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List of Acronyms and Abbreviations

µg/L	microgram per liter
µs/cm	microsiemens per centimeter
AF	acre-feet
AFY	acre-feet per year
AGR	agricultural supply
BGS	below ground surface
BMPs	Best Management Practices
CAFO	Concentrated Animal Feeding Operation
CDPH	California Department of Public Health
CECs	constituents of emerging concern
County	Lassen County
CS	City of Susanville
CUWCC	California Urban Water Conservation Council
CWA	Clean Water Act
DWR	California Department of Water Resources
EC	Electrical conductivity
GAMA	Groundwater Ambient Monitoring and Assessment
GIS	geographic information system
GPD	gallons per day
GPM	gallons per minute
HLVRCD	Honey Lake Valley Resource Conservation District
IRWM	Integrated Regional Water Management
LC	Lassen County
LCDEH	Lassen County Department of Environmental Health
LIC	Lassen Irrigation Company
LID	Low Impact Development
MCL	Maximum Contaminant Level
mg/L	milligrams per liter
MOU	Memorandum of Understanding
MUN	municipal supply
N	nitrogen
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resource Conservation Service
Plans	Salt and Nutrient Management Plans
Porter-Cologne	Porter-Cologne Water Quality Act
RWQCB	California Regional Water Quality Control Board –Lahontan Region
SAC	Stakeholder Advisory Committee
SIR	Susanville Indian Rancheria
SMCL	Secondary Maximum Contaminant Level
SSURGO	Soil Survey Geographic
Study Area	Lahontan Basins Region
SWRCB	State Water Resources Control Board
TDS	Total Dissolved Solids
TMDL	Total Maximum Daily Load
TWG	Technical Working Group
USGS GAMA	United State Geological Survey Groundwater Ambient Monitoring and Assessment Program
WDR	Waste Discharge Requirement

1. Introduction

This salinity and nutrient study is designed to establish the baseline water quality conditions within the Lahontan Basins IRWM area. As part of this study, various websites and databases were evaluated including those from Lassen County Department of Public Health, Division of Environmental Health (LCDEH); the California Department of Water Resources (DWR); the California Regional Water Quality Control Board – Lahontan Region (RWQCB); the USGS Groundwater Ambient Monitoring and Assessment (GAMA) Program; the University of California Davis, Cooperative Extension, Lassen County; Lassen Irrigation District; and many others. A search of these websites and databases indicated no readily discernible salt and nutrient management plans within the Lahontan Basins IRWM area. However, the RWQCB has issued many waste discharge requirements (WDRs) to municipal, industrial, agricultural users of surface water and groundwater which limit the discharge of salts and nutrients within the Lahontan Basins IRWM area. These WDRs and local efforts will be integral parts of a future salt and nutrient management plan for the Lahontan Basins IRWM area.

This Salt and Nutrient Management Plan evaluates the Honey Lake Groundwater Basin (6-4)

1.1. Related Efforts

1.1.1. Recycled Water Policy

On May 14, 2009, the State Water Board passed the Recycled Water Policy (Policy) (State Water Board Resolution No. 2009-0011). The Policy requires the development of salt/nutrient management plans for all groundwater basins in California within five years of passage, regardless of whether recycled water is currently being used within the basin. The Lahontan Basins SNMP must be completed before new recycled water projects in the basin may be permitted. The information developed in this study and the work with the State Water Board will provide a starting point for stakeholder participation and additional technical analysis needed to complete recycled water projects.

1.1.2 USGS GAMA

The USGS GAMA Program was created by the State Water Board to provide a comprehensive groundwater-quality baseline for the State of California. The program is a comprehensive assessment of statewide groundwater quality designed to improve ambient groundwater-quality monitoring and to increase the availability of information about groundwater quality to the public. The GAMA program includes the Priority Basin Project, conducted by the USGS in collaboration with the State Water Board and Lawrence Livermore National Laboratory.

The Lahontan IRWM area does not fall within a GAMA Priority Basin study unit. The GAMA program is designed to provide a statistically robust characterization of untreated-groundwater quality in the primary aquifer at the basin-scale. A GAMA search was performed for the Honey Lake Valley Groundwater Basin resulting in a total of 155 wells with results above comparison concentration. Samples were collected from 2005 through 2010 from these grid wells for analysis of 241 constituents. Using these data, grid-based and spatially-weighted approaches were used to assess proportions (aquifer-scale proportions) of high, moderate, and low relative-concentrations of constituents and constituent classes in the primary aquifer.

The GAMA data indicated that the concentrations of many constituents were related to depth and groundwater age. However, concentrations of individual constituents or constituent classes also were sometimes related to geochemical conditions, lateral position in the flow system, or land use. The decrease in concentrations of many constituents with depth reflects, in part, that groundwater generally gets older with depth beneath the Lahontan Basins IRWP area. Nitrate, VOC, herbicide, and perchlorate concentrations were significantly higher in groundwater having modern and mixed ages than pre-modern ages, indicating that these constituents may be affected by anthropogenic activities in the last 50 years.

The GAMA data indicated that generally, there were many similarities in groundwater quality spatially across the study unit. However, some variations in groundwater quality between study areas were evident, most likely as a result of differences in land use, lateral position, redox, and pH. High concentrations of arsenic and manganese occurred in the northern area of the Honey Lake Valley study; this pattern reflects that groundwater becomes more reducing in the northern part of the study unit. Concentrations of uranium and TDS also increased from north to south across the study unit, probably reflecting several processes that vary with valley position.

1.2 Water-Bearing Formations

The Lahontan Basins IRWM area covers the entire Honey Lake Valley groundwater basin and the adjacent Long Valley, Bull Flat, Secret Valley, and Willow Creek Valley groundwater basins (see Figure 1). The median depth to water the Honey Lake Valley groundwater basin is approximately 20.4 feet bgs (GAMA, GeoTracker). Holocene sedimentary deposits, Pleistocene lake and near-shore deposits, and Pleistocene and Plio-Pleistocene volcanic rocks comprise the Honey Lake Valley Groundwater Basin aquifer system. These aquifer systems are discussed in the following paragraphs.

Holocene Sedimentary Deposits. These deposits consist of intermediate alluvium, alluvial fans, and basin deposits that partly fill the structural depression underlying Honey Lake Valley. The alluvial deposits contain poorly sorted silt, sand, and gravel that accumulate near the rim of the

basin and along perennial streams where they enter the valley. The permeability of these deposits is moderate and, due to their limited thickness (up to 100 feet), yield small amounts of water.

The alluvial fans consist of poorly sorted deposits ranging in size from clay to boulders that interfinger with fine-grained lake deposits toward the center of the basin. These deposits have moderate to high permeability and may reach a thickness of 300 feet. The fans have limited areal extents along the southern perimeter of the basin. The fans yield large amounts of confined and unconfined groundwater.

The finer-grained basin deposits consist of poorly consolidated, bedded sand, silt, and clay deposited near the center of the basin. The basin deposits interfinger with the alluvial deposits. The deposits are generally thin, have low permeability, and are considered a poor source of water.

Underlying the Holocene sedimentary deposits are Pliocene semiconsolidated sedimentary and pyroclastic deposits of tuffaceous silt, clay, diatomite, sand, and pyroclastic air-fall and water-laid volcanic tuffs. The thickness is over 4,500 feet between Litchfield and Herlong and thins toward the edge of the basin. The deposits generally have low permeability.

Pleistocene Lake and Near-Shore Deposits. Lake and near-shore deposits reach a thickness up to 700 feet. The lake deposits contain a number of highly permeable sand beds in the area northwest of Honey Lake where they are important sources of groundwater. Lake deposits found east of Honey Lake and north of Herlong consist mainly of silt and clay with low permeability and are a poor source of groundwater.

The near-shore deposits are coarse-grained and form a continuous belt around the edge of the valley. The deposits are highly permeable and yield large amounts of water where saturated.

Plio-Pleistocene and Pleistocene Volcanic rocks. These volcanic rocks consist of jointed volcanic flows of the Modoc Plateau, which generally have scoriaceous tops and bottoms and dense interiors. They are found in the north and east side of the basin. This unit has moderate to high permeability and is an important confined aquifer in the northwestern and northeastern portions of the valley. The lava flows also serve as important recharge areas.

1.3 Groundwater Hydrogeology/Levels/Movement

Groundwater recharge in Honey Lake Valley occurs through direct precipitation, infiltration of stream flows, and precipitation that infiltrates basalt north of the valley and then percolates laterally to beneath the valley floor. (DWR 1963). Upland recharge areas consist of Pleistocene Volcanic Rocks, recharge occurs as precipitation infiltrates the volcanic rocks and then percolates laterally beneath the valley floor. Subsurface flow may also enter Honey Lake Valley from Secret Valley through Pliocene Lake Deposits, which may be continuous beneath volcanic rocks separating the valleys (DWR, 1963). Groundwater storage capacity to a depth of 750 feet

has been estimated to be about 16,000,000 acre-feet, however much of this storage is not available for use due to water quality impairments (DWR, 1963). Characterization of aquifer properties completed by Berger in 2004 indicate that transmissivity in Dry Valley is 1,200 to 1,500 square feet per day, the hydraulic gradient ranges from 0.003 to 0.005 foot per foot, and subsurface outflow to the Long Valley portion of the Honey Lake Groundwater Basin is estimated to be 50 to 250 acre-feet per year.

Hydrographs in Figure 15 at the end of this section show that groundwater levels in Honey Lake Valley exhibit different trends in different areas. Hydrographs for wells along the California/Nevada state line show that groundwater levels do not fluctuate seasonally in that area. Hydrographs for wells in the northwestern portion of the valley show that the groundwater table is influenced by summer pumping and that groundwater fluctuates from five to 30 feet annually. Groundwater in the northwest portion of the valley also is affected by drought periods, showing changes in spring groundwater levels of 20 feet over the period from 1987 to 1991 as compared to preceding and subsequent years. Hydrographs in the area near Herlong do not appear to be affected by drought periods, but instead show a continued decline in groundwater levels of 20 feet during period from 1984 through 2005.

Figure 15 also shows that agricultural land use is concentrated in the western and northwestern portions of the valley. The areas with groundwater mixed source (surface and groundwater) supplies are the areas that show annual fluctuations in groundwater, which is consistent with summer groundwater withdrawals.

Groundwater movement is largely controlled by topography in Honey Lake Valley, generally moving towards Honey Lake. Long Valley Creek is a losing stream (surface water moves downward through the streambed and recharges groundwater) as it crosses Honey Lake Valley. The Susan River, Gold Run Creek, and Baxter creek are gaining streams (groundwater moves upward through the streambed and contributes to stream flow) within Honey Lake Valley. Unconfined groundwater in the vicinity of Herlong appears to be recharged by Long Valley Creek (USGS, 1963). Phreatophyte evapotranspiration accounts for a significant amount of groundwater use in the basin (Mayo, 1992)

Groundwater movement in Honey Lake Valley may also be affected by structural features. Honey Lake Valley is bounded by faults and faults are also present inside Honey Lake Valley, concealed under Holocene Lake Deposits. Holocene Lake Deposits are not displaced at the surface, likely due to emplacement after fault movement. Some faults may act as conduits for upward migration of thermal water (DWR, 1963). Because the faulting is so extensive, additional research and compilation of existing studies should be undertaken to understand its effects on groundwater flows (Grose, 2004).

1.4 Occurrence of Surface Water

Honey Lake Valley is similar to other valleys of the Great Basin in its physiography and its agricultural land and water use. Most development of the surface water and ground water has been in the western, less arid pan of the study area, but ground water also is used to irrigate about 1,800 acres of alfalfa and pasture in the eastern part of the basin at Fish Springs Ranch. In 2000, surface water supplies made up 61 percent of water supplies in Lassen County, while groundwater supplies made up 35 percent of water supplies.

The hydrologic characteristics of the region's rivers and streams vary depending on the watershed of origin, area-elevation relationships, and snowfall accumulation patterns. The Susan River flows easterly to Honey Lake and Long Valley Creek flows from Upper Long Valley north into Honey Lake. Honey Lake, the largest lake in region and receives water from the Susan River, Long Valley Creek, Baxter Creek, and Willow Creek.

Susan River

Flows on the Susan River are high in the spring and lower in the summer and fall. Average monthly flows are over 100 cfs in February through May, and below 50 cfs in August through November. Rainfall increases at the three weather stations in November and December without a corresponding increase in Susan River flows over the same period, likely due to accumulation of the precipitation as snowpack. In April and May, the snowpack melts, increasing flow volumes on the Susan River.

