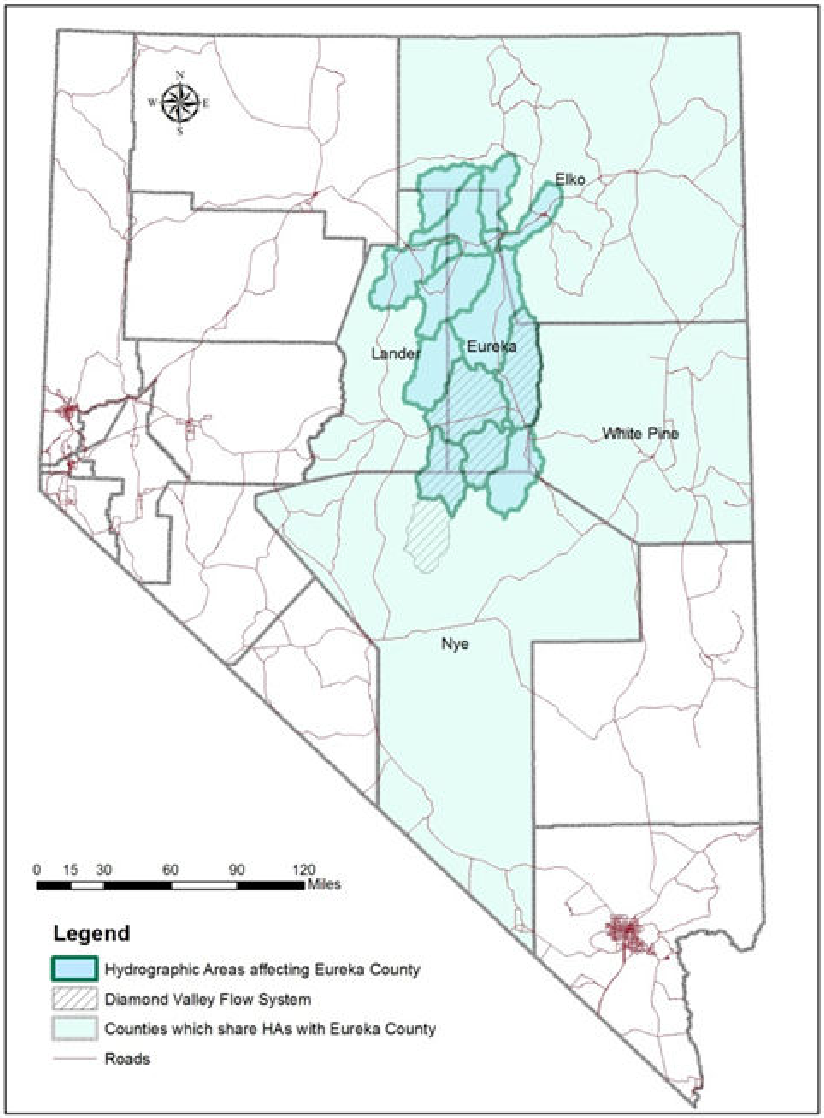
EUREKA COUNTY

WATER RESOURCES MASTER PLAN



September 2016

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Abbreviations and Definitions

ADD – Average Day Demand
af – acre-foot
af/yr – acre-feet per year
BARCAS – Basin and Range Carbonate Aquifer System
BHPS - Bureau of Health Protection Services
BLM - Bureau of Land Management
BMRR – Bureau of Mining Regulation and Reclamation
BSDW – Bureau of Safe Drinking Water
BWPC - Bureau of Water Pollution Control
BWQP – Bureau of Water Quality Planning
CMA – Critical Management Area
CNRWA – Central Nevada Regional Water Authority
DNRPCA – Diamond Natural Resources Protection and Conservation Association
EPA – Environmental Protection Agency
ET – evapotranspiration
FEMA - Federal Emergency Management
GID – General Improvement District
GMP – Groundwater Management Plan
gpd – Gallons per Day
HA – Hydrographic Area
HRBWA – Humboldt River Basin Water Authority
MCL – Maximum contaminant Level
MDD – Maximum Day Demand
mgd – Million Gallons per Day
mg/l – milligrams per liter
NAC – Nevada Administrative Code
NDEP – Nevada Division of Environmental Protection
NFIP - National Flood Insurance Program
NHD – National Hydrography Dataset
NRS – Nevada Revised Statutes
NSE – Nevada State Engineer
POD – Point of Diversion
PRISM – Parameter-elevation Regressions on Independent Slopes Model
SWAP - Source Water Assessment Program
TDS – Total dissolved solids
TMDL – Total Maximum Daily Load

Acre-foot - The amount of water it takes to cover an acre of land with water to a depth of 1 foot. It is equivalent to approximately 325,900 gallons of water. The annual duty of a water right is commonly defined in terms of acre-feet per year.

Appropriated Water Right – The right to use surface or groundwater acquired through the permit process.

Aquifer - (1) A geologic formation, a group of formations, or a part of a formation that is water bearing. (2) A geological formation or structure that stores or transmits water, or both, such as to wells and springs. (3) An underground layer of porous rock, sand, or gravel containing large amounts of water. Use of the term is usually restricted to those water-bearing structures capable of yielding water in sufficient quantity to constitute a usable supply. (4) A sand, gravel, or rock formation capable of storing or conveying water below the surface of the land. (5) A geologic formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield significant quantities of water to wells and springs.

Beneficial Use – (1) The amount of water necessary when reasonable intelligence and diligence are used for a stated purpose. (2) A use of water resulting in appreciable gain or benefit to the user, consistent with state law, which varies from one state to another. Most states recognize the following uses as beneficial: domestic and municipal uses, industrial uses, irrigation, mining, hydroelectric power, navigation, recreation, stock raising, public parks, wildlife and game preserves.

Critical Management Area – A hydrographic area or portion of a hydrographic area where the NSE recognizes that withdrawals of groundwater have consistently exceeded the perennial yield of the basin or a portion of the basin and where water levels continue to decline.

Decreed Water Rights - Water rights determined through the adjudication process and memorialized by a court decree. Decrees are primarily associated with surface water rights.

Discharge – The processes by which groundwater is removed from a hydrographic area or an aquifer, including evapotranspiration, spring and seeps, seepage to streams, and pumping by wells.

Ephemeral streams – Streams that flow only for a short time after a precipitation event.

Evapotranspiration - The combined processes by which water is transferred from the earth surface to the atmosphere; evaporation of liquid or solid water plus transpiration from plants. Evapotranspiration occurs through evaporation of water from the surface, evaporation from the capillary fringe of the groundwater table, and the transpiration of groundwater by plants whose roots tap the capillary fringe of the groundwater table.

Flood plain – The low-lying, relatively flat area along a stream that floods.

Hydraulic fracturing - An oil and gas well stimulation process used by the petroleum industry to enhance the recovery of petroleum and natural gas; commonly referred to as "fracking."

Hydrographic area - A defined geographic area, sub-area, sub-basin, basin, region or watershed encompassing the drainage area or catchment area of a stream, its tributaries, or a portion thereof. In Nevada, it is an administrative geographic division employed by the NSE to regulate groundwater resources (commonly referred to as a *groundwater basin*). There are a total of 256 Hydrographic Areas and Hydrographic Sub Areas in Nevada.

Intermittent stream – A stream that flows only part of the year.

Nonpoint source pollution – Pollution caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands, coastal waters and groundwaters.

Perennial Stream – A stream that flows year round.

Perennial Yield – The maximum amount of groundwater that can be salvaged each year over the long term without depleting the groundwater reservoir. Perennial yield is ultimately limited the maximum amount of natural discharge that can be salvaged for perennial use. The perennial yield cannot be more than the natural recharge to a groundwater basin and in some cases is less. If the perennial yield is exceeded, groundwater levels will [continue to] decline and steady state conditions will not be achieved, a situation commonly referred to as groundwater mining. Commonly used interchangeably with *Safe Yield*.

Phreatophyte – Plants whose roots tap the capillary fringe of the groundwater table.

Primary Drinking Water Standard – The Maximum Contaminant Level for contaminants in water that present a risk to human health.

Public Water Reserve No. 107 – In 1926, President Coolidge signed an executive order to preserve access to water on public lands for stock watering and to preserve watering places for travelers. The purpose of PWR 107 was to reserve natural springs and water holes yielding amounts in excess of homesteading requirements.

Public Water System - A system, regardless of ownership, that provides the public with water for human consumption through pipes or other constructed conveyances, if the system has 15 or more service connections, as defined in NRS 445A.843, or regularly serves 25 or more persons.

Recharge – The process by which water is added to an aquifer, including *natural recharge* by which precipitation or stream flow makes its way into the groundwater supplies, *secondary recharge* by which water used for irrigation or other purposes infiltrates the ground and adds to the groundwater supplies, or *artificial recharge* which includes actions specifically designed to increase groundwater supplies.

Reserved Water Rights - A category of federal water rights created by federal law and recognized by judicial decision. These rights are created when the federal government withdraws land from the public domain to establish a federal reservation such as a national park, forest, or Indian reservation (not to be confused with Public Water Reserve No. 107).

Secondary Drinking Water Standard - Guidelines for contaminants in water that address aesthetic considerations such as taste, color and odor.

Secondary Recharge - Water that returns to the aquifer(s) in a hydrographic area after use, such as infiltration of a portion of water applied for irrigation, infiltration of effluent from a waste water treatment facility, water pumped to dewater mines that is returned to the aquifer by means such as infiltration, heat-spent geothermal fluids that are re-injected to the geothermal reservoir, etc.

Spring - A concentrated discharge of ground water coming out at the surface as flowing water; a place where the water table crops out at the surface of the ground and where water flows out more or less continuously; includes seasonal springs or seeps

Subsisting water rights – A State of Nevada right to water livestock on open range based on documented continuous use of the water for stock watering purposes virtually anywhere within a grazing allotment or on private land.

Total Dissolved Solids – A measure of the combined content of all inorganic and organic substances contained in a liquid; commonly reported in mg/l.

Total Maximum Daily Load – The maximum amount of a pollutant that a body of water can receive while still meeting water quality standards. Alternatively, TMDL is an allocation of that water pollutant deemed acceptable to the subject receiving waters.

Vested Water Right - The water right to use either surface or ground water acquired through more or less continual beneficial use prior to the enactment of water law pertaining to the source of the water (prior to 1905 for surface water and prior to 1939 for groundwater).

303(d) list - The list of impaired and threatened waters (stream/river segments, lakes) that the Clean Water Act requires all states to submit for EPA approval every two years on even-numbered years.

Acknowledgement

The 2016 Eureka County Water Resources Mast Plan is the result of collaboration between the residents of Eureka County and Eureka County governmental entities and their staff. The Plan could not have been completed without their help as well as input from other members of the community whose names do not appear below. The following individuals provided specific information, guidance and expertise essential to the plan.

