elevation in reference to a commonly used reference datum (e.g., NAVD 1988). In this context, static means that the water level in the well is not influenced by pumping of the well. For comparability, measurements should be obtained according to an established schedule designed to capture times of both highest and lowest seasonal water level elevations. Also for comparability, measurements during a particular field campaign should be obtained consecutively and without delay within the shortest reasonable time.

Measurement Procedure

- If well is being pumped, do not measure (see below "Special Circumstances – Pumping Water Level on Arrival" for additional instructions).
- Turn on water level indicator signaling device and check battery by hitting the test button.
- Remove access plug or well cap from the well cover and lower probe (electric sounder) into the well.
- When probe hits water a loud "beep" will sound and signal light will turn red.
- Retract slightly until the tone stops.
- Slowly lower the probe until the tone sounds.
- Note depth measurement at rim (i.e., the surveyed reference point for water level readings) of well to the nearest 0.01 foot and rewind probe completely out of well.
- Remove excess water and lower probe once again into well and measure again.
- If difference is within ±0.02 foot of first measurement, record measurement.
- If difference is greater repeat the same procedure until three consecutive measurements are recorded within ± 0.02 foot.
- Rewind and remove probe from well and replace the access plug or well cap in the well cover.
- Clean and dry the measuring device/probe and continue to next well.

Special Circumstances

Oil Encountered in Well

If oil is detected in the well structure, the depth to the air-oil interface is measured. To obtain such a measurement, the electric sounder is used similar to the way chalked steel tapes were traditionally used for depth-to-water measurements.

1. Lower the cleaned probe well below the air-oil interface (e.g., 1 foot). Read and record the depth at the reference point (since this depth is chosen somewhat arbitrarily by the field technician, an even number can be chosen, e.g., 37.00 feet). This measurement is the length of cable lowered into the well and corresponds to a line that the oil leaves on the probe or cable (i.e., the oil inundation line). Above this line, smudges of oil may appear on the cable. Below this line, the cable/probe is completely covered with oil. If the probe is lowered too far, completely penetrates the oil, and is far submerged in the water below the oil, parts of the probe/cable below the oil inundation line may also appear smudgy.
2. Retrieve probe, identify and record the oil inundation line on the cable (e.g., 2.72 feet). This measurement does not reflect the thickness of the oil. It reflects the length of the cable below the air-oil interface.
3. Compute the depth to oil by subtracting the length of line below the air-oil interface from the corresponding measurement at the reference point: Depth to oil = 37.00 feet – 2.72 feet = 34.28 feet.

Since oil has a slightly smaller density than water, a depth-to-oil measurement will always be smaller than a corresponding depth-to-water measurement in the same well if oil were not present. Depth-to-oil measurements yield a reasonable approximation to depth-to-water measurements unless the oil thickness is great. For each foot of oil in the well casing, the depth-to-oil measurement will be approximately 0.12 foot smaller than a corresponding depth-to-water measurement if oil were not present.

Pumping Water Level on Arrival

If well is being pumped, do not measure. Return later when the water level has stabilized. Using past field notes, the field technician will use his/her experience to determine the appropriate duration necessary for static measurements. Upon returning to the well site (at a location where pumping was previously noted on the same day), the technician will measure the water level. The technician will have available historical water level data to determine whether the measurement is consistent with past measurements. If the initial measurement appears anomalous, the technician will measure water levels every 10 minutes over a period of 30 minutes. If measurements vary significantly from past measurements (taking into account seasonal variations), the technician will note the circumstances (i.e., the date and time when the well was first visited, total time it was pumping (if known), when it was shutoff, when the technician returned, and subsequent water level measurements [on the same day, or as the case may be based on experience, the day immediately following]). Subsequent consideration of pumping effects at a site-specific well location will be addressed as necessary.

Recordation

1. Name of field technician
2. Unique identification of well
3. Weather and site conditions (e.g., clear, sunny, strong north wind, intense dust blowing over wellhead from nearby plowed field; dry ground, easy access)
4. Condition of well structure (e.g., well cap cracked – replaced with new one; wasp hive between well casing and well housing; no action, discuss with project manager)
5. Time and date of depth-to-water reading
6. Any other pertinent comments (e.g., sounder hangs up at 33 feet, thus no measurement; or: fifth measurement of ~55.68 feet in a row…residual water in end cap?; or: oil in well…measurement is depth to oil; or: intense sulfur odor upon opening well cap; or: nearby (west ~100 feet) irrigation well pumping)

CALIFORNIA STATEWIDE GROUNDWATER ELEVATION MONITORING
(CASGEM)

STATE OF CALIFORNIA DEPARTMENT OF WATER RESOURCES

GROUND WATER LEVEL MEASUREMENTS

Monitoring Entity: Napa County
Monitoring Period:_____
Measuring Agency Number: 3983
Measured By:_____

STATE WELL NUMBER	COUNTY WELL ID	MSRMNT DATE	R.P. ELEVATION (NAVD88 ft)	DIST. R.P. TO WATER	METHOD OF WATER DEPTH MSRMNT	MSRMNT QUALITY CODES[1]	MSRMNT TIME	COMMENTS

1 **MEASUREMENT QUALITY CODES:**

- If **no** measurement is taken, a specified "no measurement" code, must be recorded.
  0. Discontinued 1. Pumping 2. Pumphouse locked 3. Tape hung up 4. Can't get tape in casing 5. Unable to locate well 6. Well destroyed 7. Special 8. Casing leaking or wet 9. Temporarily inaccessible D. Dry well F. Flowing well
- If the quality of a measurement is **uncertain**, a "questionable measurement" code can be recorded.
  0. Caved or deepened 1. Pumping 2. Nearby pump operating 3. Casing leaking or wet 4. Pumped recently 5. Air or pressure gauge measurement 6. Other 7. Recharge operation at nearby well 8. Oil in casing 9. Acoustical sounder measurement

APPENDIX D

Example Field Sheet for Groundwater Quality Sampling

FIELD PURGE DATA
Monitoring Wells

Client: _____ Date: _____

Project: _____ Project No.: _____

Well ID: _____ Measured By: _____

TOTAL WELL DEPTH (ft)		CASING DIAMETER (in)		STICKUP (ft)		STATIC WATER LEVEL (ft)	
		PVC / Steel					
STANDING WATER COLUMN (ft)	x	0.16 (for 2" casing); 0.37 (for 3" casing) 0.65 (for 4" casing); 1.0 (for 5" casing) 1.47 (for 6" casing); 2.61 (for 8" casing) 4.08 (for 10" casing); 5.88 (for 12" casing) 10.45 (for 16" casing); 16.32 (for 20" casing)	=	WET CASING VOLUME, Vc (gal)		3 Vc (gal)	

Clock Time	Pumping Time (min)	Pump Rate (Hz)	Flow Rate (gpm)	Cumulative Flow (gals)	DTW (ft)	Temp (°F / °C)	pH	Sp. Cond. at 25°C (µs/cm)	Turbidity (NTU)	DO (mg/L)	ORP (milliVolt)	Observations (redox, color, odor, etc.)

Water Sample Collection (number of bottles and sample I.D.)