Long Valley Creek

Long Valley Creek flows from the south to the north into Honey Lake. Long Valley Creek flows year round in Upper Long Valley, and is intermittent in stretches in Honey Lake Valley. Flows on Long Valley Creek were measured for five years from 1989 through 1994. Average flows over this period are high in March and lower in the rest of the year, and could be affected by one high flow event in March. Average monthly flows are over 35 cfs in March, and below 15 cfs the rest of the year. Rainfall increases at the three weather stations in winter and spring without a corresponding increase in Long Valley Creek flow measurements, likely due to the short period of record of the stream gauge.

1.5 Delivered Water

The Susan River has been a source of irrigation water for agricultural purposes for well over 140 years. Two entities – Lassen Irrigation Company (LIC) and the Honey Lake Valley Resource Conservation District – administer the delivery of water to irrigation customers in the lower Susan River. The LIC delivers stored irrigation water to the non-riparian agricultural areas of the Lower Susan River. The LIC distribution network serving the non-riparian water users in the Lower Susan River consists of three primary components: storage, conveyance, and distribution.

The Susan River begins as two channels draining Silver and Caribou Lakes in western Lassen County. These channels merge and flow through canyons and mountain meadows for 13 miles before entering McCoy Flat Reservoir. Runoff is temporarily stored in McCoy Flat and Hog Flat Reservoirs in the upper watershed over the winter and spring. The LIC delivers this stored water from the two reservoirs to non-riparian agricultural users of the Lower Susan River, with releases to the river completed by no later than July 1. After leaving McCoy Flat, the river flows for another 4.5 miles before being met by the inflow channel from Hog Flat Reservoir. The river soon enters a canyon and flows another 17 miles before entering the city of Susanville and the Honey Lake Valley.

In order to insure adequate supplies of irrigation water to areas having the highest potential for agricultural productivity, Lassen County supports analysis and, when warranted, development of water impoundments and aqueducts to transport water resources to areas within Lassen County which have the foremost agricultural soils.

1.6 Treated Wastewater

Most of the sanitary sewer systems within the unincorporated areas of the region serve individual small communities. Sanitary sewer service within the unincorporated Lassen County portions of the region is generally provided by special districts including community service districts, public utility districts, sanitary districts, and sewer maintenance districts. Some agencies provide sewer collection service only, and contract with surrounding agencies for wastewater treatment and disposal.

Most of the unincorporated areas outside of Susanville are designated for agricultural use and discharge wastewater through onsite wastewater treatment systems or septic systems. In areas serviced by individual or community systems, property owners are generally responsible for maintenance and improvement. Due to the rural nature of these wastewater systems, wastewater data was not available at the time of research for the IRWMP.

The Susanville Sanitation District treats and disinfects up to two million gallons of municipal wastewater per day before discharging into an irrigation channel that crosses several large ranches and connects to the Jensen Slough. The Jensen Slough is a controlled waterway that receives water diverted by the federal water master from the Susan River to irrigate private lands southeast of Susanville. The Jensen Slough may also receive some return inflow in the form of runoff from the irrigated lands that it serves (termed tailwater). The Jensen Slough also returns to the Susan River, a water of the United States, and so the Jensen Slough is considered a water of the U.S. by the "tributary rule" as defined in the Basin Plan. In accordance with the federal Clean Water Act, the point-source discharge of pollutants to Jensen Slough requires a National Discharge Elimination System (NPDES) Permit. The Discharger does not control the flow of

wastewater after it enters the irrigation channel and has applied for reissued NPDES requirements for existing operations.

2. Groundwater Quality

Groundwater quality in Honey Lake Valley is generally good with some areas of concern. DWR's Bulletin 118 reports that poor quality waters, exist east of Honey lake, and North of Herlong, near the ordinance depot and that Total Dissolved Solids (TDS) generally increase west to east, and range from 89 mg/L to 2,500 mg/L (DWR, 2003). In eastern Honey Lake Valley, there are areas where fault-related water is found, which may be of geothermal origin (Moll 2000). Water quality concerns regarding trichloroethylene (TCE) are present and are being remediated in the vicinity of the Sierra Army Depot (Brathode, 2006). Nitrate has been reported as a groundwater quality issue near Herlong, and arsenic has been an issue in the playa areas near Honey Lake. Arsenic has been detected in wells at the Sierra Army Depot (Brathode, 2006).

Residential septic systems located upgradient from water supply sources (Bagwell springs and Cady Springs) for the City of Susanville represent water quality concerns for nitrates and other pathogens for this municipal supply.

Subsidence has been observed in the area surrounding Amedee hot springs, where groundwater extraction for geothermal purposes is ongoing. The County assumes, but no studies have been completed, that the observed subsidence is associated with groundwater extraction.

Many constituents, both anthropogenic (man-made) and naturally occurring, are present in the groundwater supply within the Honey Lake Groundwater Basin. The constituents identified in this section either currently impact groundwater usage within the basin or have the potential to impact groundwater usage in the future. Honey Lake groundwater data came primarily from three sources. The first source was from LCDEH. This data included periodic measurements from water supply wells from 1984 through 2014 for the following constituents: arsenic, chloride, iron, manganese, nitrate, electrical conductivity, and DBCP. The second and third sources of groundwater quality data came from the State Water Board's GeoTracker data management system and the USGS GAMA Program website. Data from these sources included periodic measurements from 589 water supply and environmental wells from 1980 through 2012 for the following constituents: arsenic, benzene, chloride, hexavalent chromium, DBCP, MTBE, nitrate, nitrite, perchlorate, PCE, 111-TCA, TCE, specific conductance, 123-TCP, and TDS, among others.

Evaluation Methodology

The periodic measurements from 589 water supply and environmental wells provided unique latitudes and longitudes and/or the site address that could be used to locate the water supply wells. The groundwater quality data were evaluated using map views showing the past 10-year average (2004 through 2014) and distribution of constituents and time concentration plots by constituent.

For discussion purposes, each constituent was compared to the primary and/or secondary drinking water maximum contaminant level (MCL) published by the California Department of Public Health (CDPH) and/or United States Environmental Protection Agency. In addition, for discussion purposes, the Honey Lake Groundwater Basin has been divided into three quadrants consisting of the Susanville / Standish to the north, Honey Lake in the center, and Herlong / Doyle to the south.

It should be noted that well depth information was generally not readily available. Often available depth information is only in hard copy driller's logs, which are further complicated by confidentiality issues. The lack of depth information is a critical data gap that should be addressed in the future (see Section 5 for more detail on data gaps).

2.1 Salinity and Nutrient Constituents

Groundwater salinity is caused by various salts, metals, and inorganic compounds dissolved in groundwater. Salts are composed of positively charged cations and negatively charged anions that disassociate when dissolved in water. Common dissolved salts in groundwater include calcium (Ca+), sodium (Na+), potassium (K+), chloride (Cl-), carbonate (CO3 -), sulfate (SO4-) and perchlorate (ClO4-). Common dissolved metals and nutrients in groundwater include arsenic (As), iron (Fe+), hexavalent chromium (Cr6), manganese (Mn+), nitrate (NO3 -), potassium (K+), and phosphate (PO43-).

2.1.1 Total Dissolved Solids

Salinity levels within the Honey Lake Basin area range from 60 milligrams per liter (mg/L) to greater than 3,320 mg/L as measured by TDS. The recommended secondary MCL for TDS is 500 mg/L with an upper limit of 1,000 mg/L (CDPH, 2012). The 10-year average (2004 through 2014) TDS in groundwater in the far north quadrant of the basin is generally less than 600 mg/L (Figure 2). TDS in the central quadrant just north of Honey lake is slightly elevated beneath the Standish area. TDS in groundwater also increases in the southern quadrant near Herlong and east of the Sierra Army Depot to as much as 1,000 mg/L. In these areas, high TDS water is found in wells deeper than 350 feet. Better quality groundwater (less than 1,000 mg/L) in these areas is found at shallower depths.

2.1.2 Specific Electrical Conductivity

Specific Electrical Conductivity (SEC or EC) can be used as an indirect measurement of salinity levels in groundwater. Within the Honey Lake Basin area, SEC ranges from 107 µs/cm to greater than 2356 µs/cm (Figure 3). The secondary MCL for SEC is 900 µs/cm with an upper limit of 1,600 µs/cm (CDPH, 2011). The 10-year average (2004 through 2014) SEC in groundwater in the northern quadrant of the Honey Lake Basin area is generally greater than 1000 µs/cm especially under the Leavitt and Standish ares. Like TDS, the SEC in groundwater increases in the southern quadrant towards Herlong and Doyle to as much as 1,100 µs/cm.

2.1.3 Arsenic

Arsenic (As) is a dissolved metal commonly associated with saline groundwater. Within the Honey Lake Basin area, As concentrations range from non-detect (less than 1 microgram per liter [µg/L]) to as much as 460 µg/L. The primary MCL for As is 10 µg/L (CDPH, 2011). The 10-year average (2004 through 2014) As concentration in groundwater in the southern quadrant of the Honey Lake Basin area is generally less than 10 µg/L (Figure 4). As in groundwater increases in the northern quadrant near Standish, Leavitt and just north of Honey Lake to as much as 460 µg/L.

2.1.4 Chloride

Chloride (Cl) is a dissolved salt commonly associated with saline groundwater. Within the Honey Lake Basin area, Cl concentrations range from non-detect (less than 2 mg/L) to as much as 190 mg/L. The recommended secondary MCL for Cl is 250 mg/L and the upper secondary MCL is 500 mg/L (CDPH, 2011). The 10-year average (2004 through 2014) Cl concentration in the Honey Lake Basin groundwater averages between 65-90 mg/L (Figure 5).

2.1.5 Iron

Iron (Fe) is a dissolved metal commonly associated with mineralized groundwater. Within the Honey Lake Basin area, Fe concentrations range from non-detect (less than 1 mg/L) to as much as 77 mg/L. The secondary MCL for Fe is 0.3 mg/L (CDPH, 2011). The 10-year average (2004 through 2014) Fe concentration in groundwater in the northern quadrant of the Honey Lake Basin area ranges from non-detect to over 77 mg/L (Figure 6), while the Fe concentration in groundwater in the southern quadrant is generally less than 1 mg/L. The elevated Fe concentration in the north quadrant of the Honey Lake Basin area is a result of leaching of Fe from the subsurface materials in the source area.

2.1.6 Manganese

Manganese (Mn) is a dissolved metal commonly associated with mineralized groundwater. Within the Honey Lake Basin area, Mn concentrations range from non-detect (less than 1 mg/L) to as much as 8.7 mg/L. The secondary MCL for Mn is 0.05 mg/L (CDPH, 2011). The 10-year average (2004 through 2014) Mn concentration in groundwater beneath most of the Honey Lake Basin area is 1.5 mg/L or less (Figure 7). Like TDS, the Mn concentration in groundwater

increases towards the Herlong area as well as the Standish and Leavitt areas to as much as 8.7 mg/L.

2.1.7 Nitrate

Nitrate (NO3) occurs from both natural and anthropogenic sources and is widespread in groundwater in many parts of the Central Valley. High NO3 concentrations in groundwater are often associated with the use of fertilizers (commercial/animal waste) and onsite wastewater treatment systems (OWTS or septic systems). Within the Honey Lake Basin area, NO3 concentrations range from non-detect (less than 2 mg/L) to as much as 104.6 mg/L. The primary MCL for NO3 is 45 mg/L (CDPH, 2011). The 10-year average (2004 through 2014) NO3 concentration in groundwater in the Honey Lake Basin area is generally less than 20 mg/L (Figure 8). In the northwest quadrant near the Honey Lake Rest Area, there are several small areas where NO3 concentrations exceed 50 mg/L. The Standish area has NO3 concentrations range from 50 to 100 mg/L. The elevated NO3 concentration in these areas may be associated with animal confinement facilities and other agricultural non-point sources or high density OWTSs.

2.1.8 Perchlorate

Perchlorate (ClO4) occurs from both natural and man-made sources and is widespread in groundwater in many parts of the Central Valley. High ClO4 concentrations in groundwater are often associated with the use of nitrate fertilizer or munitions manufacturing. Within the Honey Lake Basin area, ClO4 concentrations range from non-detect (less than 2 µg/L) to as much as 8 µg/L. The primary MCL for ClO4 is 6 µg/L (CDPH, 2011). The 10-year average (2004 through 2014) ClO4 concentration in groundwater in the Lahontan Basins IRWM area is generally less than 1 mg/L (Figure 9).