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Eureka County Board of County Commissioners

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Michael Sharkozy, Vice Chairman
Fred Etchegaray, Member

Eureka County Planning Commission

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Robin Hicks, Vice Chairman
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Eureka County Natural Resources Advisory Commission

Jim Baumann, Chairman
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Leo Damele
Mike Rebaleati
Jim Wise
Mike Protani

Eureka, Nevada October 6, 2016

RESOLUTION OF THE BOARD OF EUREKA COUNTY COMMISSIONERS APPROVING THE 2016 EUREKA COUNTY WATER RESOURCES MASTER PLAN

WHEREAS, the Nevada Legislature determined that it is the policy of the State of Nevada to continue to recognize the critical nature of the State's limited water resources; and

WHEREAS, the Nevada Legislature recognizes the important role of water resource planning and that such planning must be based upon identifying current and future needs for water; and

WHEREAS, the purpose of the State's water resource planning is to assist the State, its local governments and its citizens in developing effective plans for the use of water; and

WHEREAS, N.R.S. Chapter 278 enables counties to prepare, conduct hearings on, and adopt a plan for the development and orderly management of the County; and

WHEREAS, the Eureka County Natural Resources Advisory Commission contributed to the development of a Water Resources Master Plan for Eureka County; and

WHEREAS, on the August 1, 2016, the Eureka County Planning Commission held a public hearing, after which they voted to approve the 2016 Eureka County Water Resources Master Plan; and

WHEREAS, the Eureka County Planning Commission recommended the Board of Eureka County Commissioners approve the 2016 Eureka County Water Resources Master Plan; and

WHEREAS, on September 20, 2016, the Board of Eureka County Commissioners held a public hearing on the 2016 Eureka County Water Resources Master Plan, and upon conclusion of the hearing, the Commissioners voted unanimously to adopt the Plan, which is comprised of 245 pages and includes maps and charts; and

WHEREAS, the Board of Eureka County Commissioners finds, pursuant to N.R.S. 278.020, the 2016 Eureka County Water Resources Master Plan promotes the health, safety, and general welfare of the community; and

WHEREAS, the maps, findings and policy options contained within the Plan are severable and if any portion thereof is found to be invalid by a court of competent jurisdiction, the Board finds that the remaining elements are intended to survive and remain in effect;

NOW, THEREFORE, BE IT RESOLVED, that the Board of Eureka County Commissioners does hereby find that the 2016 Eureka County Water Resources Master Plan conforms to N.R.S. 278.150 to N.R.S. 278.210, inclusive, and the same shall be, and hereby is, adopted as an addition to and will now be a part of the 2010 Eureka County Master Plan. A copy of this Resolution shall be placed with the Plan.

Adopted this 6th day of October 2016.

Approved this 6th day of October, 2016.

Ayes: GOICOECHEA, SHARKOZY, ETCHEGARAY
Nays: NONE

J.J. Goicoechea, Chairman
Eureka County Board of Commissioners

Attest:

Beverly Conley
Clerk of the Board

1.0 EXECUTIVE SUMMARY

1.1 WHY PREPARE A COUNTY WATER RESOURCE MASTER PLAN?

Water resources in Nevada are allocated according to the prior appropriation doctrine, which can be summarized as “first in time, first in right.” In Nevada, water resources belong to the public and permission to use the water – a water right - is administered by the Nevada State Engineer (NSE) through the appropriation and adjudication processes. Rights to the use of groundwater and surface water can be obtained via appropriation. Adjudication as described in the Nevada Revised Statutes (NRS) commonly applies only to surface water but can apply to groundwater. Virtually all streams in Nevada are either fully appropriated or have been adjudicated. Adjudication can also be accomplished through Federal court for streams shared with a neighboring state.

The *hydrographic area* (abbreviated HA, also commonly referred to as a groundwater basin) is an administrative geographic division employed by the NSE to regulate groundwater resources. In Nevada, there are a total of 256 hydrographic areas and *hydrographic sub areas*. The NSE is authorized through the NRS to regulate the use of the resource of an individual HA in the context of its *perennial yield*. That is, in order to prevent mining the water resource and to provide for its sustainable use, groundwater rights should be restricted to the natural discharge from a basin that can be captured and put to *beneficial use*. Typically, capturing discharge is accomplished through the use of wells.

This beneficial use of the resource has consequences. These include lowering the water table, reduction of spring discharge or stream flow, fugitive dust, drying of wet meadows and land which is naturally *sub-irrigated*. These changes can lead to conflicts between junior (later in time) and senior (earlier in time) water rights. Water planning helps resource users recognize these consequences and can lessen or eliminate these conflicts.

1.1.1 Water Planning on the State Level

The hydrographic area is also the basic water resource planning unit in Nevada. Presently, water planning on the State level is embodied by an attempt to balance the committed water rights with estimates of the resource within a specified region or hydrographic area. However, there are many examples of where this objective has not been met.

Statewide water resource planning in Nevada was initiated in 1977 and a State Water Plan was updated in 1999 by the Nevada Division of Water Planning. Soon after completion of the update, the Water Planning Division was abolished and responsibility for water planning since then has largely been relegated to the counties or other local entities, but the Water Planning Section of the Division of Water Resources continues to assist with local water planning efforts.

1.1.2 Eureka County Land and Water Resources Planning

Inclusion of a water resource element of a land use master plan is authorized under NRS 278.160.1.(b) which plainly states a land use master plan may include a Conservation Plan

> *"For the conservation, development and utilization of natural resources, including, without limitation, water and its hydraulic force, underground water, water supply."*

The current Eureka County Master Plan was adopted in 2010 and includes a Water Resource Element. The Master Plan together with the Eureka County Code express the County's goals, objectives and policies intended to safeguard water resources within the County in the hope that water will be available to future generations. A primary purpose of the County's Water Resources Master Plan is to flesh out the details of the County Master Plan Water Resource Element.

1.1.2.1 Eureka County Water Resources Master Plan Goals and Objectives

<u>Goal</u>

The goal of this Eureka County Water Resources Master Plan (Plan) has its origin in the Water Resource Element of the Eureka County Master Plan and the Eureka County Code. As stated in the Eureka County Code

> *"Eureka County will continue to work to maintain its water resources in a condition that will render it useable by future generations for the full range of beneficial uses that further a viable and stable economic and social base for its citizens."*

In essence, it is the County's aim to provide sufficient information and guidance so the residents, local officials, State and Federal Agencies promote development and protection of the water resources within the County in a manner that ensures the resource will be available in perpetuity.

<u>Objectives</u>

The Plan includes objectives which are essential to meeting its stated goal. These are:

1) Quantify the water resources available for use in the 16 hydrographic areas which comprise the County's Water Resource Master Plan planning area.
2) Estimate the amount of water which is currently being consumed within the planning area.
3) Identify areas where water use currently exceeds the supply or may someday outstrip supply if all approved water rights were to be put to beneficial use.
4) Estimate how much water may be available for future growth and provide insight as to where these supplies might be developed.
5) Identify the issues that might affect water supplies within the County and help residents recognize how these issues might affect them. These concerns may be related either to water quantity or water quality.
6) Raise residents' awareness of the potential threat from flooding within the County.
7) Ensure that water and water resource related management actions are consistent with Eureka County plans, policies, and desires through local, grass-roots planning and management of the water resources within Eureka County.
8) Help stakeholders identify, evaluate and implement management strategies to address water-resource issues.

9) Coordinate with the Central Nevada Regional Water Authority, the Humboldt River Basin Water Authority, local entities such as the Eureka County Conservation District, and state and federal agencies to efficiently manage the resource to the benefit of all stakeholders in a manner consistent with County policies and the letter of the applicable laws.

1.2 Water Resources in Eureka County

1.2.1 Geology

The occurrence, movement and availability of groundwater are governed by the hydraulic properties of geologic formations. Eureka County is located within what is referred to as the Basin and Range Physiographic Province which is characterized by broad north-south trending valleys separated by mountain ranges. Groundwater resources in the Basin and Range have been developed from bedrock and basin-fill or alluvial *aquifers*. The alluvial aquifers within the valley-fill deposits are primarily comprised of sediments eroded from the mountains and transported by water to the valleys. The valley-fill deposits are hundreds to thousands of feet thick, but the entire thickness of these deposits may not constitute productive aquifers. Often, a large percentage of the total thickness of the valley fill sediments is fine-grained and, therefore, does not yield developable quantities of groundwater to wells. Bedrock underlies the valley-fill deposits and makes up the mountains separating the valleys. Carbonate bedrock (especially limestone) can form aquifers capable of transmitting and producing large quantities of groundwater. These underlie some, but not all, of the basin-fill deposits in Eureka County and they comprise large portions of the mountain ranges which separate the individual groundwater basins. Where continuous over a large area, the carbonate rocks can readily transmit groundwater from one basin to another or enable pumping in one basin to affect adjacent basins. The Diamond Valley Flow System is one such regional flow system linking Monitor Valley, Kobeh Valley, Antelope Valley, Stevens Basin and Diamond Valley. The terminus of the system is the playa in northern Diamond Valley where groundwater historically discharged in the northern half of the valley.

1.2.2 Groundwater Resources

The footprint of Eureka County touches on portions of 16 hydrographic areas within two regions (Figure 1-1). These are:

<u>Humboldt River Basin</u>

- The Elko Segment Hydrographic Area
- The Mary's Creek Hydrographic Area
- The Maggie Creek Hydrographic Area
- The Pine Valley Hydrographic Area
- The Crescent Valley Hydrographic Area
- The Lower Reese River Valley Hydrographic Area
- The Whirlwind Valley Hydrographic Area
- The Boulder Flat Hydrographic Area
- The Rock Creek Valley Hydrographic Area