2.2 Petroleum Hydrocarbon, Pesticides, and Organic Constituents

Anthropogenic sources of petroleum hydrocarbons, pesticides, and organic compounds can have significant impacts on water quality when present in groundwater. The most commonly found petroleum hydrocarbon compounds of concern are benzene and MTBE. The most commonly found pesticides include DBCP, EDB, and TCP. The most commonly found VOCs include 111-TCA, PCE, and TCE.

2.2.1 Benzene

More than 200 unauthorized releases of petroleum hydrocarbons from underground storage tanks have occurred in the Honey Lake Basin area. The primary hydrocarbons of concern are benzene and MTBE, both of which are suspected carcinogens. Benzene concentrations in groundwater in the Honey Lake Groundwater basin area range from non-detect (less than 0.5 µg/L) to greater than 34,000 µg/L (Figure 10). The primary MCL for benzene is 1 µg/L (CDPH, 2011). The 10-year average (2004 through 2014) benzene concentration in groundwater in the

Honey Lake Basin area is generally less than 307 µg/L, with elevated concentrations found in localized urban areas such as the California Correctional Center and the City of Susanville.

2.2.2 Methyl Tertiary Butyl Ether

MTBE concentrations in groundwater in the Honey Lake Basin area range from non-detect (0.2 µg/L) to greater than 170,000 µg/L. The primary MCL for MTBE is 13 µg/L (CDPH, 2011). The 10-year average (2004 through 2014) MTBE concentration in groundwater in the Honey Lake Basin area is generally less than 11 µg/L (Figure 11), with elevated concentrations found in localized urban areas such as the California Correctional Center and the City of Susanville

2.2.3 1,2,3-Trichloropropane

The VOC 1,2,3-Trichloropropane (123-TCP) is a commonly used solvent in manufacturing facilities and as a carrier solvent for DBCP and other pesticides. 123-TCP concentrations in groundwater in the Honey Lake Basin area range from non-detect (0.5 µg/L) to 1 µg/L. Until the MCL is developed, CDPH is utilizing a Notification Level of 30 µg/L (CDPH, 2012). The California Office of Environmental Health Hazard Assessment (OEHHA) has set a Public Health Goal (PHG) for 123-TCP of 0.0007 µg/L (OEHHA, 2009). A notification level is a health-based advisory level established by CDPH for chemicals in drinking water that lack MCLs, while the PHG is a level of drinking water contaminant at which adverse health effects are not expected to occur from a lifetime of exposure. The 10-year average (2004 through 2014) 123-TCP concentration in groundwater in the Honey Lake Basin area is generally less than 1 µg/L (Figure 12).

2.2.4 Tetrachloroethylene

The VOC Tetrachloroethylene (PCE) is a commonly used solvent in manufacturing facilities and dry cleaners. PCE concentrations in groundwater in the Honey Lake Basin area range from non-detect (0.5 µg/L) to over 950 µg/L. The primary MCL for PCE is 5 µg/L (CDPH, 2011). The 10-year average (2004 through 2014) PCE concentration in groundwater in the Honey Lake Basin area is generally less than 5 µg/L (Figure 13), with elevated concentrations found in localized areas in the northern quadrant beneath the California Correctional Center.

2.2.5 Trichloroethylene

The VOC Trichloroethylene (TCE) is a commonly used solvent in manufacturing facilities. TCE concentrations in groundwater in the Honey Lake Basin area range from non-detect (0.5 µg/L) to over 5.7 µg/L. The primary MCL for TCE is 5 µg/L (CDPH, 2011). The 10-year average (2004 through 2014) TCE concentration in groundwater in the Honey Lake Basin area is generally less than 5 µg/L (Figure 14), with elevated concentrations found in localized areas in the north quadrant.

2.3 Emerging Contaminants

Many chemical and microbial constituents that have not historically been considered as contaminants are occasionally, and in some cases with increasing frequency, detected in groundwater. These newly recognized (or emerging) contaminants are commonly derived from municipal, agricultural, industrial wastewater, and domestic wastewater sources and pathways. These newly recognized contaminants are dispersed to the environment from domestic, commercial, and industrial uses of common household products and include caffeine, artificial sweeteners, pharmaceuticals, cleaning products, and other personal care products. Residual waste products of genetically modified organisms are also of potential concern.

3. Surface Water and Delivered Water Quality

As noted in Section 1.5, the Susan River is the primary source of surface water and delivered water within the Lahontan Basins IRWM area. Samples of Susan River water collected near the USGS monitoring station in Susanville between September 2011 and December 2012. This data shows that the Susan River water is mostly a calcium-bicarbonate type water. This is typical of most surface water derived from Sierra Nevada sources.

The Lassen Irrigation Company provides irrigation water to approximately 5,864.7 acres in the Lahontan Basins IRWM area. Most of this water is surface water from the Susan River. During dry periods, the surface water supply is occasionally supplemented with groundwater.

4. Recycled Water Quality

Wastewater reclamation plants are operated by the municipalities to treat and discharge effluent back into the Honey Lake Basin area. The city of Susanville discharges treated wastewater to land under NPDES permits. Treated water from the Susanville Sanitation Districts treatment plant meet the discharge requirements specified by their respective NPDES permits. A review of available effluent water quality data on the California Integrated Water Quality System Project database indicates that the calcium-bicarbonate type water. These waters are reused for agricultural purposes.

5. Local Data Management

As noted above, there were no readily discernible salt and nutrient management plans within the Lahontan Basins IRWM area. The USGS GAMA program collects groundwater quality samples from selected wells within the Honey Lake Basin area periodically. The LCDEH also collects groundwater quality data from public water supply wells periodically and from private wells when constructed under local permit, and as some properties are sold. Water users with WDRs also collect water quality data and report it to the RWQCB as part of their WDRs. These

data sets cover much of the Honey Lake Basin area and are useful in evaluating water quality. However, the water quality data collected are inconsistent in the parameters analyzed, frequency of sampling, and quality of reporting. Often the depth of groundwater samples is not known, which is critical to early identification of the impacts of practices at the land surface on groundwater quality. Furthermore, the water quality data collected is stored in a variety of data management methods by a number of agencies, making analysis of the available water quality data complex and time consuming.

It is recommended that as part of the salt and nutrient management plan for the Lahontan Basins IRWM area, a consistent set of wells and surface water monitoring points should be sampled on a regular basis. These samples should be analyzed for a full suite of constituents periodically with indicator parameters during the other semi-annual sampling events. The water quality data should be stored in an internet based data management system and made publically available. Information on the depth of the screened intervals on groundwater monitoring wells should be included in the system, either through compilation of existing data or through new data collection efforts.

The development of such a monitoring plan should be undertaken through a stakeholder-driven process. To provide a starting point for that process, the following may be considered for such as plan:

- Groundwater Monitoring Wells: Select wells consistent with CASGEM wells. Additional wells may be needed to meet water quality needs, particularly shallow wells.

- Surface Water Monitoring Points: Select locations along the Susan River and smaller streams, plus canal locations in both the upper and lower portions of the conveyance system.

- Frequency: Indicator parameters every 6 months and a full suite of constituents every 2 years.

- Constituents: Indicator parameters include TDS, SEC, and NO3. Full suite of constituents includes general minerals, metals, basic nutrients, VOCs, and selected pesticides.

Like much of the northeastern portion of California, most surface and groundwater utilized in the Lahontan Basins IRWM area is for irrigation purposes, including crop land and animal confinement facilities. Municipal and industrial water uses are a smaller component given the rural nature. The Lahontan Basins IRWM area is most vulnerable to salts and nutrients resulting from the over application of fertilizers, application of fertilizers to coarse-grained soils, salts reached from soil in agricultural return water, and wastewater generated by agriculture, residential, municipal, and industrial waste water sources. It should be noted that changes in the

regulatory environment related to septic systems (also known as on-site wastewater treatment systems, or OWTS) are occurring through the State Water Board's Water Quality Control Policy for Siting, Design, Operation, and Maintenance of Onsite Wastewater Treatment Systems (State Water Board, 2012). Future salt and nutrient management should be conducted in coordination with these efforts, including the potential development of Local Agency Management Program.

5.1 Best Management Plan Strategy

Major land use sectors of the Honey Lake Valley currently have Best Management Plans (BMPs) in place. Within populated urban areas such as the City of Susanville, communities are adopting BMPs for water conservation, water budgeting, water management, and prohibition of water waste to minimize over-watering and runoff. These BMPs help reduce the contribution of salts and nutrients to the groundwater basin.

The Honey Lake Valley Resource Conservation District as well as other RCD's are managing a Safe Septics program aimed at improving the management of spetic tanks and leachfields in the region in order to minimize the likelihood of accidents and overload. Also, septic systems will fall under the State Water Resources Control Board's recently adopted Resolution No. 2012-0032: the Water Quality Control Policy for Siting, Design, Operation and Maintenance of Onsite Wastewater Treatment Systems, which is a statewide, risk-based, tiered approach for the regulation and management of septic installations and replacements and sets the level of performance and protection expected from septic systems.

For the municipal wastewater management agencies (Susanville Sanitary District), source control techniques are available to maintain and improve the quality of the treated wastewater which becomes recycled water used for agricultural irrigation throughout the Honey Lake Valley groundwater basin.

5.2 Project Submittal

The project solicitation process begins with a RWMG review of previous IRWM Plan project submittals and evaluation followed by a discussion of how potential project submittals may assist mitigating current groundwater quality issues. These projects will be evaluated and considered for inclusion into the IRWM Plan Update.

Periodic email reminders were sent out to the RWMG and meetings were conducted; to assist project proponents with completion of the Project Application Form. During the meetings the following topics were completed: review of instructions for completing the Project Application Form, questions individuals had on the project review process, review of the types of projects to be submitted, and examples of a completed Project Application Form. Completed Project Application Forms were returned by email.

5.3 Antidegradation Analysis Summary

The antidegradation analysis is an examination of existing basin-wide water quality conditions with estimated future regional water quality and Basin Plan Objectives. This analysis brings together all technical data and goals. In the study area of Honey Lake Groundwater basin the existing quality of water is better than the Water Quality Objectives in the Basin Plan. After closer examination of GAMA data and CASGEM thresholds the Honey Lake Groundwater basin is just below meeting the classification of "Medium Priority Basin" In such situations, Resolution 68-16 states that "such existing high quality will be maintained until it has been demonstrated to the State that any change will be consistent with maximum benefit to the people of the State, will not unreasonably affect present and anticipated beneficial use of such water and will not result in water quality less than that prescribed in the policies."

The results of the groundwater quality trend and loading analyses, based on a series of conservative assumptions and over a 25-year time horizon, indicate that basin-wide average TDS and nitrate conditions will increase over time. This analysis needs to occur on an annual basis in order to stay ahead of a CASGEM Medium Priority Basin classification. This annual assessment needs to focus on monitoring supply and shallow wells, and recommend focused soil monitoring to be carried out in partnership with the UC Davis Cooperative Extension Lassen County.

These potential increases are almost entirely driven by existing activities in the basin compounded by drought conditions. Given the economic importance of the existing water supplies and agricultural and urban uses that contribute to salt and nutrient loading in the basin, and given the projection of the continued ability of groundwater to meet present and anticipated beneficial uses, the qualitative cost benefit analysis concludes that the increases are consistent with the maximum benefit to the people of the Honey Lake Groundwater basin.

6. Summary

The results of this salt and nutrient study indicate that in general, most of the Honey Lake Basin area has good surface and groundwater quality as shown using TDS (Figure 2) minus known trouble areas that are currently being mitigated. The monitoring data indicate localized areas where groundwater constituents exceed primary MCLs. These results are consistent with the findings of the USGS GAMA program.

The Honey Lake Basin area would benefit from implementation of a consistent surface and groundwater monitoring program to evaluate changes in water quality over time. The region needs to continue existing BMPs. The SNMP needs to be updated on a 5 year timescale to include updated information from; USGS model results, land use changes, new projects, operation changes, and new regulations. Improved management of available surface and groundwater quality data in the Lahontan Basins IRWM area will allow for optimization of

available surface and groundwater supplies to minimize over application of fertilizers, reduce salt leaching, and reduce salt and nutrient loading in waste water.