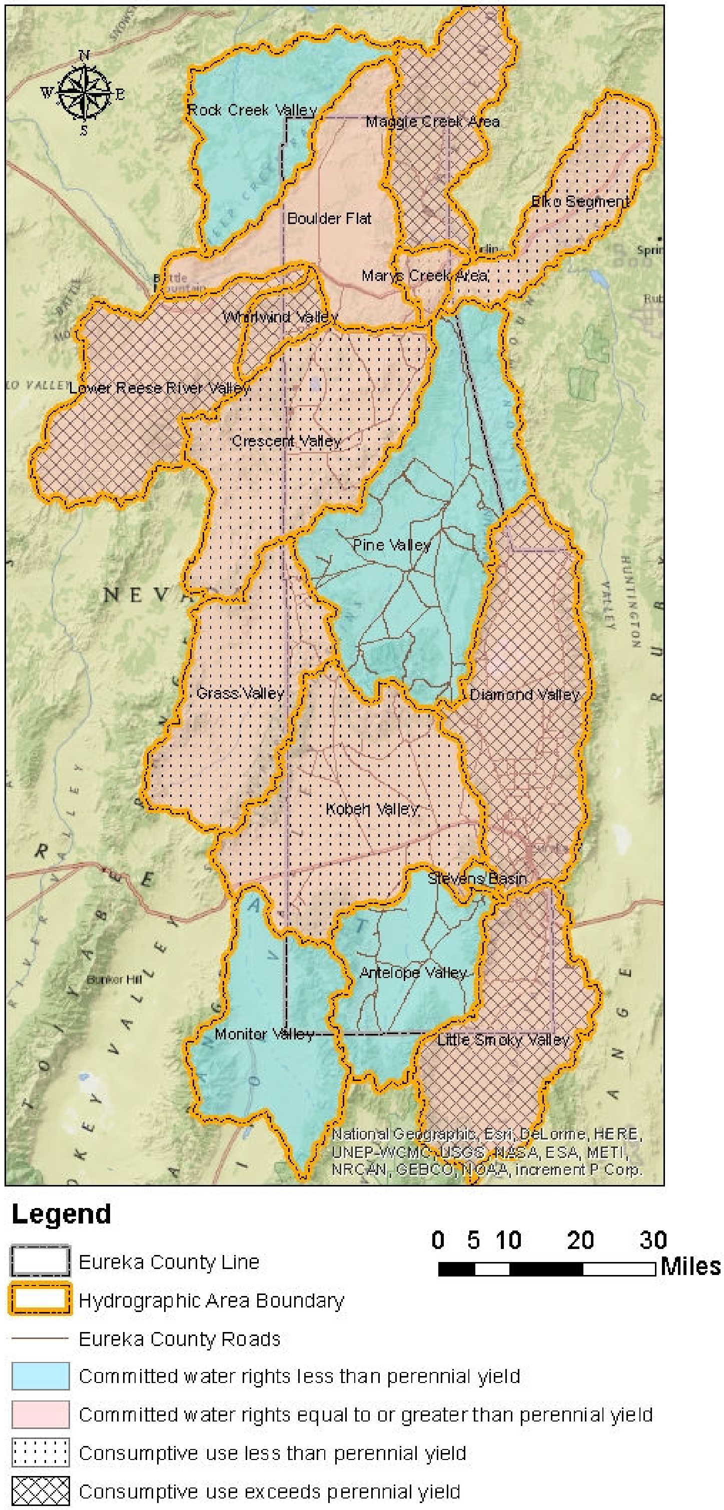


Figure 1-1 Comparison between Perennial Yield, Committed Water Rights and Consumptive Use for Hydrographic Basins Affecting Eureka County.

- The Grass Valley Hydrographic Area

Central Region

- The Kobeh Valley Hydrographic Area
- The Monitor Valley (Northern Part) Hydrographic Area
- The Antelope Valley Hydrographic Area
- The Stevens Basin Hydrographic Area
- The Little Smoky Valley (Northern Part) Hydrographic Area
- The Diamond Valley Hydrographic Area

All but one, Stevens Basin, is shared with the neighboring counties – Lander, Elko, White Pine and Nye Counties. The combined estimated perennial yield of the basins is approximately 181,000 acre-feet per year (af/yr).

More than 3,000 wells have been drilled within Eureka County to explore for, monitor, and exploit groundwater resources. The vast majority of wells have been drilled by the mining industry, followed by the agricultural industry. Wells have also been drilled for individual residential use (domestic wells), stock watering, public water supplies and various industries including gravel mining operations, road construction, and power generation, including power generation by the geothermal industry.

1.2.3 Surface Water Resources

More than 1,600 springs and seeps have been catalogued within Eureka County and approximately 325 miles of streams have been classified as *perennial* streams. The largest stream is the Humboldt River with an average annual flow, measured at Palisade in northern Eureka County, of approximately 291,000 af/yr. The principal perennial stream entirely within Eureka County is Pine Creek, a tributary to the Humboldt River. Most streams in the County's planning area are perennial only in the mountains or for relatively short distances below the range front. Stream flow that infiltrates the underlying geologic deposits represents a major component of recharge to aquifers. *Intermittent* streams provide valuable sources of water supply for the period of the year when there is flow and also recharge basin aquifers.

Virtually all streams in Eureka County are fully appropriated or have been adjudicated. The water from many springs has been appropriated and the flows of literally hundreds of springs and seeps are the subject of claims to vested rights that have yet to be determined through the adjudication process. Many springs are also the subject of claims to public reserve water rights filed by Federal agencies.

1.3 Current Groundwater Rights in Eureka County

The NSE has approved more than 400,000 af/yr of groundwater rights in the 16 hydrographic basins comprising the County's Water Resources Master Plan study area. This equates to approximately two and a half times the combined estimated perennial yield of the 16 basins (approximately 181,000 af/yr). Committed groundwater rights exceed the perennial yield in 11 hydrographic areas (see Figure 1-1). Committed groundwater rights are presently less than perennial yield in Pine Valley, Rock Creek, Monitor Valley, Antelope Valley and Stevens Basin. However, unappropriated water in these basins total less than about 4,000 af/yr. If pending applications in Pine Valley are approved by the NSE, then it will become fully appropriated, leaving only three of the 16 basins with unappropriated water.

The small amount of unappropriated groundwater in Eureka County underscores the need to plan for future use of the resource.

1.4 Chemical Quality of Water in Eureka County

1.4.1 Groundwater Quality

With some exceptions the chemical quality of groundwater within much of Eureka County meets current drinking water standards. These exceptions include:

- The shallow groundwater near the playa in northern Diamond Valley (the discharge area for the Diamond Valley flow system) exceeds the drinking water standard for multiple chemical constituents. These exceedances are caused by a combination of dissolution of salts from the playa soils and evaporation.
- TDS (total dissolved solids) is elevated near mineralized areas in the vicinity of Mt. Hope, the former Gold Bar project in Kobeh Valley, the geothermal resource in Whirlwind Valley, and near the oil fields in Pine Valley.
- Arsenic in groundwater exceeds the drinking water standard in several areas of the county. It is frequently, but not always, associated with mineral deposits exploited by the mining industry. These areas include parts of southern Diamond Valley, near the southern flank of Roberts Mountain, the area near Cortez, parts of Crescent Valley, parts of Boulder Flat and Maggie Creek HAs. High arsenic is also associated with the geothermal resource in Whirlwind Valley and brines from the oil fields in Pine Valley. The water supply for the community of Crescent Valley is treated to remove arsenic.

Water-quality data are limited over large portions of the County and the absence of data should not be construed to mean that the water quality throughout the County will meet all the drinking water standards.

1.4.2 Surface Water Quality

The chemical quality of many streams in Eureka County has been assessed by the Nevada Division of Environmental Protection. Standards of Water Quality for beneficial uses have been developed for:

- The Humboldt River from Battle Mountain to Osino,
- Maggie Creek from where it is formed at its tributaries down-steam to the Humboldt River,
- The JD ponds,
- Denay Creek from its origin to Tonkin Reservoir, Tonkin Reservoir and Denay Creek downstream of Tonkin Reservoir,
- Rock Creek below Squaw Valley Ranch,
- Roberts Creek, and
- Fish Springs Pond.

The 303(d) List of Impaired Waters relates to streams where standards of water quality are not being met. In Eureka County, the list includes:

- The Humboldt River from Palisade to Battle Mountain,
- Maggie Creek from where it is formed by tributaries downstream to its confluence with Soap Creek,
- Pine Creek from its confluence with Dry Creek to the Humboldt River,
- Rock Creek below Squaw Valley Ranch, and
- Trout Creek from its origin to Pine Creek.

The U.S.E.P.A. has approved Total Maximum Daily Loadings (TMDLs) for the Humboldt River from Osino downstream to Battle Mountain.

1.5 Water Resources Available for Growth

The total combined quantity of committed water rights for the basins comprising the Eureka County Water Resources Master Plan planning area is more than double the estimates of perennial yield. Current consumptive use over the same area is estimated at approximately 70% of the perennial yield, but there are basins where consumptive use exceeds the perennial yield (Figure 1-1). Where water rights exceed the available resource, the NSE is unlikely to grant new appropriations. In fact, Nevada water law requires applications be denied if there is no unappropriated water at the source.

Water resources to sustain future growth within the county must come from several sources. These are:

- The basins in Eureka County where committed water rights are less than perennial yield (Rock Creek Valley, Pine Valley, Monitor Valley, Antelope Valley, and Stevens Basin). However, the combined amount of unappropriated groundwater in the hydrographic areas is relatively small.
- Water conservation, primarily through improved irrigation efficiency or introduction of low-water use crops.
- Temporary mining water rights reverting back to the source at the conclusion of mining projects.

The Nevada State Engineer routinely has approved "temporary" water rights in excess of the perennial yield for mining projects. The NSE's rationale for provisionally approving mining water rights in this case is that a mine has a finite life. After it ceases operation and its water use ends the basin may return to a condition where use is less than perennial yield. However, this rationale has not been extended to other beneficial uses, with one notable exception. The NSE over-appropriated Diamond Valley by a factor of six under the rationale that the vast majority of farmers would be unsuccessful and economic forces would ultimately result in water use in the basin reaching equilibrium with recharge. However, there is no basis in the statutes for this type of management scheme.

1.6 Future Public Water Supply and Domestic Well Demand

Population in Eureka County is strongly influenced by the boom and bust cycles of the mining industry. In the past 20 years the population in Eureka County as a whole has twice jumped by 30 percent followed by a sharp decline. Thus, the cyclical trends in population make predicting future population somewhat speculative; therefore, assessing future water demand involves a significant degree of uncertainty.

Absent short-term spikes in population, the trend in Eureka County for the past 20 years has been modest, nearly flat. However, to be conservative for planning purposes, a linear trend was fitted to population data for the past 20 years to estimate the population 20 years into the future (through 2035).

1.6.1 Projected Future Water Demand for the Town of Eureka Water System

The current capacity of the Town of Eureka Water System supplied from two wells in Diamond Valley and 10 springs in the mountains south of the Town is 1,366,000 gallons per day (gpd). The Average Day Demand (ADD) is 150,000 gpd (165 af/yr) and the Maximum Day Demand (MDD) is 450,000 gpd. At 100 percent build out, the ADD is estimated to be 532,000 gpd and the MDD is estimated to be 1,340,000. The current sources are sufficient to meet the buildout demand.

At the current rate of population growth it will take many decades for build out of the system to occur. For planning purposes, a 20 year planning horizon was evaluated. In 2035, the ADD is projected to be 161,000 gpd and the MDD projected to be 483,000 gpd, well below the buildout demand.

1.6.1.1 Issues Potentially Affecting the Town's Water Supply

The Diamond Valley Hydrographic Area is severely over appropriated and water consumption is approximately double the perennial yield. More than 40 years of mining the aquifer has led to large-scale drawdown over a large part of southern Diamond Valley. Senior users have recently demanded the courts to compel the Nevada State Engineer to curtail groundwater pumping by junior appropriators, one of which is the Eureka Town Water System. If the action is successful, the Town could be faced with purchasing senior water rights or importing water from outside of Diamond Valley to assure a water supply. To supply the current demand, the County might need to acquire approximately 167 acre-feet of senior water rights. To meet the demand projected for 20 years into the future, the County would need to acquire approximately 596 acre-feet of senior groundwater rights.

The alternative to a curtailment action is a Groundwater Management Plan in response to designating Diamond Valley as a Critical Management Area (see 1.8.1, below). The reality of the situation is groundwater pumping in the basin will likely need to be reduced by 50 to 60 percent.

1.6.2 Projected Future Water Demand for the Devil's Gate GID Water System

The current capacity of the Devil's Gate GID Water System is 177,120 gpd supplied from two wells in Diamond Valley. The Current ADD is 31,756 gpd and the MDD is 95,268 gpd. At buildout, the ADD increases to 76,448 gpd and the MDD is estimated to be 198,720 gpd. Comparison with the current well capacity shows the system to be incapable of meeting the buildout demand. To do so, the GID would need to acquire additional water rights and drill an additional well.

Similar to the Town of Eureka Water System, at the current population trend, buildout is likely to be decades away. Projecting the current average population trend 20 years into the future (2035) predicts the ADD to be 35,600 gpd and the MDD to be 106,800 gpd, both of which can be met with the current capacity of the GID's water wells.

1.6.2.1 Issues Potentially Affecting the GID's Water Supply

The Devil's Gate GID is faced with issues similar to those faced by the Town of Eureka Water System, except their situation is even more tenuous. The GID's rights are more junior than the Town's rights and it does not have a backup source from springs in the mountains south of the Town. To meet the current ADD the GID would need to acquire approximately 36 acre-feet of senior water rights and approximately 40 acre-feet of senior water rights to meet the projected ADD 20 years in the future.

To further complicate matters, water levels in the GID wells are approaching the depth of the bottom of its two water supply wells. At the current rate of decline, the wells may not be capable of meeting the current demand as early as 2017 or 2020.

1.6.3 Projected Future Water Demand for the Town of Crescent Valley Water System

The current capacity of the Town of Crescent Valley Water System is 432,000 gpd supplied from two wells. All the water is treated to remove arsenic. The Current ADD is 146,000 gpd and the MDD is 438,000 gpd, which for all practical purposes can be met by the existing wells. At the current usage, at buildout the ADD is increases to 532,000 gpd and the MDD is estimated to be 1,351,000 gpd, which cannot be met by the existing sources. However, a considerable portion of the current usage is irrigation of the Town Park and these quantities can be reduced by improving efficiency of the park irrigation system.

By the year 2035, the ADD is projected to increase to 141,000 gpd and the MDD to 423,000 gpd if the irrigation usage at the park is reduced by 25 percent. With that reduction, the demands can be met by the current supply.

1.6.4 Projected Future Water Demand from Domestic Wells

The NSE estimated domestic well usage for 2013 in the 16 HAs comprising the County's water planning area to be 1,708 acre-feet, based on an assumed average domestic well use of 1.0 acre-feet per year. Most of this usage occurs outside of Eureka County, and the NSE estimated domestic well usage within the County for 2013 was 203 acre-feet, equivalent to 0.1 percent of all water pumped in the County.

Domestic wells in Nevada are permitted to pump up to 2.0 acre-feet per acre, but this can be reduced in a basin designated as a Critical Management Area. They can be drilled on a parcel of land one acre in size or larger. In Eureka County there are approximately 2,300 existing parcels larger than one acre where a domestic well could realistically be drilled. Parcels within or adjacent to active mining operations and parcels that are likely to be served by the three community water systems are not included in this total. The maximum quantity of water allowed by law for domestic wells on these parcels is 4,600 acre-feet per year, but may be closer to 2,300 af/year, given the NSE's estimate of actual use for a domestic wells. Compared to other uses, this quantity is small, slightly more than 1% of the water pumped in the 16 HAs during 2013. Because domestic well use is small and growth rates are modest, no estimates of increased domestic use by 2035 were made.

Eureka County's Master Plan addresses division of existing parcels. Large parcels can be divided so long as no lot proposed to be served by a domestic well and individual sewage system is less than 2.5 acres. For each new parcel, 2.0 acre-feet of water rights must be dedicated to the County and the ". . . form and type water rights . . . must be acceptable to Eureka County in all respects."

1.6.4.1 Issues Potentially Affecting Domestic Wells in Diamond Valley

The overdraft situation in Diamond Valley also has the potential to affect future domestic well use. A water right is not required for a domestic well in Nevada. They do have a "protectable interest" with a priority date equal to the date the well was completed. If Diamond Valley is designated as a Critical Management Area and water users cannot agree to a groundwater management plan, the NSE may curtail water use on the basis of priority, in accordance with state law. Only two domestic wells in Diamond Valley have a priority date old enough that they are likely immune from curtailment. It seems unlikely that the NSE would curtail pumping from domestic wells, but he does have the authority to reduce the quantity of water pumped from them.

1.7 Floodplain Management

A floodplain is the low-lying, relatively flat area along a stream that floods. Within Eureka County, the Federal Emergency Management Agency (FEMA) has classified approximately 340 square miles of land as floodplain for the so-called 100-year flood. FEMA's analysis does not address flash flooding that occurs as a result of high intensity, short duration storms. Flash floods are a fairly common phenomenon in Eureka County. Virtually all mountain drainages in the County have some chance of experiencing a flash flood in any given year, although flash flooding is nearly impossible to predict.

According to the Nevada State Water Plan, "Floodplain management consists of planning and implementing programs designed to alleviate the impact of flooding on people and communities." "The two overarching purposes of floodplain management at all levels are (1) to avoid or at least minimize the damage and disruption caused by floods, and (2) to protect natural floodplain resources and functions as much as possible."

Eureka County has no zoning regulations, in general, and no regulations governing land use in floodplains, in particular. The Eureka County Public Works Department maintains flood-control facilities such as roadside ditches, culverts and detention basins in the County.

1.8 Management Alternatives

There are at least four alternatives available to Eureka County with respect to meeting the County's goal and management objectives for the 16 hydrographic areas that affect Eureka County. Four alternatives include:

1. THE NO ACTION ALTERNATIVE - Rely solely on the Nevada State Engineer (NSE) to manage the water resources within the County.

2. THE REVIEW AND REACT MANAGEMENT ALTERNATIVE – Rely on the NSE to properly manage the resource, but intervene when the County's Master Plan, Water Resources Master Plan, County Code, or other plan or policy may be or is violated.

3. THE COORDINATED MANAGEMENT ALTERNATIVE – Provide data and technical assistance to and actively engage with the NSE and federal agencies to enhance science-based decision making.

4. THE ACTIVE MANAGEMENT ALTERNATIVE – Develop comprehensive land use or other regulations, plans or policies which will enable the County to administer water management plans and policies in parallel with the NSE and other applicable agencies.

Eureka County currently combines Alternatives 2 and 3 in their approach to water resource management in the County. Unfortunately, input from the County is often ignored by State and Federal agencies and science is not always incorporated into the decision-making process. Alternative 1 may require revisions to the County's current Master Plan and the Eureka County Code which currently requires the County to take an active role in water resource issues. Alternative 4 would require a change in the County's residents' present-day stance against any policy that even hints at zoning or similar land use regulation. No recommendation regarding a preferred alternative is provided in the Water Resource Master Plan.

Table 1-1

Summary of Management Alternatives

Alternative	Description	Advantages	Disadvantages
1-THE NO-ACTION ALTERNATIVE	Rely solely on the NSE to manage water resources and Federal Agencies to manage water-related resources in Eureka County	1. Little to no out of pocket expense to Eureka County.	1. May require amendment to Eureka County Code and Land Use Master Plan. 2. Possible high socio-economic costs if there is a conflict with County residents' interests. 3. May cause Eureka County to forfeit opportunity to challenge adverse decisions by agencies.
2-THE REVIEW AND REACT MANAGEMENT ALTERNATIVE	Rely on the NSE to properly manage the resources, but intervene when the County's Land Use Master Plan, Water Resource Master Plan or County Code or other plan or policy is violated.	1. Little to no initial out of pocket expense to Eureka County unless a conflict with County Code or Policies arises.	1. May cost more to appeal an adverse decision than to proactively try to resolve issues. 2. Possible high socio-economic costs if there is a conflict with County residents' interests.
3-THE COORDINATED MANAGEMENT ALTERNATIVE	Provide data and technical assistance to and actively engage with the NSE and Federal Agencies to enhance science-based decision making,	1. The NSE is encouraged by the Legislature to utilize the best available science in rendering decisions. 2. Reduces the likelihood for agencies to make a decision inconsistent with Eureka County Code or other plans and policies.	1. Data collection and analysis is expensive. 2. Agencies may ignore County data, information and analysis. 3. May result in an expensive appeal of a "bad" decision.

4-THE ACTIVE MANAGEMENT ALTERNATIVE	Develop comprehensive land use or other regulations, plans or policies which will enable the County to administer water management plans and policies in parallel with the NSE or other applicable agencies.	3. Provides authority for local control over water resource development. 4. Provides an opportunity for close cooperation between Federal and local governmental entities.	1. The current culture within Eureka County is strongly opposed to zoning. 2. The vast majority of land in Eureka County comprises public land administered by the BLM. The Federal Government, not Eureka County, has primacy over these lands. 3. Requires close cooperation between Federal Agencies and the County which is often difficult to achieve.
Note: Eureka County currently relies on a combination of Alternatives 2 and 3 to help manage water resources within the County.			

1.8.1 Other Management Options

Groundwater Management Areas represent a reactive approach to over appropriation of the resource which has resulted in mining of the resource evidenced by long-term continuous water-level declines with no end in sight, a situation that can be avoided through proper planning. They are discussed in the Water Resources Master Plan because the County, as a water rights holder, would likely be an active participant in the development of a Groundwater Management Plan along with the other water appropriators and users as opposed to serving as the entity which develops and implements the plan.

1.8.1.1 Critical Management Areas

Nevada law allows for some local control over groundwater resources in areas where the resource is incontrovertibly being depleted due to over-appropriation of the resource. Local control may be accomplished through the designation of a basin as a Critical Management Area and the development of a Groundwater Management Plan by the appropriators. Upon approval of the plan by the NSE, it becomes the basis for regulating use of the resource. In a Critical Management Area the water users can exert a degree of control over their destiny even if extreme measures might be required to address the problem. However, a CMA is not explicitly one of the four identified management strategies because it is reactionary rather than proactive, as planning should be.

Diamond Valley was designated as a CMA by the NSE on August 25, 2015 as a CMA, but any basin which meets the criteria is a possible future candidate. In response to designation as a CMA, water users in the Diamond Valley have initiated the water management process. Efforts to date have included:

- The Diamond Natural Resources Protection and Conservation Association (DNRPCA) sponsored two economic analyses by Hansford Economic Consulting that were funded by grants from the Eureka Board of County Commissioners to examine the economics of groundwater management strategies.
- The Eureka County Conservation District engaged Steve Walker of Walker and Associates to conduct two workshops in Eureka to poll residents as to their concerns, the issues and possible solutions. Steve also privately interviewed a number of water users in Diamond Valley for their input.

- The Conservation District circulated a questionnaire to all residents in Diamond Valley with valid post office boxes to poll the valley residents – irrigators, ranchers, domestic well users, Devil's Gate GID water users, Eureka Town water users, and mining interests - regarding whether or not they backed designation of the basin as a Critical Management Area. Approximately 75 percent of the poll respondents favored such a designation.
- The Conservation Districted began hosting a series of workshops a groundwater management plan in the fall of 2015 and these have continued into 2016. Attendees elected a Groundwater Advisory Committee to flesh out the components of a proposed plan and the water rights holders have been meeting regularly to develop the plan.

1.9 Adoption of the Plan by the Eureka County Planning Commission and the Board of County Commissioners

1.9.1 Adoption of the Water Resources Master Plan

A preliminary draft of the Plan was reviewed by Eureka County staff and a subsequent draft was then submitted to the Eureka County Natural Resources Advisory Commission. Their comments were incorporated in a second draft submitted to the Eureka County Planning Commission. The Planning Commission reviewed the draft and their comments were incorporated into the Plan. A public hearing was held by the Planning Commission to elicit input from Eureka County residents. Upon review of the draft, the Planning Commission forwarded the Plan to the Eureka County Board of Commissioners for their review and comment and, ultimately, their approval.