7. References

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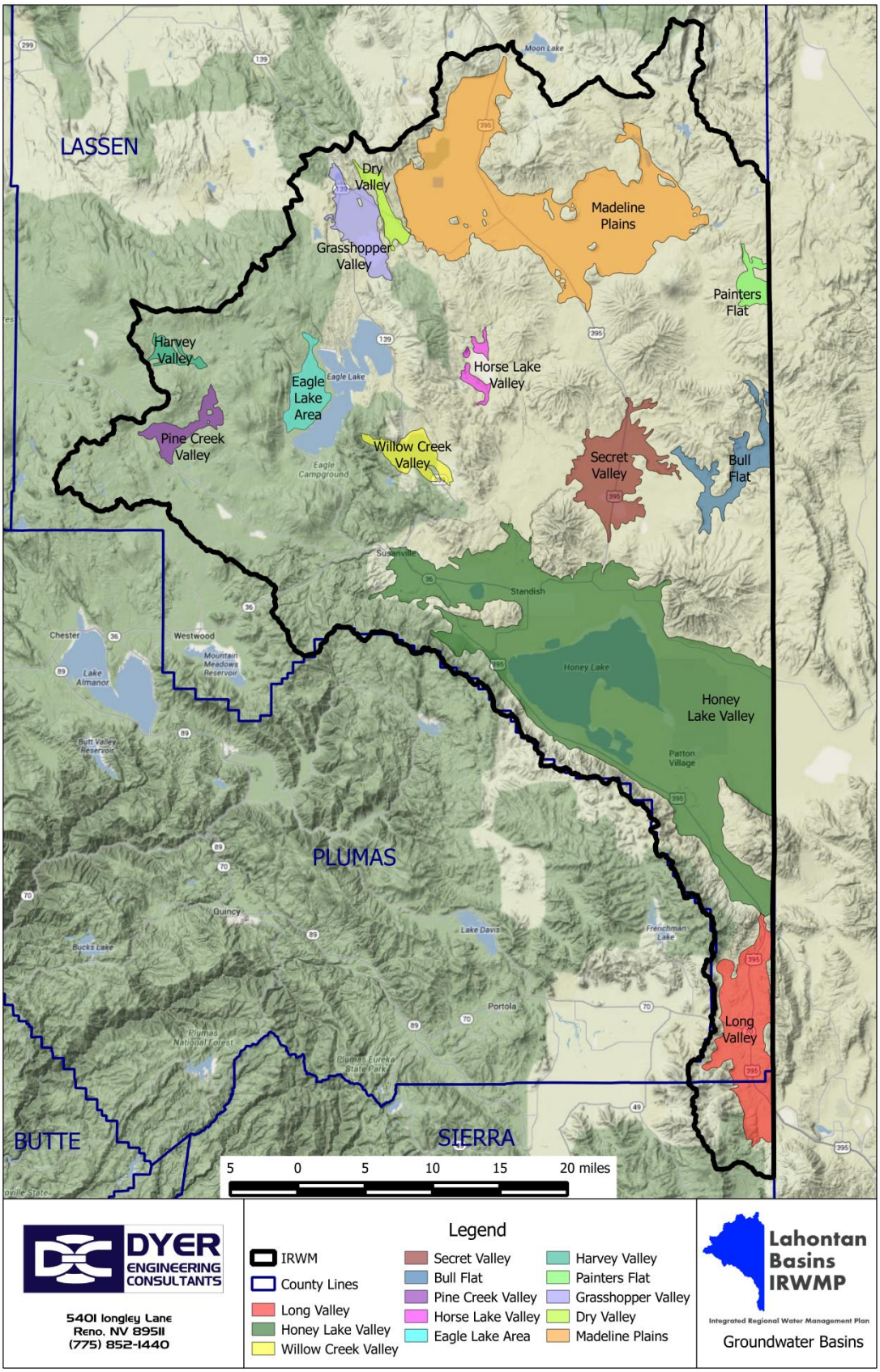


Figure 1 Lahontan Basins IRWM Groundwater Basins

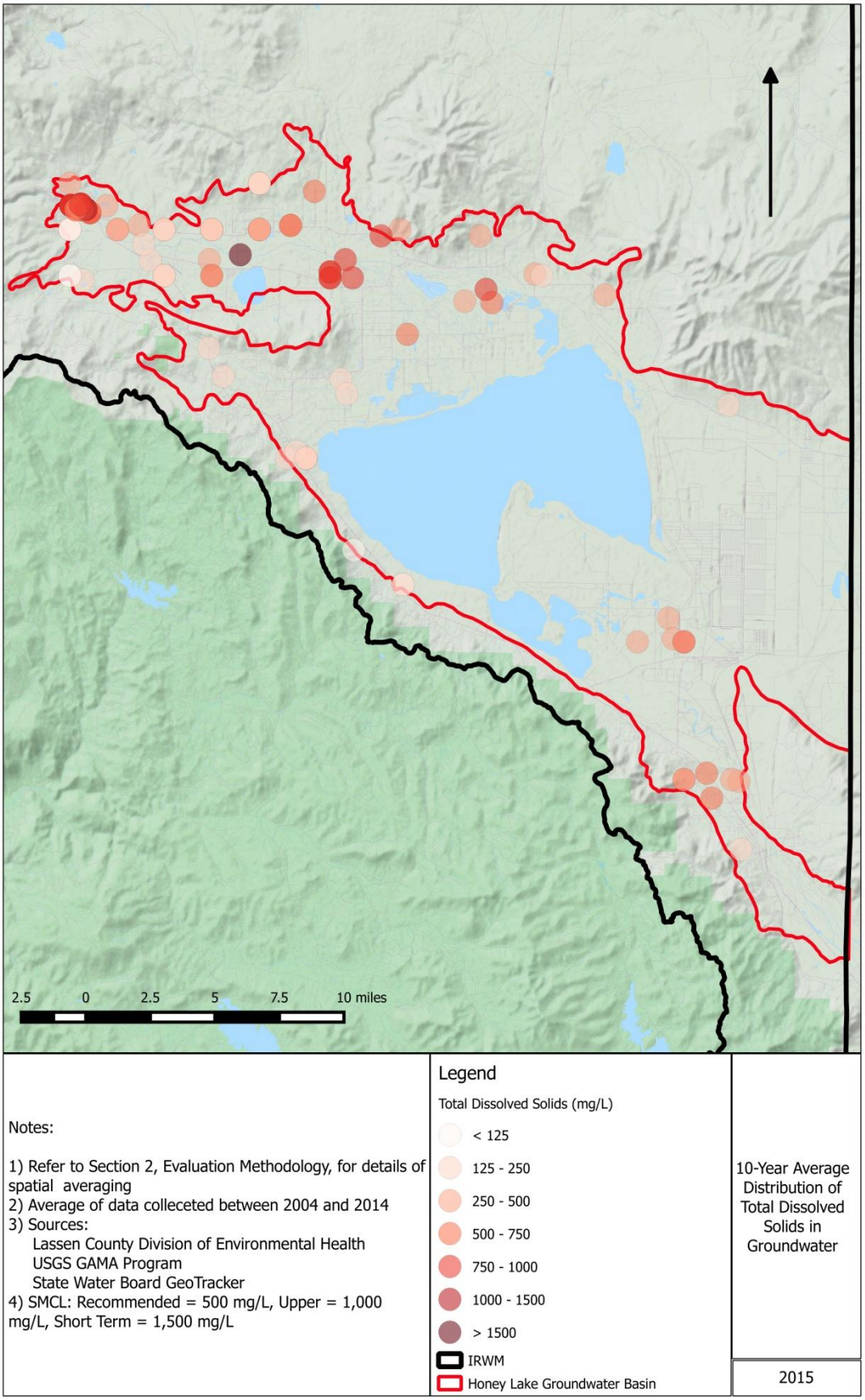
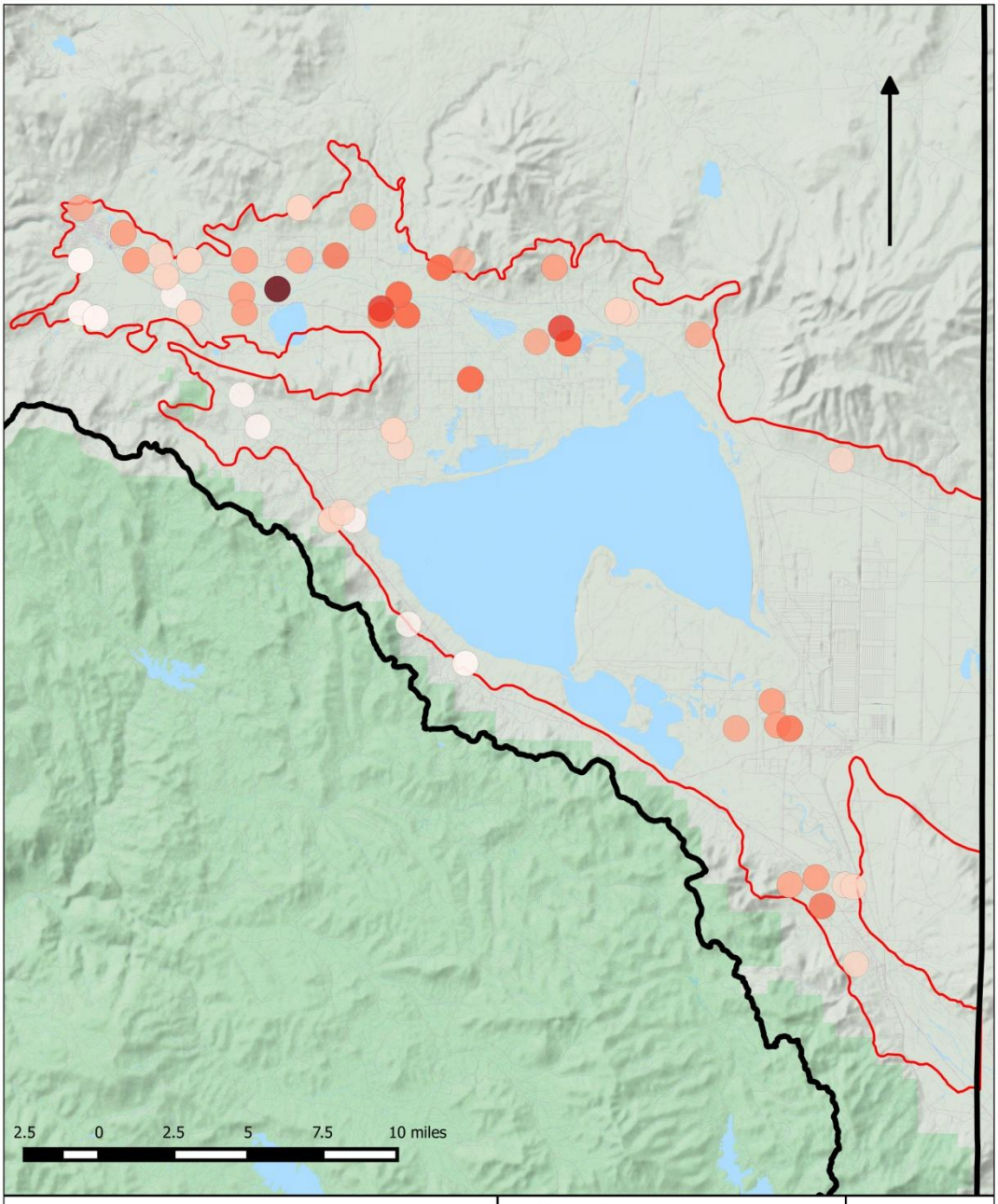


Figure 2 TDS Distribution in Groundwater



Notes:

1) Refer to Section 2, Evaluation Methodology, for details of spatial averaging
2) Average of data colleceted between 2004 and 2014
3) Sources:
   Lassen County Division of Environmental Health
   USGS GAMA Program
   State Water Board GeoTracker
4) SMCL: Recommended = 900 µS/cm, Upper = 1,600 µS/cm, Short Term = 2,200 µS/cm