1.9.1.1 Public Hearings

NRS 278.210 states that "Before adopting the master plan . . . the commission shall hold at least one public hearing . . ." Public hearings were held in Eureka on August 1, 2016 and September 20, 2016.

1.9.1.2 Adoption of the Plan by the Eureka County Planning Commission and the Board of County Commissioners

The Eureka County Planning Commission held a public hearing August 1, 2016 to elicit comments from the public. Written public comments were received and the Planning Commission deliberated to respond to the comments. The public's comments and the commissioners' responses are provided in the Appendix. Upon completion of the hearing the Planning Commission approved the draft of the Plan and forwarded it to the Board of County Commissioners.

The Eureka County Board of County Commissioners held a public hearing September 20, 2016 to receive public comment on the plan. No public comments were received and the plan was approved by a unanimous vote of the Commissioners. The resolution adopting the Plan is incorporated into the document.

2.0 INTRODUCTION

2.1 WHY PREPARE A COUNTY WATER RESOURCE MASTER PLAN?

Precipitation in Nevada averages nine inches per year, which makes Nevada the driest state in the United States. So long as water use is small compared to the available resource and there is more than enough water to go around, there may be little incentive to manage the resource and plan for its future. However, as demand for water increases to the point where the resource approaches being fully committed or actually developed, competition for the resource intensifies and the need to plan for optimum use of the resource becomes palpable. Competition for scarce water supplies dates back thousands of years.

> Rival – from the Latin *rivalis*, one using the same stream as another.

The importance of water planning in Nevada is underscored by Chapter 540 of the Nevada Revised Statutes (NRS):

"NRS 540.011 Legislative declaration.

1. The Legislature determines that it is the policy of the State of Nevada to continue to recognize the critical nature of the State's limited water resources. It is acknowledged that many of the State's surface water resources are committed to existing uses, under existing water rights, and that in many areas of the State the available groundwater supplies have been appropriated for current uses. It is the policy of the State of Nevada to recognize and provide for the protection of these existing water rights. It is the policy of the State to encourage efficient and nonwasteful use of these limited supplies. It is also the policy of the State to encourage suppliers of water to establish prices for the use of water that maximize water conservation with due consideration to the essential service needs of customers and the economic burdens on businesses, public services and low-income households.

2. The Legislature further recognizes the relationship between the critical nature of the State's limited water resources and the increasing demands placed on these resources as the population of the State continues to grow.

3. The Legislature further recognizes the relationship between the quantity of water and the quality of water, and the necessity to consider both factors simultaneously when planning the uses of water.

4. The Legislature further recognizes the important role of water resource planning and that such planning must be based upon identifying current and future needs for water. The Legislature determines that the purpose of the State's water resource planning is to assist the State, its local governments and its citizens in developing effective plans for the use of water."

Anyone who doubts the importance of water planning on the local level need only refer to the administrative hearings held by the Nevada State Engineer in late 2011 to address applications by the Southern Nevada Water Authority (SNWA) to appropriate groundwater from Spring, Cave, Dry Lake, and Delamar Valleys. In their Exhibit 189, SNWA stated that up to 184,655 acre-feet per year of groundwater is needed to meet the future water supply demand in the Las Vegas area. During the hearings, SNWA unequivocally stated this groundwater supply will come from rural Nevada and for SNWA "The ongoing drought in the Colorado River Basin has made the development of permanent groundwater supplies the highest priority." In March of 2012, the Nevada State Engineer granted applications totaling 83,988 af/yr. The additional 100,000 af/yr requested, but not granted, looms as a threat to rural northeastern Nevada.

2.2 Water Planning on the State Level

Water planning on the State Level in Nevada is embodied by an attempt to balance the committed water rights with estimates of the sustainable water resources within a specific hydrographic area.

Statewide water resource planning in Nevada was initiated in 1977 and a State Water Plan was updated in 1999 by the Nevada Division of Water Planning. Soon after completion of the update, the Water Planning Division was abolished and responsibility for water planning since then has largely been relegated to the counties or other local entities. The current Water Planning Section of the Division of Water Resources provides some water planning assistance to counties and other entities. NRS Chapter 278 enables counties in Nevada to prepare and implement master plans. These master plans may include the management and use of water resources.

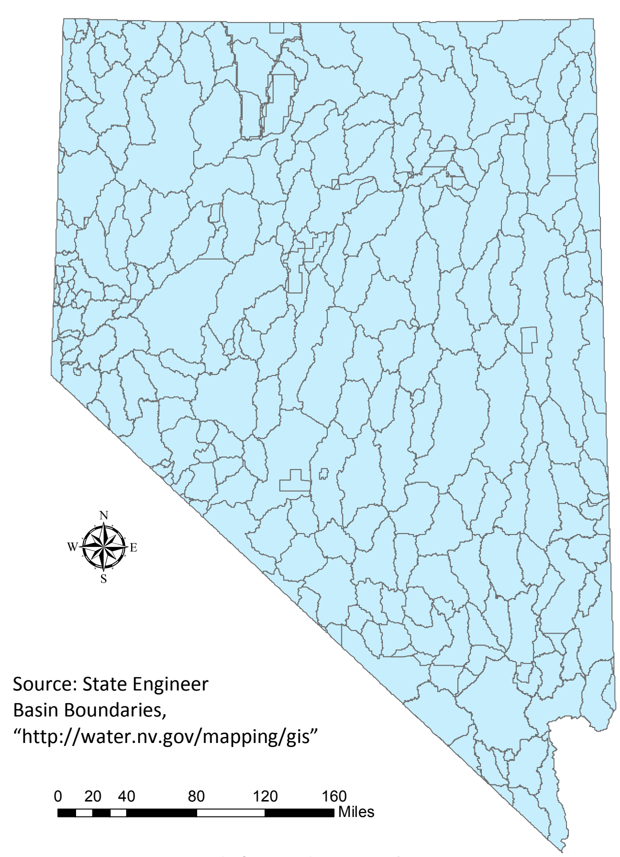


Figure 2-1. Nevada's Hydrographic Areas.

The *Hydrographic Area* is the basic water-resource planning unit in Nevada. There are 256 Hydrographic Areas and Sub Areas in the State.

The *Hydrographic Area* is the basic water resource planning unit in Nevada. In Nevada, there are 256 Hydrographic Areas and Hydrographic Sub Areas. These are depicted in Figure 2-1. ". . . *[I]n its most general sense, [a Hydrographic Area] may refer to a defined geographic area, sub-area,* *sub-basin, basin, region or watershed encompassing the drainage area or catchment area of a stream, its tributaries, or a portion thereof. Typically defined as a study area for analysis or planning purposes in which the land or undersea contours results in surface water flows or measures of elevation draining to a single point. At its smallest extent, a hydrographic area may encompass a single valley containing a single stream system, or a portion of a valley or stream system with distinctive drainage characteristics. At its greatest extent, a hydrographic area may encompass the entire drainage area of a major river system, e.g., the Mississippi River hydrographic area, including all tributary rivers, streams and other sources of surface water flow. Conventionally, a number of hydrographic subareas comprise a hydrographic area whereas a number of hydrographic areas comprise a hydrographic basin or region."* (http://water.nv.gov/ programs/planning/dictionary).

Presently, water planning on the State level is embodied by an attempt to balance the committed water rights with estimates of the resource within a specified region or hydrographic area (Rick Felling, NDWR Deputy Administrator, personal communication). However, this ideal has not been achieved in many areas throughout Nevada.

In other words, the state attempts a water budget approach to water planning, which can be represented by a simple water-budget equation for each hydrographic area:

Committed Water Rights [should be] ≤ Available Resource

The use of the water resource is sustainable in perpetuity so long as water use or committed water rights are less than or equal to the available water resources. Another way of looking at the water budget approach is:

Water in (recharge) = Water out (discharge)

A goal of this water budget approach is to limit the total amount of water consumed in a hydrographic area to less than the natural recharge or discharge. Prior to groundwater exploitation, the quantity of water entering a hydrographic area is in balance with water leaving it, a situation referred to as a steady-state or equilibrium condition. As groundwater is exploited (in other words, put to use) the components of the water budget can become a little more inclusive, but the basin will remain in balance so long as total discharge (natural plus anthropogenic) does not exceed total recharge.

The major components of a hydrographic area water budget include:

<u>Water in (recharge)</u>:

- *Recharge* to a hydrographic area arising from direct infiltration of precipitation;
- *Recharge arising from infiltration of stream flow* (water that leaks from a stream to the aquifer(s) in a hydrographic area);
- *Recharge arising from natural inter-basin inflow* (underground flow of water into one hydrographic area from an adjacent area); and
- *Secondary recharge* (water that returns to the aquifer(s) in a hydrographic area after use, such as infiltration of a portion of water applied for irrigation, infiltration of effluent from a waste

water treatment facility, water pumped to dewater mines that is returned to the aquifer by means such as infiltration, heat-spent geothermal fluids that are re-injected to the geothermal reservoir, *etc.*).

Water out (discharge):

- *Natural discharge due to evapotranspiration by phreatophytes* (water consumed by plants whose roots extend to the water table);
- *Natural discharge due to evaporation of water from the surface of lakes, streams and playas;*
- *Natural discharge of groundwater to streams;*
- *Natural discharge of groundwater by springs;*
- *Natural inter-basin outflow* (underground flow of water out of one hydrographic area to an adjacent area); and
- *Groundwater extracted via wells.* (Note that not all water removed from an aquifer via wells, and surface water that is put to use, for that matter, is consumed. A portion often returns to the groundwater system as secondary recharge, as described above).

The concept of *perennial yield* provides a basis for the amount of water available for use in a hydrographic area. Perennial yield may be defined as:

> *"The maximum amount of groundwater that can be salvaged each year over the long term without depleting the groundwater reservoir. Perennial yield is ultimately limited to the maximum amount of natural discharge that can be salvaged for perennial use. The perennial yield cannot be more than the natural recharge to a groundwater basin and in some cases is less. If the perennial yield is exceeded, groundwater levels will [continue to] decline and steady state conditions will not be achieved, a situation commonly referred to as groundwater mining."* (http://water.nv.gov/ programs/planning/dictionary).

A similar term is *safe yield*, commonly defined as the amount of water that can be pumped on an annual basis without something bad happening. The "something bad" may include, but not be limited to, drying up springs or reducing the flow of streams, large declines in water level in the aquifer leading to uneconomically high pumping costs, land subsidence, drying up of wet meadows or sub-irrigated land, and degradation of water quality.

> Safe Yield – the amount of water that can be pumped from a hydrographic area on an annual basis without something bad happening.

The severity of these responses of the aquifer to groundwater exploitation will depend largely on proximity to the area of groundwater development and the quantity of water consumed relative to the magnitude of the available resource. If comparatively small quantities of groundwater are used at a distance from sensitive areas within a hydrographic area with a large resource, the result may be imperceptible. However, if large amounts of groundwater are exploited near sensitive areas, and the amount of water exploited is comparatively large relative to the perennial yield, impacts can be dramatic.