Legend

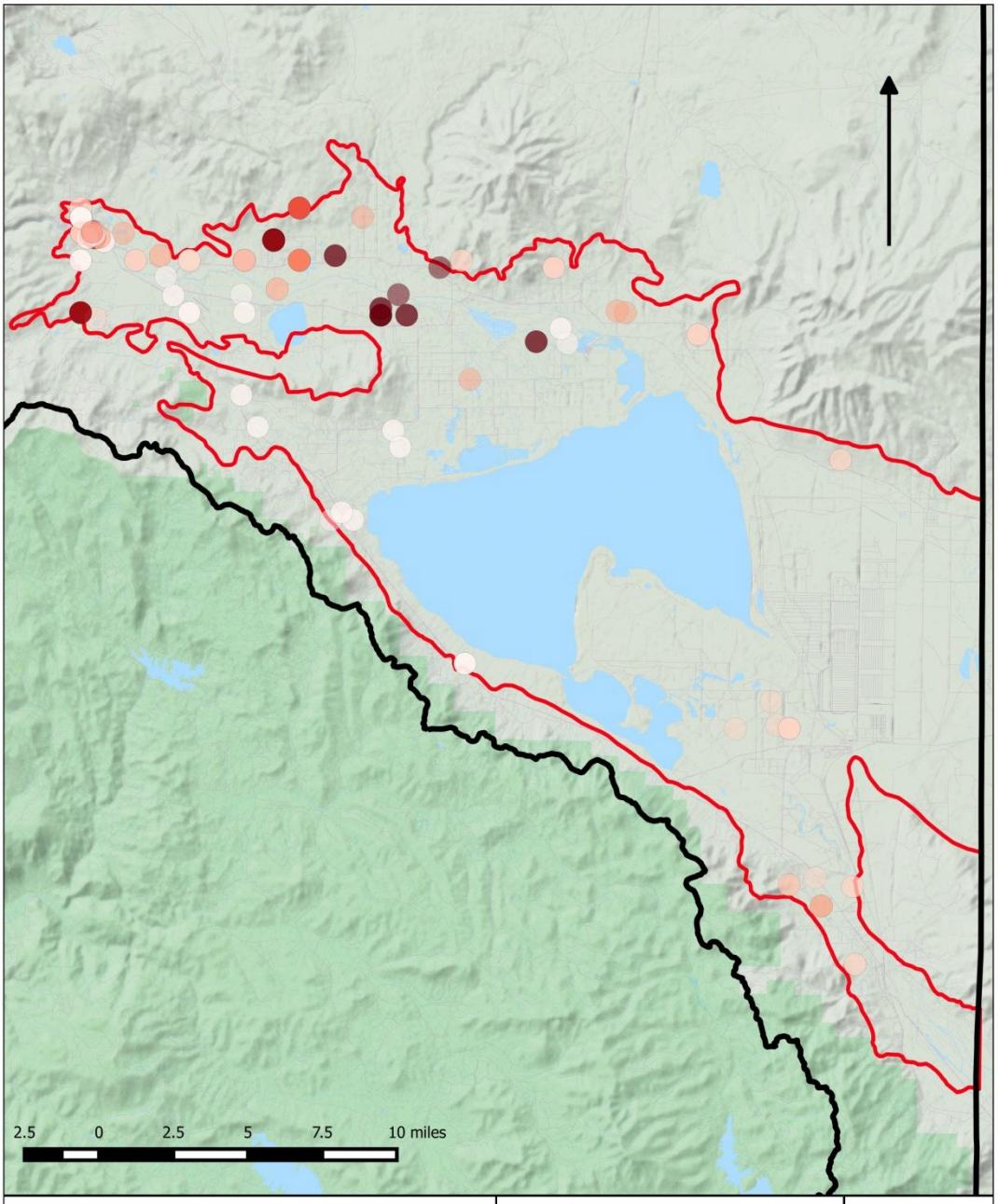
Electrical Conductivity (µS/cm)

- 0 - 225
- 225 - 450
- 450 - 900
- 900 - 1350
- 1350 - 1600
- 1600 - 2200
- > 2200
- IRWM
- Honey Lake Valley

10-Year Average Distribution of SEC in Groundwater

2015

Figure 3 SEC Distribution in Groundwater



Notes:

1) Refer to Section 2, Evaluation Methodology, for details of spatial averaging
2) Average of data colleceted between 2004 and 2014
3) Sources:
   Lassen County Division of Environmental Health
   USGS GAMA Program
   State Water Board GeoTracker
4) SMCL: 10 µg/L

Legend

Arsenic (µg/L)

- < 2.5
- 2 - 5
- 5 - 10
- 10 - 15
- 15 - 20
- 20 - 30
- > 30
- IRWM
- Honey Lake Groundwater Basin

10-Year Average Distribution of Arsenic in Groundwater

2015

Figure 4 Arsenic Distribution in Groundwater

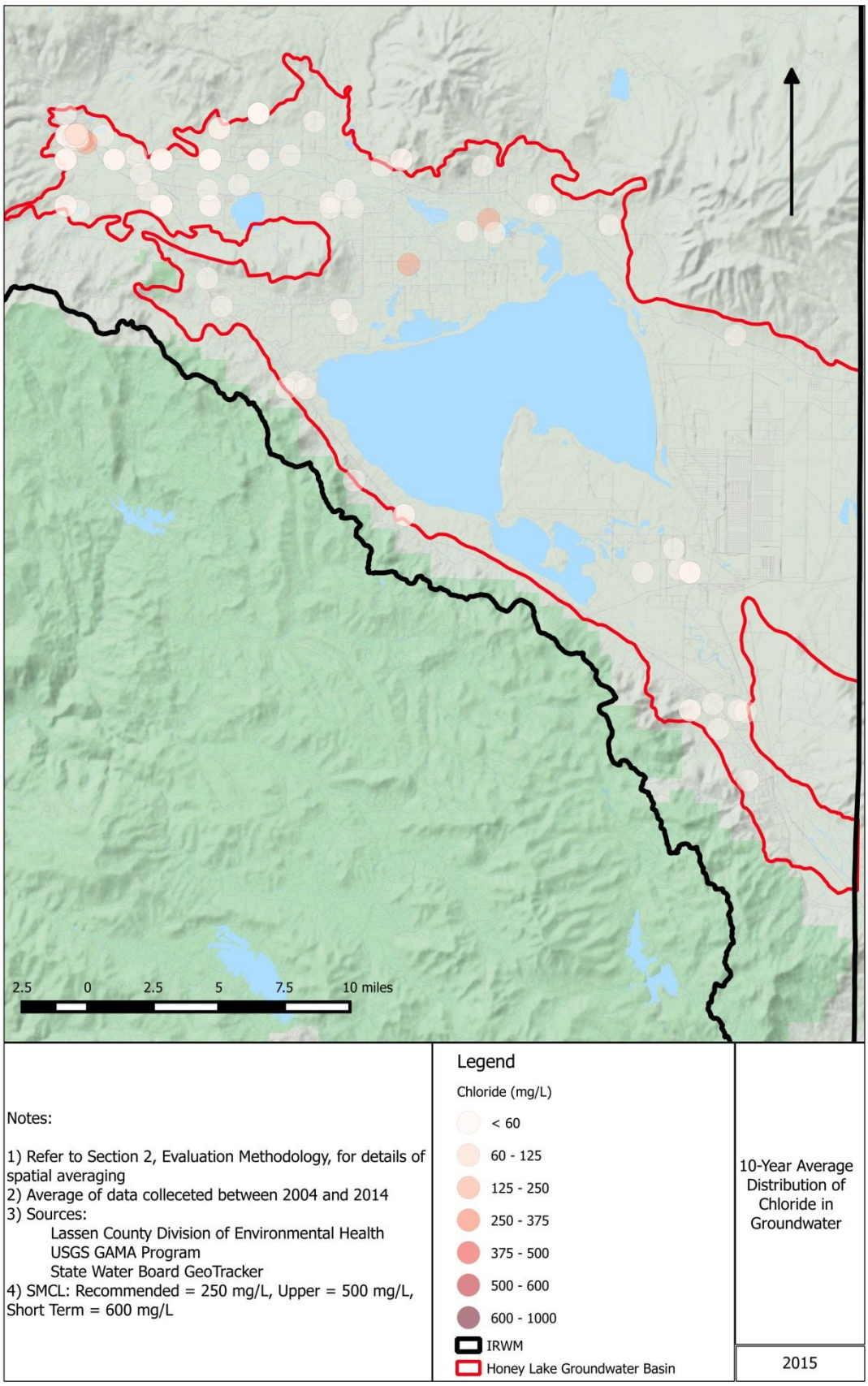
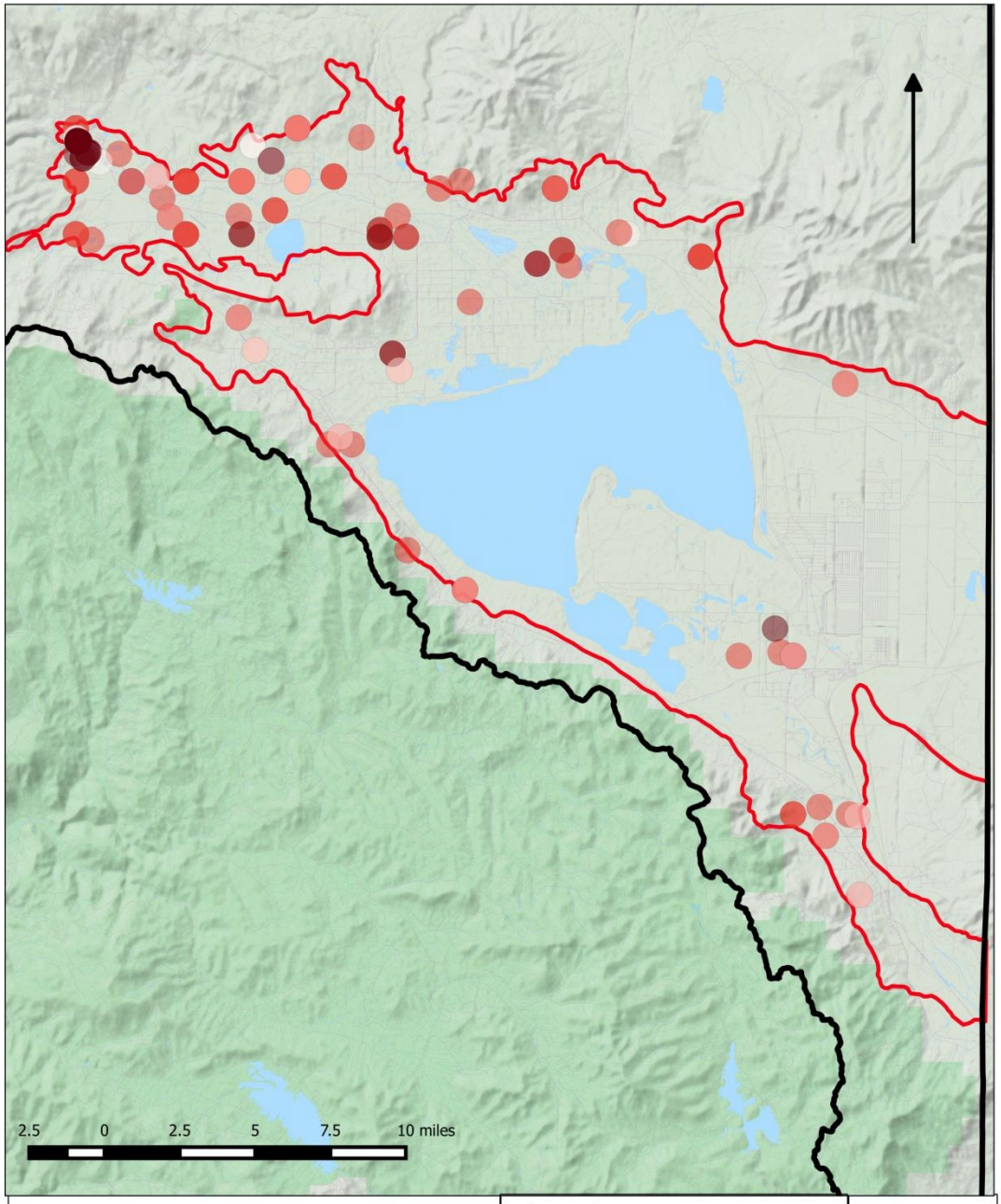


Figure 5 Chloride Distribution in Groundwater



Notes:

1) Refer to Section 2, Evaluation Methodology, for details of spatial averaging
2) Average of data colleceted between 2004 and 2014
3) Sources:
   Lassen County Division of Environmental Health
   USGS GAMA Program
   State Water Board GeoTracker
4) SMCL: 0.3 mg/L