The footprint of Eureka County overlies 16 of the administrative subdivisions (hydrographic areas) the State uses in its attempts to manage water resources (Figure 2-2). Only one area, Stephens Basin (a comparatively tiny hydrographic area in southeastern Eureka County), is entirely within the county. The others are shared by the surrounding counties – Elko, White Pine, Lander and Nye Counties.

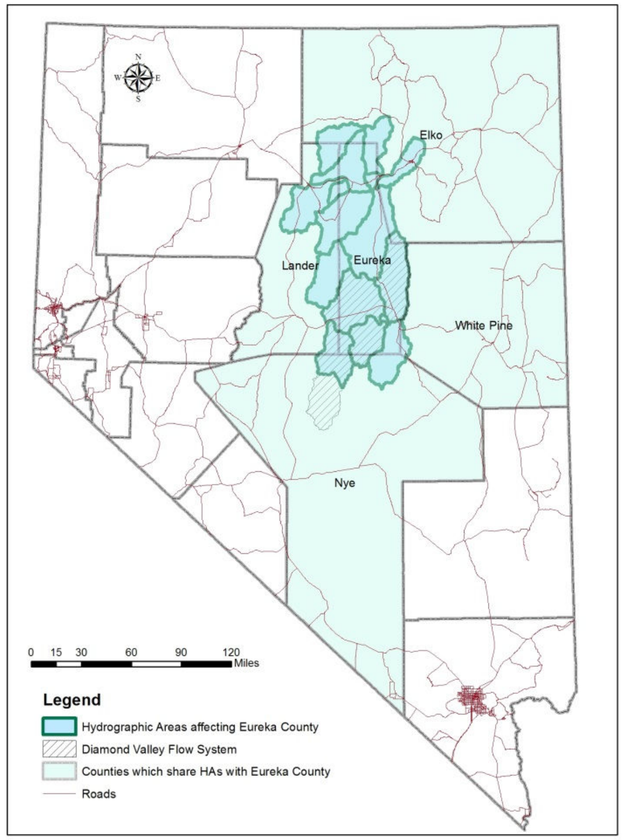


Figure 2-2. Eureka County Water Resources Master Planning Area

Because these counties share water resources with Eureka County, it is incumbent on each entity to coordinate their plans to manage the resource in order for each county to utilize an equitable share of the resource. However, under Nevada's prior appropriation scheme, correlative rights[1] are not recognized, nor is there a mandate for adjoining counties to equitably share the water in a common hydrographic area. It is therefore possible for groundwater appropriations in one county to account for most of the water resources in a shared basin, leaving little water available its neighbor. Another possible conflict over water resource development in a basin shared by neighboring counties occurs when water is appropriated in one county for use in the neighboring county. NRS 533.438 and 533.4385 address the administrative procedures to move water between counties within the same hydrographic areas. To help address potential conflicts with its neighbors, Eureka County is an active member of the Central Nevada Regional Water Authority (see Section 2.3.1).

Additionally, many of the individual hydrographic areas administered independently by the State are hydraulically connected to adjacent basins such that there is flow between them. For example, in Eureka County's water planning area, the Diamond Valley Flow System encompasses northern Monitor Valley, Kobeh Valley, Antelope Valley and the terminus of the system, Diamond Valley (Figure 2-2). Because there is groundwater interflow between these basins, development in one basin has the potential to ultimately affect the ability to develop water resources in an adjoining basin.

The State maintains up-to-date accountings of the committed resource (water rights), but it does not universally provide an accounting of the amount of water that is actually consumed in each planning area. It is the amount of water consumed, not just the committed rights, which can determine whether

[1] A correlative water right is the right of a land owner to a reasonable use of a common source of groundwater based on the proportion of land owned on the surface above the resource.

or not there are resources available for new and future uses. However, basing the magnitude of the resource that is available for future use solely on current estimates of the quantity of the appropriated resource is actually consumed is problematic. For example, it might be possible to increase the efficiency of water pumped for a particular permitted beneficial use such as manufacturing. The water-rights holder benefits from increased efficiency because more efficient water use might allow enhanced productivity, but the action may result in less secondary recharge to a hydrographic area. If secondary recharge is factored into the overall water budget of the planning area, then an increase in efficiency by one permittee might reduce the amount of water available to other users.

2.2.1 Summary of Nevada Water Law and the Appropriation Process

In Nevada, water belongs to the public and it is the State's role to regulate the public's use of the resource. The approach to water planning on the State level is to balance committed water rights with estimates of the available resource to ensure that use of the resource can be sustained in perpetuity. An overview of Nevada's water law, the purpose of which is to achieve this objective, plus a discussion of the process of obtaining water rights are provided below so that water planning can be discussed in the context of Nevada's water law and the appropriation process. The overview was extracted *verbatim* from the Nevada Division of Water Resources website. (reference: http://water.nv.gov/-waterrights/waterlaw last accessed 04/30/12).

Overview

"Nevada's first water statute was enacted in 1866 and has been amended many times since then. Today, the law serves the people of Nevada by managing the state's valuable water resources in a fair and equitable manner. Nevada water law has the flexibility to accommodate new and growing uses of water in Nevada while protecting those who have used the water in the past.

Nevada water law is based on two fundamental concepts: prior appropriation and beneficial use. Prior appropriation (also known as "first in time, first in right") allows for the orderly use of the state's water resources by granting priority to senior water rights. This concept ensures the senior uses are protected, even as new uses for water are allocated.

> Prior appropriation - "first in time, first in right" - is a fundamental tenet of Nevada water law.

> A second tenet of Nevada water law is that water must be beneficially used; wasting water is prohibited.

All water may be appropriated for beneficial use as provided in Chapters 533 and 534 of the Nevada Revised Statutes (referred hereafter as NRS). Irrigation, mining, recreation, commercial, industrial and municipal uses are examples of beneficial uses, among others."

The Role of the State

"The Nevada Division of Water Resources is responsible for administering and enforcing Nevada water law, which includes the adjudication and appropriation of groundwater and

surface water in the state. The appointed administrative head of this division is the State Engineer, whose office was created by the Nevada Legislature in 1903. The purpose of the 1903 legislation was to account for all of the existing water use according to priority. The 1903 act was amended in 1905 to set out a method for appropriation of water not already being put to a beneficial use.

It was not until the passage of the Nevada General Water Law Act of 1913 that the Nevada Division of Water Resources was granted jurisdiction over all wells tapping artesian water or water in definable underground aquifers. The 1939 Nevada Underground Water Act granted the Nevada Division of Water Resources total jurisdiction over all groundwater in the state.

The 1913 and 1939 acts have been amended a number of times, and Nevada's water law is considered one of the most comprehensive water laws in the West. The above-mentioned acts provide that all water within the boundaries of the state, whether above or beneath the surface of the ground, belongs to the public, as referenced in NRS 533.025 and is subject to appropriation."

<u>Permits</u>

"To acquire a water permit, an application must be made on an approved form and filed with the State Engineer (NRS 533.325). Pursuant to Nevada water law, the application must be supported by a map prepared in a prescribed form by a water rights surveyor. The supporting map must show the point of diversion and place of use of the water within the proper legal subdivisions. No application shall be for the water of more than one source to be used for more than one purpose (NRS 533.330).

When the application and map are properly completed, a notice must be sent to a newspaper of general circulation in the area where the application was filed. This notice is published for approximately 30 days [once each week for four consecutive weeks] (NRS 533.360). Interested parties may file a formal protest up until 30 days after the last day of publication explaining their objections to the application and requesting denial of the application or other appropriate action by the State Engineer (NRS 533.365).

After the expiration of the protest period, the application is ready for action by the State Engineer.

When considering a water right application for approval or denial, the State Engineer must consider the following:

- Is there unappropriated water at the source?
- Will the use of the water under the proposed application conflict with existing rights?
- Will the use of the water under the proposed application prove detrimental to the public interest?
- Will the use of the water under the proposed application adversely impact domestic wells? (NRS 533.370)

In addition to these items, other criteria within NRS 533.370 deal with impacts within irrigation districts, the good faith intent of the applicant to construct the works of diversion and put the water to beneficial use, and the financial ability and reasonable expectation to construct the works of diversion and put the water to beneficial use.

The State Engineer may require any additional information needed prior to approval or rejection of an application (NRS 533.375). The State Engineer also has the discretion to hold a hearing prior to any decision.

The State Engineer reviews any pertinent information and either approves or denies the application. When an application is denied, the State Engineer notifies the applicant of denial, retains the denied application for the record and will not pursue any further action under the application. The denial may be appealed in the appropriate court of jurisdiction within 30 days after the denial action (NRS 533.450). When a water permit is approved, the permit terms and limitations are specified as part of the permit. A fee is also required for any permit issued in accordance with NRS 533.435. Once a permit is issued, the applicant may initiate the work to divert and use the water established as the beneficial use.

Once granted, water rights in Nevada have the standing of both real and personal property - meaning they are conveyed as an appurtenance to real property unless they are specifically excluded in the deed of conveyance. When water rights are purchased or sold as personal property or treated as a separate appurtenance in a real-estate transaction, the water rights are conveyed specifically by a deed of conveyance. It is possible to buy or sell water rights and change the water's point of diversion, manner of use and place of use by filing the appropriate application with the State Engineer.

The State Engineer has the authority to require a hydrological, environmental or any other study necessary prior to final determination of an application (NRS 533.368)."

Proof of Completion

"As one of the conditions of the permit's approval, the State Engineer requires that a Proof of Completion of the work be filed. This Proof of Completion usually must be filed within two years from the permit issuance. This affidavit provides information on the well construction and other information as requested by the State Engineer."

Proof of Beneficial Use

"Beneficial use is the basis, the measure and the limit of the right to the use of the water. Each water permit issued is limited to the amount that can be applied to beneficial use, not to exceed a specified diversion rate and annual duty. The Proof of Beneficial Use is usually required within five years after the approval of the permit. The Proof of Beneficial Use identifies how the property has been developed and indicates the amount of water placed to beneficial use. Once the Proof of Beneficial Use application has been filed and accepted, the water cannot be used for any additional development."

Extension of Time

"The State Engineer may grant an Extension of time to comply with the permit requirements such as filing the Proof of Completion or the Proof of Beneficial Use, provided due diligence and good cause are demonstrated as to why such proofs cannot be submitted as required by the terms of the permit."

Abandonment and Forfeiture of Rights

"Surface water rights are subject to abandonment as described in NRS 533.060. Groundwater rights, once granted by the State Engineer, are subject to abandonment and forfeiture as described in NRS 534.090. A water right holder who fails for five consecutive years to use all or any part of a water right for its acquired use runs the risk of forfeiting the water right to the extent of the non-use. In other words, the portion not used could be forfeited. However, a timely filed request for an Extension of Time may be granted by the State Engineer for good cause shown for a period not to exceed one year for any single extension."

Domestic Wells

"A domestic well is one well that serves one home. Domestic wells are exempt from the water-right permitting process when the pumpage does not exceed a daily maximum of 1,800 gallons (NRS 534.180) and water cannot be furnished by an entity such as a water district or municipality (NRS 534.120). The domestic well exemption is not subject to forfeiture or revocation, and a homeowner cannot be required to cease pumping as long as the domestic well is operating properly."

Although domestic wells are not subject to the appropriation process, they do have an associated priority date which is the date they were drilled. In areas where water resource utilization exceeds the perennial yield of a basin, the NSE has the power to regulate water use by priority and domestic well use can be regulated.

2.2.1.1 Categories of Water Rights

Water rights in Nevada may be categorized by the manner by which they are acquired.

Appropriated Water Right – The right to use surface or groundwater acquired through the permit process described in Section 2.4.

Vested Water Right —The water right to use either surface or ground water acquired through more or less continual beneficial use prior to the enactment of water law pertaining to the source of the water (prior to 1905 for surface water and prior to 1939 for groundwater). These claims are documented through filings of Proofs and become final through adjudication (a legal proceeding) and claims of vested rights become valid once the proof of appropriation has been filed with the State Engineer's office, but the amount of water associated with the right may be adjusted during the adjudication process. A vested stock watering right may have an implied foraging right[2] associated with it.

Decreed Rights (Water) — Water rights determined through the adjudication process and memorialized by a court decree. Decrees are primarily associated with surface water rights.

Reserved Water Rights (Federal) — A category of federal water rights, created by federal law and recognized by judicial decision. These rights are created when the federal government withdraws land from the public domain to establish a federal reservation such as a national park, forest, or Indian reservation (not to be confused with Public Water Reserve No. 107).

Public Water Reserve No. 107 – In 1926, President Coolidge signed an executive order to preserve access to water on public lands for stock watering and to preserve watering places for travelers. The purpose of PWR 107 was to reserve natural springs and water holes yielding amounts in excess of homesteading requirements. This order states that "legal subdivision(s) of public land surveys which is vacant, unappropriated, unreserved public land and contains a spring or water hole, and all land within one quarter of a mile of every spring or water be reserved for public use." There was no intent to reserve the entire yield of each public spring or water hole, rather reserved water was limited to domestic human consumption and stock watering. All waters from these sources in excess of the minimum amount necessary for these limited public watering purposes is available for appropriation through state water law (Bureau of Land Management, *Federal Reserved Water Rights* <www.blm.gov>). The BLM has interpreted the Public Water Reserve No. 107 to include water sources used by wildlife and wild horses and by sometimes claiming sources that did not exist at the time the executive order was issued.

Subsisting water rights – A State of Nevada right to water livestock on open range based on documented continuous use of the water for stock watering purposes virtually anywhere within a grazing allotment or on private land. Claims to subsisting water rights can be proven by a license issued by the Taylor Grazing Service, a license issued by the US Forest Service, an affidavit concerning the number and kind of livestock, to name a few. The NSE is obliged by law to reject applications to appropriate water that interfere with subsisting water rights.

2.2.1.2 Additional Federal and State Water Regulations

In addition to Nevada’s regulations that govern how the office of the Nevada State Engineer administers the use of the public’s water resources, there are federal and state regulations that are applicable to water resources within Nevada. The major regulations are briefly addressed below.

---

[2] US vs. Estate of E. Wayne Hage et al., 2:07-cv-01154_RCJ-VCF filed 04/23/13. In his decision, Judge Jones stated “It shall not be a trespass if cattle graze within half a mile of a water source in which Defendants have stock watering rights, or attendant ditches or other diversions in which Defendants have stock watering rights, to the extent it cannot reasonably be prevented while the cattle are corralled on federal land for the purpose of watering. . . it is not unreasonable that some cattle may graze while drinking.”
In January 2016, the U.S. Court of Appeals Ninth Circuit overruled Judge Jones’s opinion.

Safe Drinking Water Act

The Safe Drinking Water Act is the primary federal law that regulates underground sources of drinking water. The Act established national primary and secondary drinking water standards, provided a permitting program for injection wells, and established a wellhead protection program. The U.S. Environmental Protection Agency has granted authority to administer the provisions of the Act within Nevada to the Nevada Division of Environmental Protection (NDEP). The Bureau of Safe Drinking Water (BSDW) within NDEP is responsible for permitting public water supplies and the Source Water Assessment Program (SWAP). However, Clark and Washoe Counties have authority to regulate public water supplies within their borders.

Clean Water Act

The Clean Water Act is the primary federal law intended to prevent pollution of surface water. Specifically, the Act prohibits anyone from discharging "pollutants" through a "point source" into a "water of the United States" unless they have an NPDES (National Point Discharge Elimination System] permit (Nevada Division of Environmental Protection, Bureau of Water Pollution Control <http://ndep.nv.gov/bwpc.docs>). As is the case with the Safe Drinking Water Act, NDEP has been delegated the authority to implement the provisions of the Act within Nevada. Within NDEP, the Bureau of Water Pollution Control (BWPC) is charged with protecting the waters of the State and attempts to achieve this end by issuing discharge permits. The Bureau of Water Quality Planning (BWQP) is responsible for developing water standards for surface water and implementing programs that address surface water quality.

Nevada Water Pollution Control Law (Chapter 445A of the NRS and NAC)

Nevada has regulations that are more comprehensive than the requirements of the Clean Water Act in that Nevada's Statutes protect both surface water and groundwater. In Nevada,

> *". . . it is unlawful for any person to discharge any pollutant from any point source into any waters of the State or any treatment works; inject fluids through a well into any waters of the State; discharge a pollutant from a point source or inject fluids through a well that could be carried into the waters of the State by any means; or allow a pollutant discharged from a point source or fluids injected through a well to remain in a place where the pollutant or fluids could be carried into the waters of the State by any means."* (NRS 445A).

The BWPC regulates facilities such as residential septic tanks, municipal and industrial waste water treatment plants, the use of reclaimed water for irrigation, injection wells, feedlots, industrial process ponds and other process facilities. The Bureau of Mining Regulation and Reclamation (BMRR) regulates mining activities that have the potential to degrade Nevada's Waters.

Public Water Systems

Eureka County operates two public water systems. Public water systems and the various classifications of public water systems are defined below.

"40 CFR 141.2 Public water system means a system for the provision to the public of water for human consumption through pipes or, after August 5, 1998, other constructed conveyances, if such system has at least fifteen service connections or regularly serves an average of at least twenty-five individuals daily at least 60 days out of the year. Such term includes: any collection, treatment, storage, and distribution facilities under control of the operator of such system and used primarily in connection with such system; and any collection or pretreatment storage facilities not under such control which are used primarily in connection with such system. Such term does not include any "special irrigation district." A public water system is either a "community water system" or a "noncommunity water system."

"NRS 445A.235 "Public water system" defined. "Public water system" means a system, regardless of ownership, that provides the public with water for human consumption through pipes or other constructed conveyances, if the system has 15 or more service connections, as defined in NRS 445A.843, or regularly serves 25 or more persons."

"NRS 445A.808 "Community water system" defined. "Community water system" means a public water system that:

> *Has at least 15 service connections used by year-round residents of the area served by the system; or*
>
> *Regularly serves at least 25 year-round residents of the area served by the system."*

"NRS 445A.828 "Noncommunity water system" defined. "Noncommunity water system" means a public water system that is not a community water system."

"NRS 445A.829 "Nontransient water system" defined. "Nontransient water system" means a noncommunity water system that regularly serves at least 25 of the same persons for more than 6 months per year."

"NRS 445A.848 "Transient water system" defined. "Transient water system" means a noncommunity water system that does not regularly serve at least 25 of the same persons for more than 6 months per year."

Hydraulic Fracturing Regulations

Hydraulic fracturing or "fracking" is an oil and gas well stimulation process used by the petroleum industry for decades to enhance the recovery of petroleum and natural gas. It involves injecting water and chemical cocktail into a well under very high pressures (thousands of pounds per square inch). The high pressure is necessary to fracture the reservoir rocks surrounding the well and the fractures are propped open by sand or silica beads injected along with the fluids. In the past 10 years this process has been applied to previously unproductive geologic formations, stimulating a resurgence of the petroleum industry throughout the U.S.

In Nevada, wells drilled for oil and gas on state or private land are under the jurisdiction of the Division of Minerals (NDOM). The Nevada Division of Environmental Protection (NDEP) regulates the disposal of waste fluids via disposal via the Underground Injection Control (UIC) program.

Nevada currently has limited regulations governing hydraulic fracturing. Beginning in 2013, the Nevada Division of Minerals and Division of Environmental Protection jointly began a process of developing regulations related to fracking. These have since been adopted and went into effect January 1, 2015.

Some entities and individuals regard fracking as a threat to groundwater quality. NDOM's and NDEP's approach to protecting the water resources of the state revolves around stringent well construction standards and testing of the casing and annular seals to ensure fracking fluids do not escape the well or the petroleum reservoirs being stimulated. These state agencies do not require dedicated monitoring wells to be installed at each well employing hydraulic fracturing primarily because they view the risk to drinking water supplies as negligible and it is not required by any other state (Rich Perry, NDOM Administrator, presentation before the Eureka County Board of Commissioners, August 6, 2014).

2.3 Water Planning at the County Level

As discussed in Section 2.2, water planning in Nevada has largely been relegated to local entities following the elimination of the Division of Water Planning and creation of the Water Planning Section within the Division of Water Resources. Chapter 278 of the Nevada Revised Statutes addresses all aspects of planning in Nevada. Inclusion of a water resource element of a land use master plan is authorized under NRS 278.160.1.(b) which plainly states a master plan may include a Conservation Plan

> *"For the conservation, development and utilization of natural resources, including, without limitation, water and its hydraulic force, underground water, water supply."*

The local governing body (in this case, Eureka County) may divide the county into zoning districts. Zoning regulations must be adopted in accordance with the master plan for land use and be designed to

> *Preserve the quality of air and water resources.*
>
> *Provide for recreational needs*
>
> *To promote health and the general welfare* (NRS 278.250.1 and 278250.2(a)).

Although the Nevada State Engineer regulates the usage of water in Nevada, his authority does not preempt a county from enacting zoning or planning ordinances which are more restrictive[3]. The current culture within Eureka County, though, strongly opposes regulating land use.

[3] In Serpa v. Washoe County, the Nevada Supreme Court affirmed the ruling of the district court, finding that although the Nevada State Engineer may rule on usage of water in the State; this does not preempt local governments from establishing more restrictive water use policies.

2.3.1 Eureka County Membership in the Central Nevada Regional Water Authority

Eureka County is a member of the Central Nevada Regional Water Authority, along with Churchill, Elko, Esmeralda, Lander, Nye, Pershing and White Pine Counties. The Authority is governed by a 21-member board of directors appointed by the county commissioners from the member counties. The functions of the Authority are:

> The Central Nevada Regional Water Authority's mission is to protect the water resources in member counties so these counties will not only have an economic future, but their valued quality of life and natural environment is maintained. (http://www.cnrwa.com)

1. *"to combine fiscal and staff resources to obtain technical support, legal counsel and policy advice necessary for sound water resource decisions by the member counties,*
2. *to formulate and present a united position on water and water-related issues to the appropriate government entity (e.g., Nevada legislature, U.S. Congress, State of Nevada agencies, federal agencies and local government entities),*
3. *to monitor, assess and respond to water projects that may adversely impact a member county,*
4. *to develop and implement a groundwater monitoring program in areas of interest in the member counties,*
5. *to host the annual Great Basin Water Forum established by counties in three states (California, Nevada and Utah) to address water and water-related issues in the Great Basin, and*
6. *to encourage citizen participation in water and water-related issues of importance to member counties.* (http://www.cnrwa.com)

Water resource planning in Eureka County strives to comply with the mission of the Central Nevada Regional Water Authority.