Legend

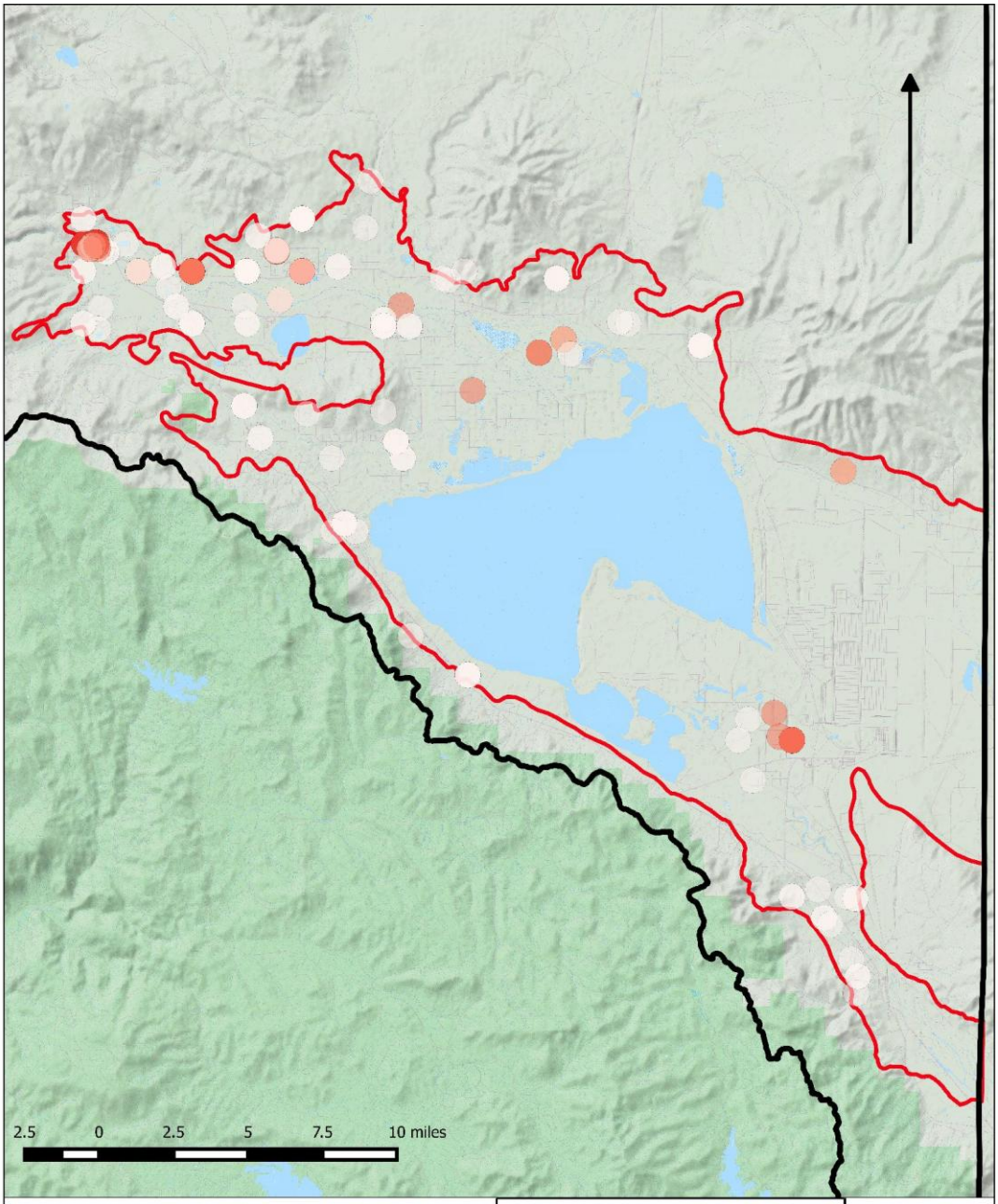
Iron (mg/L)

- < 0.08
- 0.08 - 0.15
- 0.15 - 0.3
- 0.3 - 1
- 1 - 100
- 100 - 300
- 300 - 77000
- IRWM
- Honey Lake Groundwater Basin

10-Year Average Distribution of Iron in Groundwater

2015

Figure 6 Iron Distribution in Groundwater



Notes:

1) Refer to Section 2, Evaluation Methodology, for details of spatial averaging
2) Average of data colleceted between 2004 and 2014
3) Sources:
   Lassen County Division of Environmental Health
   USGS GAMA Program
   State Water Board GeoTracker
4) SMCL: 0.5 mg/L

Legend

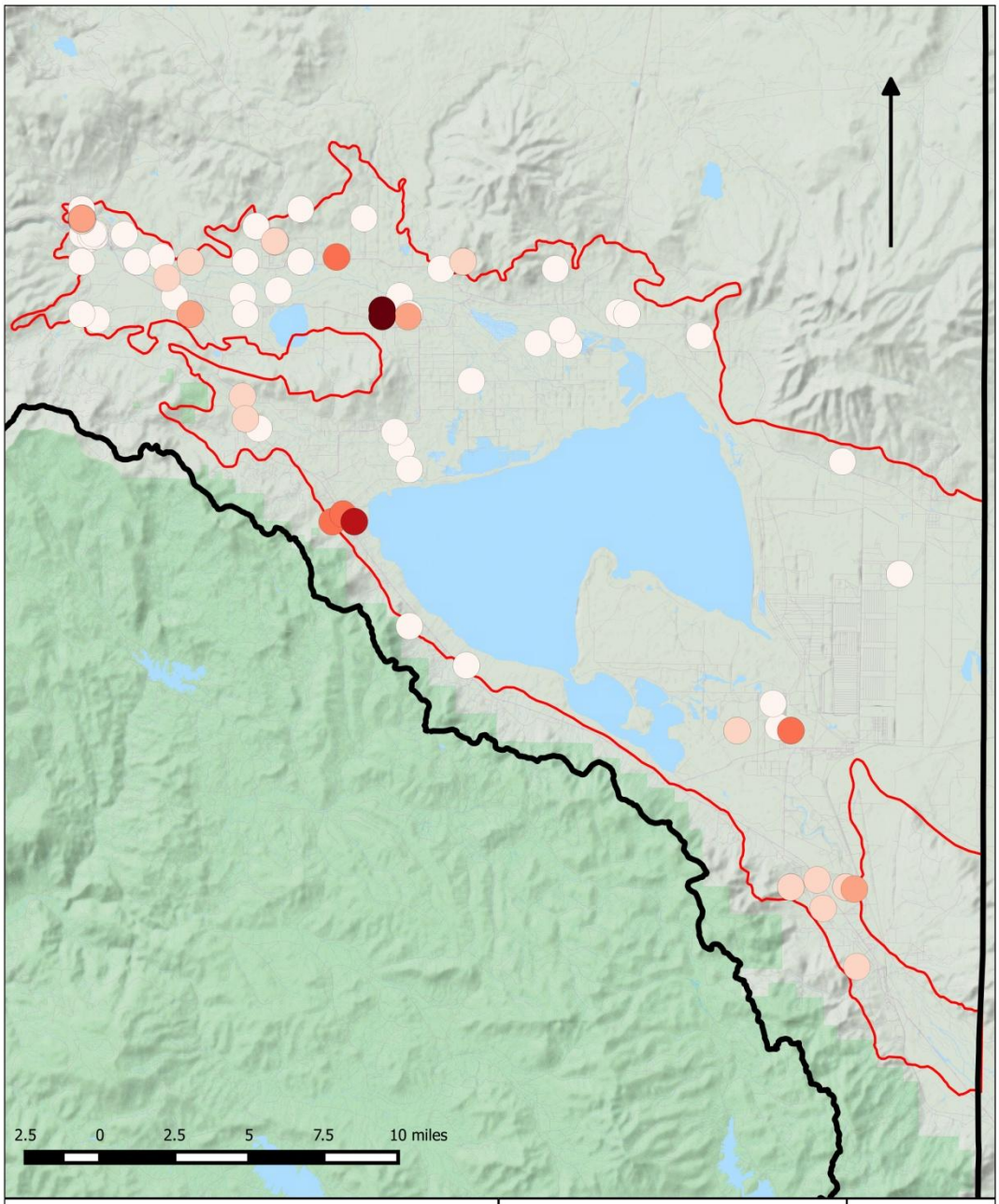
Manganese (mg/L)

- < 0.02
- 0.02 - 0.025
- 0.025 - 0.05
- 0.05 - 1.0
- 1.0 - 100.0
- 100.0 - 300.0
- > 300
- IRWM
- Honey Lake Groundwater Basin

10-Year Average Distribution of Manganese in Groundwater

2015

Figure 7 Manganese Distribution in Groundwater



Notes:

1) Refer to Section 2, Evaluation Methodology, for details of spatial averaging
2) Average of data colleceted between 2004 and 2014
3) Sources:
   Lassen County Division of Environmental Health
   USGS GAMA Program
   State Water Board GeoTracker
4) SMCL: 45 mg/L

Legend

Nitrate (NO3) mg/L

- 0 - 15
- 15 - 30
- 30 - 45
- 45 - 60
- 60 - 75
- 75 - 90
- 90 - 105
- IRWM
- Honey Lake Groundwater Basin

10-Year Average Distribution of Nitrate iin Groundwater

2015

Figure 8 Nitrate (NO3) Distribution in Groundwater

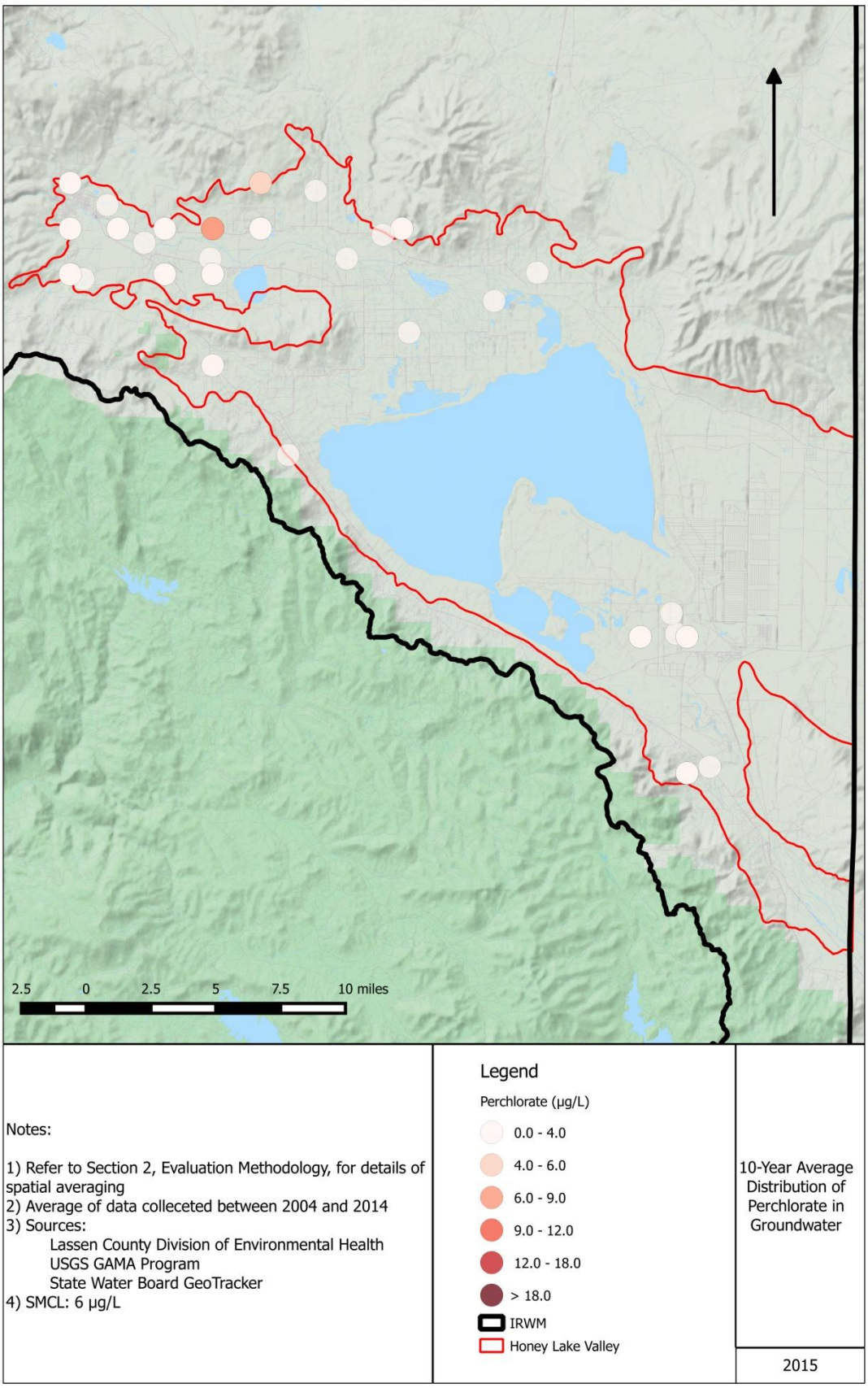
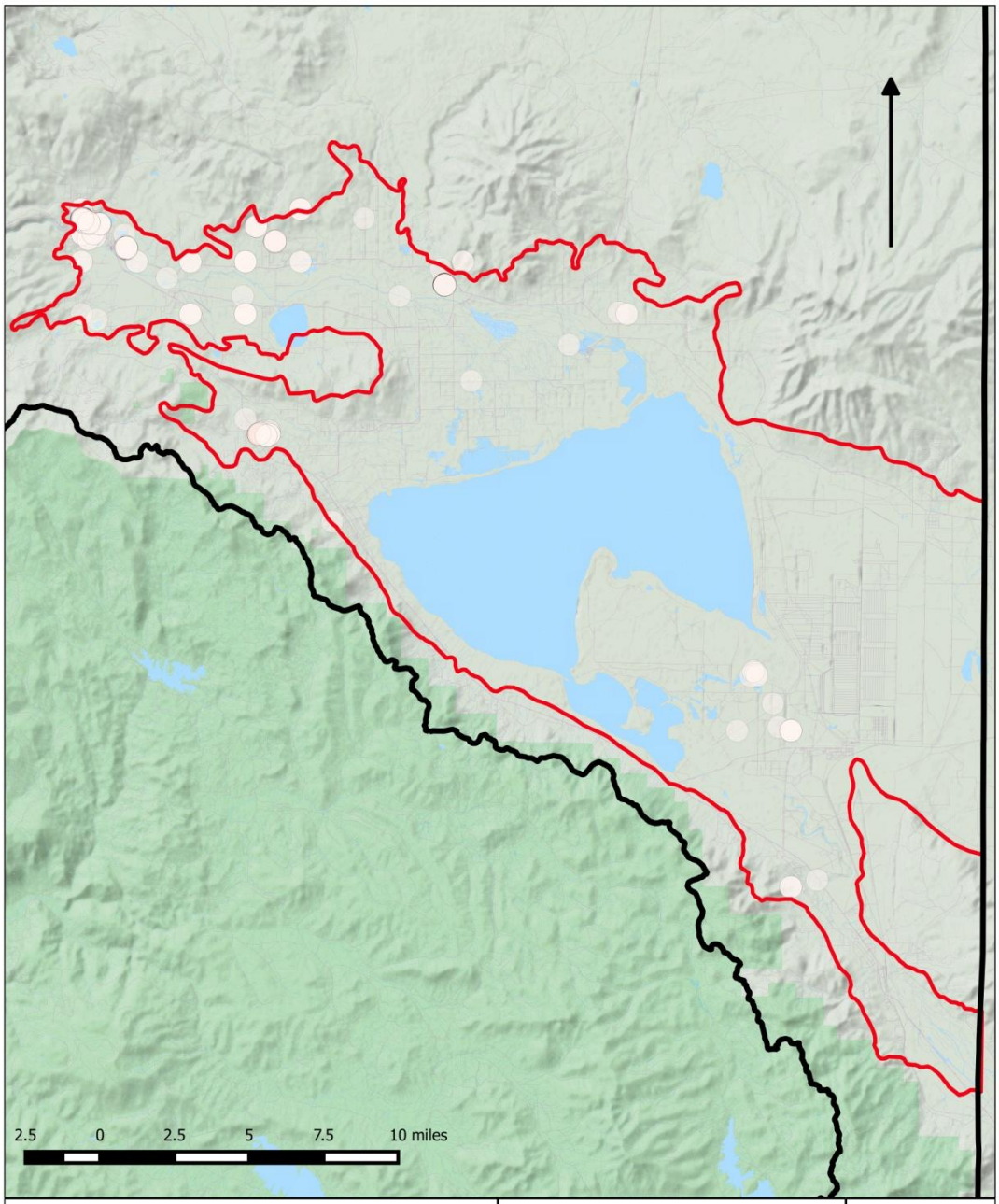


Figure 9 Perchlorate Distribution in Groundwater



Notes:

1) Refer to Section 2, Evaluation Methodology, for details of spatial averaging
2) Average of data colleceted between 2004 and 2014
3) Sources:
   Lassen County Division of Environmental Health
   USGS GAMA Program
   State Water Board GeoTracker
4) SMCL: 1 µg/L

Legend

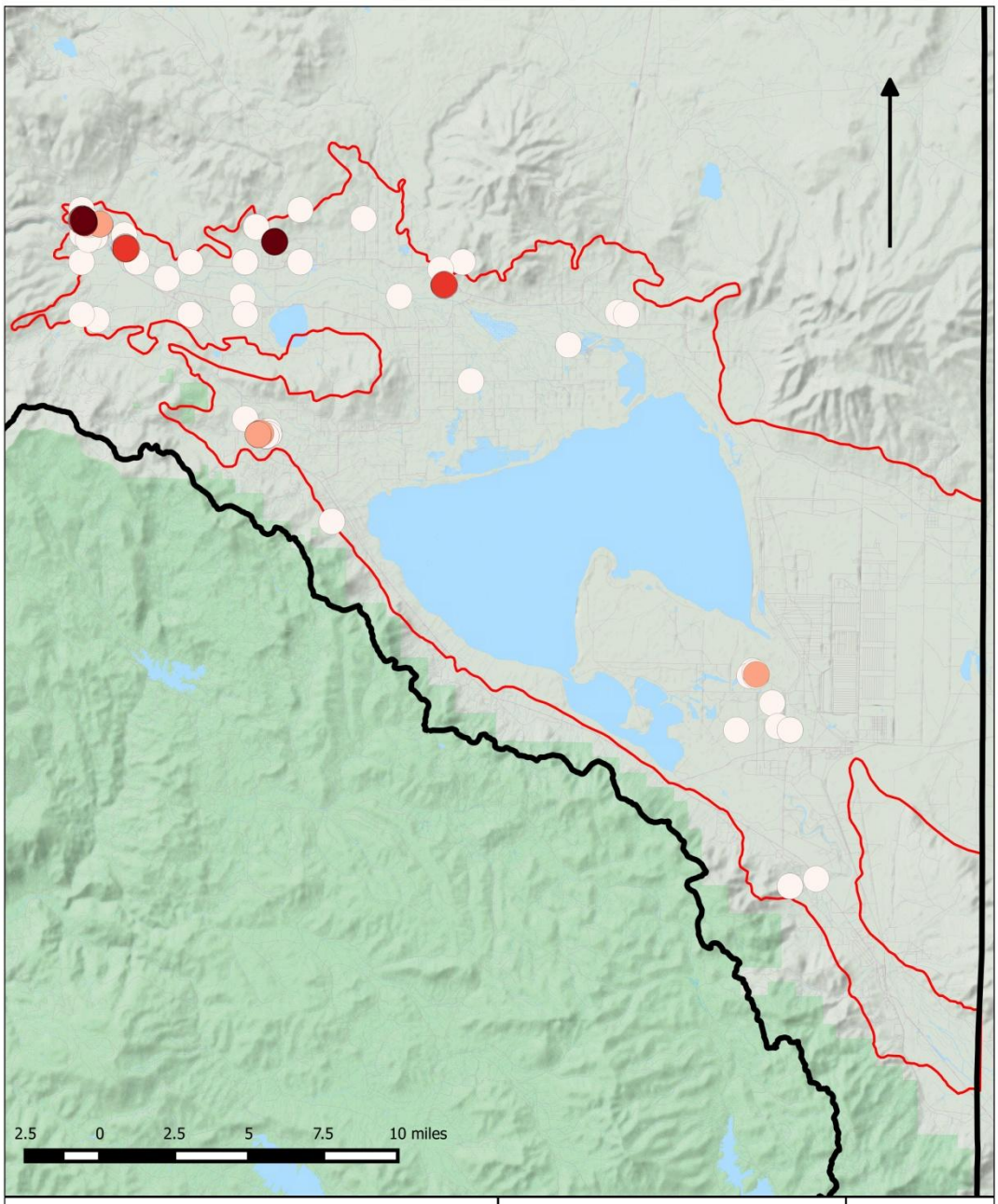
Benzene (µg/L)

- 0 - 1
- 1 - 100
- 100 - 1000
- > 1000
- IRWM
- Honey Lake Groundwater Basin

10-Year Average Distribution of Benzene in Groundwater

2015

Figure 10 Benzene Distribution in Groundwater



Notes:

1) Refer to Section 2, Evaluation Methodology, for details of spatial averaging
2) Average of data colleceted between 2004 and 2014
3) Sources:
   Lassen County Division of Environmental Health
   USGS GAMA Program
   State Water Board GeoTracker
4) SMCL: 13 µg/L

Legend

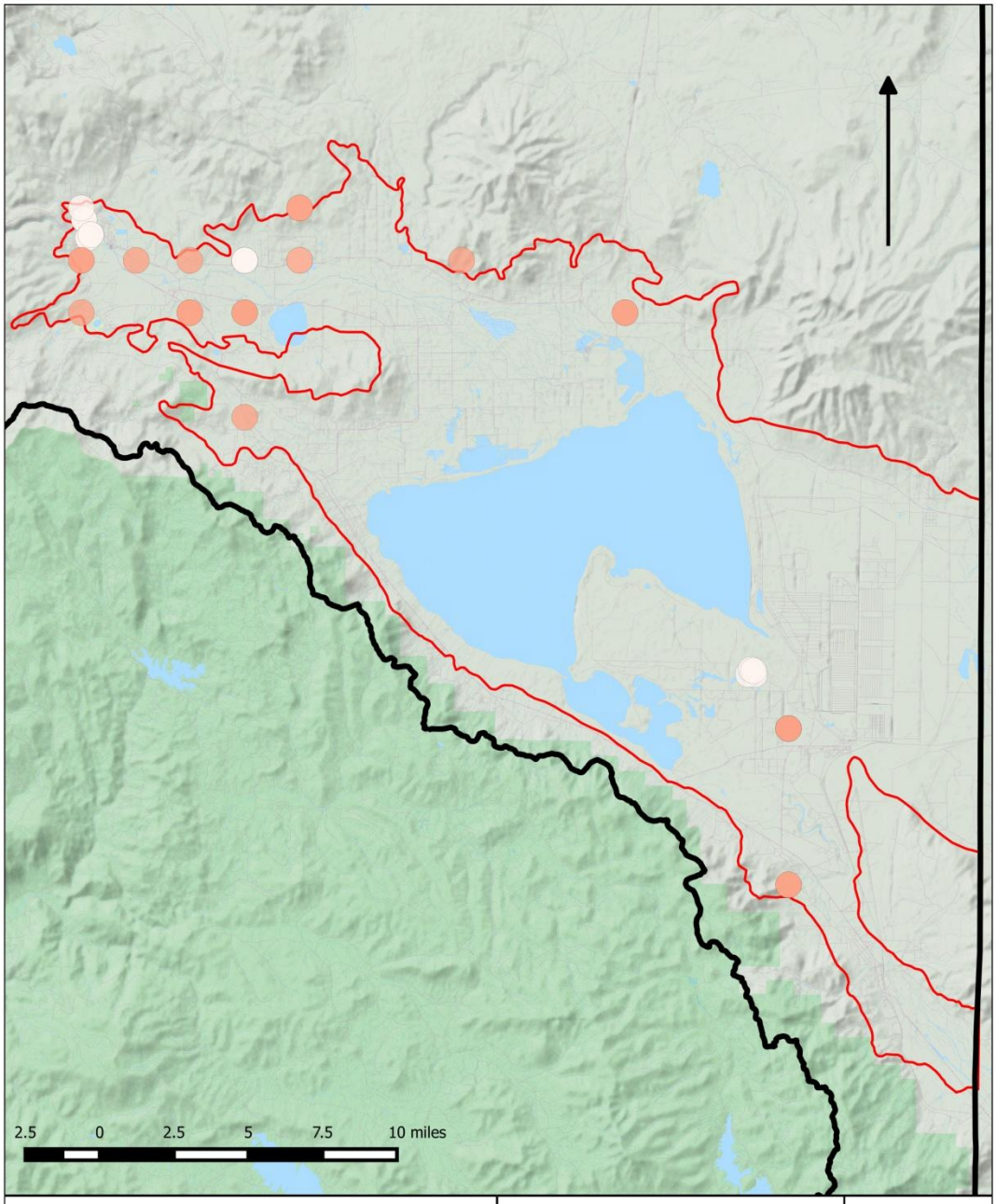
MTBE (µg/L)

- 0 - 13
- 13 - 100
- 100 - 1000
- > 1000
- Honey Lake Valley
- IRWM

10-Year Average Distribution of MTBE in Groundwater

2015

Figure 11 MTBE Distribution in Groundwater



Notes:

1) Refer to Section 2, Evaluation Methodology, for details of spatial averaging
2) Average of data colleceted between 2004 and 2014
3) Sources:
   Lassen County Division of Environmental Health
   USGS GAMA Program
   State Water Board GeoTracker
4) SMCL: 0.005 µg/L

Legend

123-TCP (µg/L)

- 0.00 - 0.005
- 0.005 - 1.00
- 1.00 - 100.00
- > 100.00
- Honey Lake Valley
- IRWM

10-Year Average Distribution of 123-TCP in groundwater

2015

Figure 12 123-TCP Distribution in Groundwater

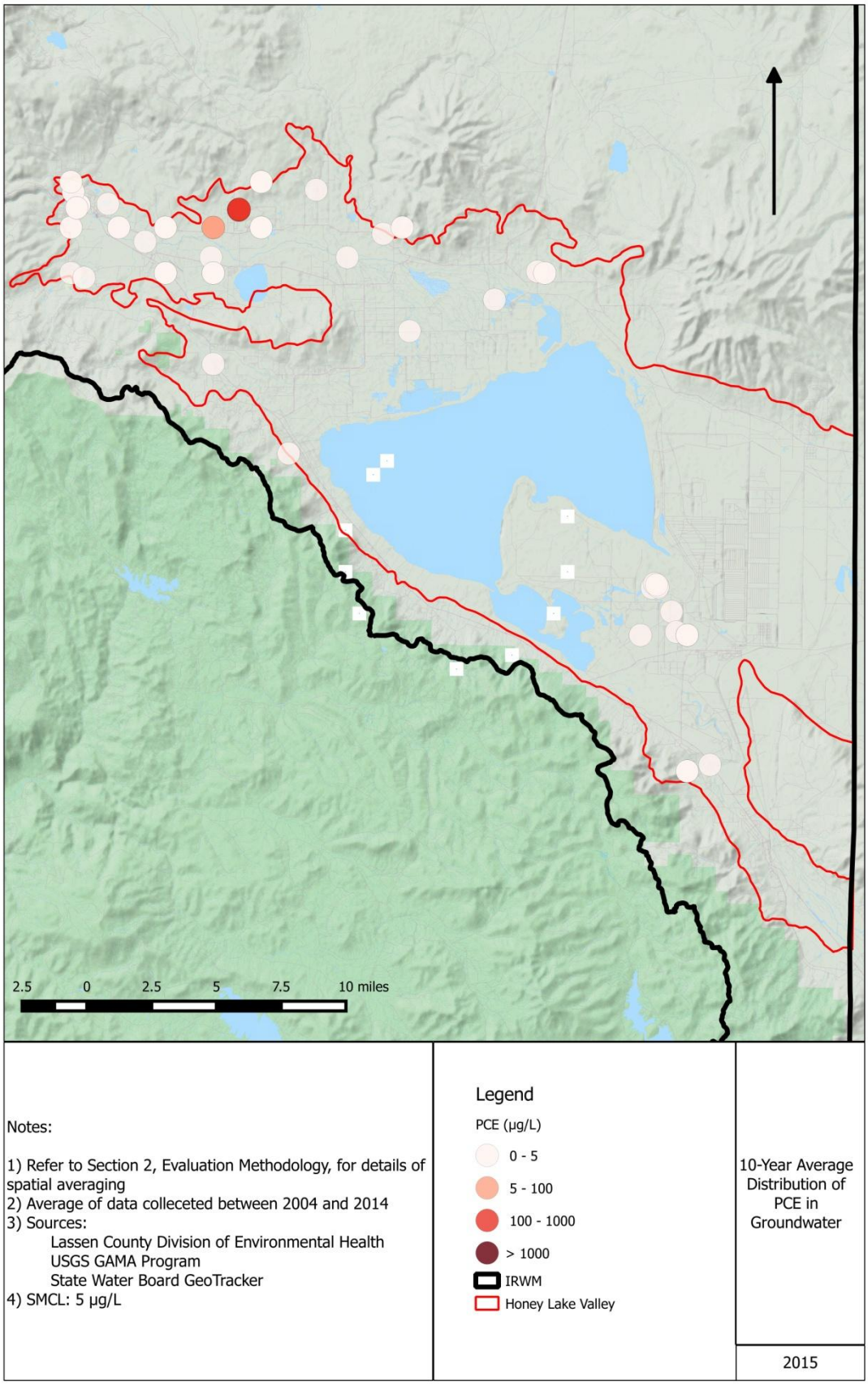


Figure 13 PCE Distribution in Groundwater

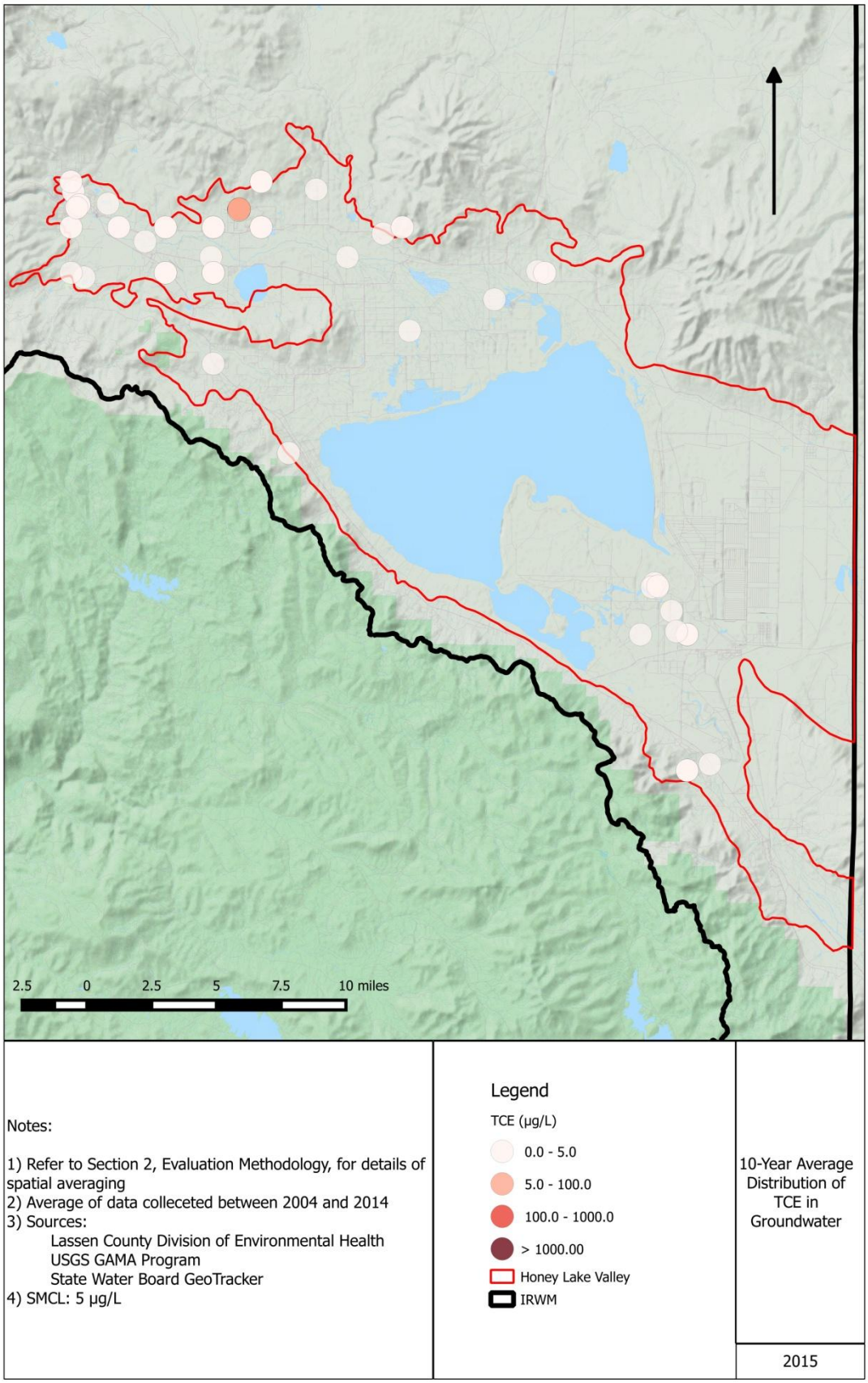


Figure 14 TCE Distribution in Groundwater

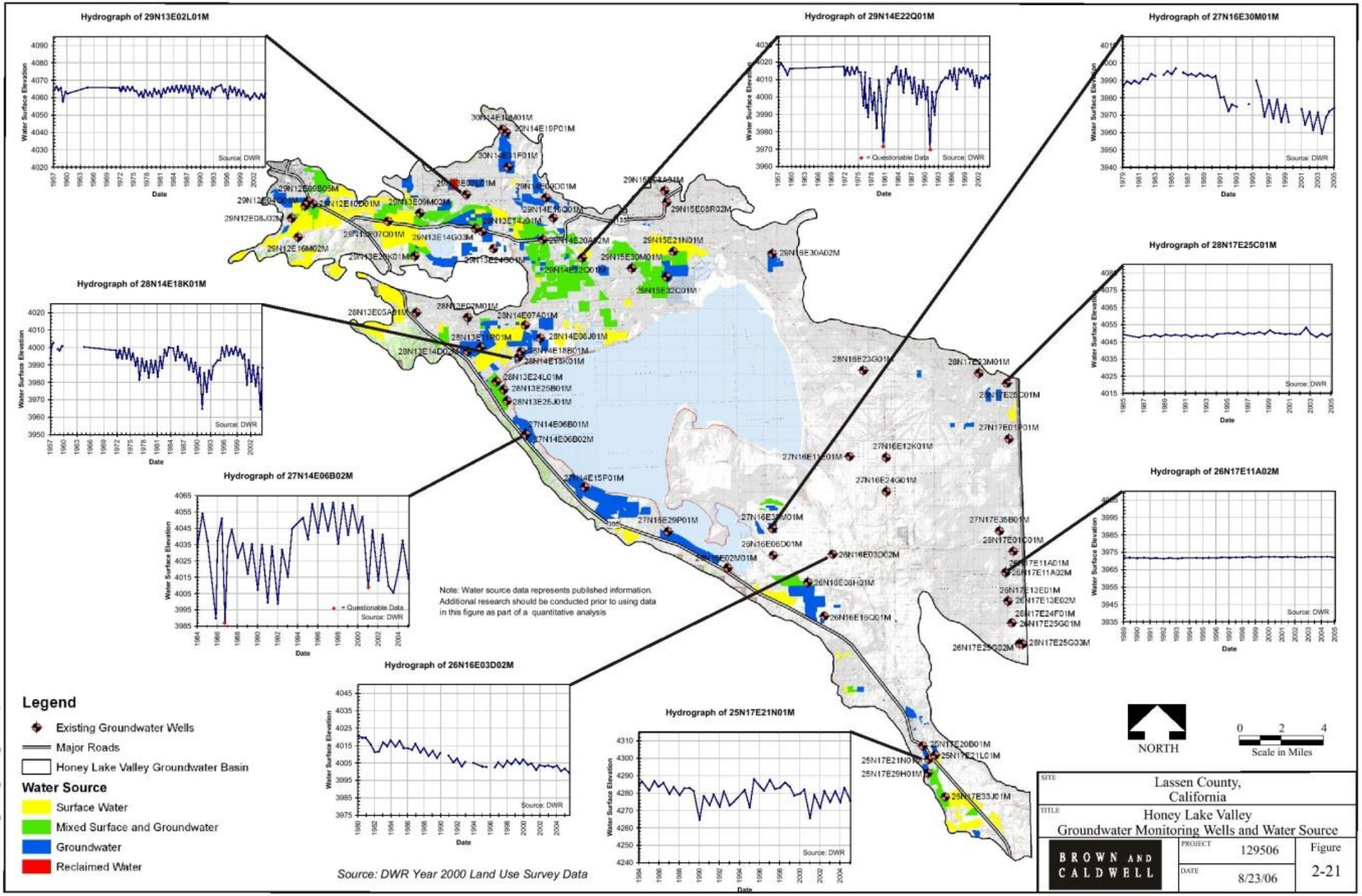


Figure 15 Honey Lake Valley Groundwater Hydrograph