2.3.2 Eureka County Membership in the Humboldt River Basin Water Authority

A significant portion of Eureka County comprises hydrographic areas that are tributary to the Humboldt River. Eureka County is a member of the Humboldt River Basin Water Authority, along with Elko, Lander, Pershing and Humboldt Counties. The Elko, Eureka, Lander, Humboldt, and Pershing County Commissions pursuant to NRS 277.080 and 277.140 inclusive of the Interlocal Cooperation Act organized the Humboldt River Basin Water Authority (HRBWA). The Authority is governed by a fifteen-member board of directors with three directors appointed by each of the five member counties, one county commissioner from each member county serves on the HRBWA's board. The HRBWA has been functioning since 1993.

The functions of the HRBWA (Authority) as defined in NRS 277 include:

- *To oversee water supplies and to develop and implement plans relating to the enhancement of the environment, social conditions, and economy of member counties as such may be dependent upon available water supplies.*
- *To monitor (1) water supplies available within the Humboldt River Basin and separately to each party from all sources, (2) demand for water within each county from all sources both of a consumptive and non-consumptive nature, (3) the extent to which proposals to develop and export Humboldt River Basin water may adversely affect the water balance for member counties of the Authority.*
- *To prepare, update and oversee recommendations for water management and conservation plans for consumptive and non-consumptive uses of ground and surface waters originating in or passing through the local jurisdiction of member parties of the Authority.*
- *To encourage citizen participation in water supply and management issues of concern to member counties of the Authority.*
- *To recommend appropriate federal and state legislation for the management of surface and groundwater within the Humboldt River Basin.*
- *To conserve the levels and flows of surface water within the Humboldt River Basin.*
- *To protect and conserve the environmental balance of the Humboldt River Basin and recharge area ecosystem.*
- *To recommend cooperative programs and management of the water resources of the Humboldt River Basin.*
- *To facilitate the development and maintenance of a common base of data and information regarding the use and management of Humboldt River Basin water resource and the establishment of systematic arrangements for the exchange of water data and information.*

Water resources planning in Eureka County strives to be consistent with the goals and objectives of the Humboldt River Basin Water Authority.

2.4 EUREKA COUNTY'S LAND USE MASTER PLAN

In 2010, Eureka County adopted an update to the County's Land Use Master Plan. The Master Plan includes a Water Resource Element (see Section 2.4.1, below). Soon afterward, the Board of County Commissioners engaged a consultant to address a number of issues or topics concerning water resources in the County. One topic to be addressed was to help the County "flesh out" the water resource element of the Master Plan in the form of a Water Resources Master Plan. The Land Use Plan represents a good starting point for a Water Resources Master Plan.

2.4.1 Eureka County Land Use Plan Goals, Objectives and Policies

Chapter 9 of the Eureka County Master Plan, amended and adopted in 2010, contains a Water Resource Element. The primary guidance (goals, objectives and policies) for the Water Resource Element is provided in the Eureka County Code 9.30.060.C, below.

1. *"Eureka County affirms support for the doctrine of prior appropriation as established by state law; that the right to appropriate water is a compensable property right available to individuals and municipalities. Ownership of the right to use water has, as key principals, those provisions set forth in Nevada Revised Statutes 533.0010 through 533.085, including, but not limited to, first right, first use, beneficial use, and point of diversion.*

2. *Eureka County promotes private development of water resources on state and federal land for beneficial use in Eureka County, including but not limited to geothermal reservoirs, power generation, municipal water supplies, irrigation and stock water.*

3. *Eureka County mandates the use of peer-reviewed science in the assessment of impacts related to water resource development.*

4. *The County discourages out-of-basin water transfers and will adamantly oppose such transfers that do not (1) pass the highest test of scientific rigor in demonstrating minimal impacts to existing water rights and (2) show a long-term benefit to the economic viability and community stability of the County Out-of-basin and out-of-county transfers of water shall be accorded full attention of N.R.S. 533.370, N.R.S. 533.438 and other applicable state laws.*

5. *Eureka County will continue to work to maintain its water resources in a condition that will render it useable by future generations for the full range of beneficial uses that further a viable and stable economic and social base for its citizens. The County supports retaining authority of States to protect water quality under the Clean Water Act. The County does not support abrogation of that authority to any other governmental or non- governmental entity. The County promotes water quality standards that are i) consistent with actual uses fur [sic] which a particular water source or body is lawfully appropriated, and ii) based on accurate information regarding its natural state and range of variability. The County will demand coordination among all responsible and affected interests when considering water quality actions."*

2.5 Eureka County's Water Resources Master Plan

2.5.1 Water Resource Issues of Concern to Eureka County Residents

The public's participation in development of the County's Water Resource Master Plan is an important component of the process. Initially, County staff developed a broad list of issues which might concern its residents and which suggested topics which might be addressed in the plan. The list was presented to the Eureka County Planning Commission, the Eureka County Natural Resources Commission, the Eureka County Wildlife Advisory Board and the Eureka County Board of Commissioners for their review and comment. Table 2-1 provides a list of issues of concern to the county's residents and the list was used to help formulate the Plan.

Table 2-1

List of topics of Concern to Eureka County Residents

- Eureka County land area overlies 16 hydrographic basins (proposed planning area)
    - Shares basins with Elko, White Pine, Lander & Nye Counties
    - Committed groundwater and geothermal water rights exceed estimates of perennial yield for Eureka County resource planning area (16 contiguous GW basins) by a factor of more than 2
    - Coordinate resource planning with adjacent Counties
    - Coordinate planning with Central Nevada Regional Water Authority
    - Coordinate planning with Humboldt River Basin Authority

- Assist Nevada State Engineer whenever possible
    - State's planning efforts are limited to attempts at constraining appropriations within estimates of the perennial yield
        - Notable exceptions
    - Provide data and information to enhance NSE actions
    - Critical groundwater basins

- Funding for groundwater resource investigations
    - Joint funding agreements
    - Eureka County in-house investigations

- Sustainability of the resource
    - All users (municipal, agriculture, mines, geothermal, etc.)
    - Perennial Yield vs. Safe Yield
    - Diamond Valley
    - What is a reasonable lowering of the water table
    - How to project usual and customary use of water-dependent resources

- Nevada State Engineer's current position that mining is a temporary use of the resource
    - Water is supposed to revert back to the source when the project is complete
        - Requires the project to be carefully described
        - Some temporary mining water rights are transferred and continue to be exercised well after the project is completed – this does not constitute a temporary use

- Transitional storage reserve

  - Should transitional storage reserve provide the basis for a new appropriation?

- Water exportation
  - Opposition to export projects not back by sound scientific investigations

- Active County participation in Water Resource Monitoring, Management and Mitigation (3M) Plans when 3M is required by the Nevada State Engineer
  - On-site vs. off-site mitigation

- Open pit mining
  - Pit dewatering
    - Infiltration and/or use as opposed to discharge
    - Consumptive use should not contribute to over-appropriation of a basin
    - Pit lake evaporation
  - Backfill alternatives and impacts on water quantity & quality

- Geothermal resource utilization
  - Consumptive vs. non-consumptive use
    - Re-injection of heat-spent fluids
  - Potential for undiscovered resources in Eureka County

- Water resource enhancement
  - P-J encroachment and impacts on water resources
  - Cloud seeding

- Public lands water issues
  - Federal ownership of water rights
    - Water rights for feral horses
    - USFS water rights
    - Public Reserve 107 water rights
  - BLM Resource Management Plan updates
    - Coordinate with County policies

- Streams
  - Wetlands
  - Riparian areas
  - Clean Water Action Plans
    - TMDLs
  - "Properly functioning streams"
  - "Impaired" waters - 303 (d)
    - Water bodies with potential problems

- Environmental Assessments
    - Status as a cooperating agency

- Hydraulic fracturing ("fracking") of petroleum reservoir rocks to enhance petroleum recovery
    - Potential to impact fresh water aquifers

- Climate change
- Flood plain management

2.5.2 Eureka County Water Resource Master Plan Goals and Objectives

<u>Goal</u>

> **Goal:** Eureka County will work toward maintaining the County's water resources in a condition that will render them useable by future generations for the full range of beneficial uses that further a viable and stable economic and social base for its citizens.

The primary guidance (goals, objectives and policies) for the Water Resource Element of the County's Land Use Master Plan is provided in the Eureka County Code 9.30.060.C, which was addressed in Section 2.3.3.1, above. The goal of the Water Resource Master Plan arises from this guidance, tempered by input from its residents, and is, quite simply, to provide sufficient information to its residents to help them develop the County's water resources in a manner that the resource can be used in perpetuity. In other words, the County hopes to be able to disseminate data and information to help County residents cooperatively manage water resources with state and federal agencies to ensure water will be available at current levels for the future.

<u>Objectives</u>

The Plan includes objectives that, if met, are essential to meeting its stated goal. These are:

1) Quantify the water resources available for use in the 16 hydrographic areas which comprise the County's Water Resource Master Plan planning area.
2) Estimate the amount of water which is currently being consumed within the planning area.
3) Identify areas where water use currently exceeds the supply or may someday outstrip supply if all approved water rights were to be put to beneficial use.
4) Estimate how much water may be available for future growth and provide insight as to where these supplies might be developed.
5) Identify the issues that might affect water supplies within the County and help residents recognize how these issues might affect them. These concerns may be related either to water quantity or water quality.
6) Raise residents' awareness of the potential threat from flooding within the County.

7) Ensure that water and water resource related management actions are consistent with Eureka County plans, policies, and desires through local, grass-roots planning and management of the water resources within Eureka County.
8) Help stakeholders identify, evaluate and implement management strategies to address water-resource issues.
9) Coordinate with the Nevada Division of Water Resources, other federal, state and local agencies (e.g., Eureka Conservation District), the Central Nevada Regional Water Authority, and the Humboldt River Basin Water Authority, to efficiently manage the resource to the benefit of all stakeholders in a manner consistent with County plans and policies and the letter of the applicable laws.

Subsequent chapters address each of the objectives of the County's Water Resources Master Plan.

2.5.3 Adoption of the Water Resources Master Plan

A preliminary draft of the Plan was reviewed by Eureka County staff and a subsequent draft was then submitted to the Eureka County Natural Resources Advisory Commission for review and comment. The Plan was discussed in detail at meetings of the Advisory Commission and comments were incorporated into the draft that was then submitted to the Eureka County Planning Commission. The Planning Commission's reviewed the Plan in detail and its comments were incorporated into a final draft which was submitted to the Eureka County Board of Commissioners for their review and comment.

2.5.3.1 Public Hearings

NRS 278.210 states that "Before adopting the master plan . . . the commission shall hold at least one public hearing . . ." Public hearings were held in Eureka on August 1, 2016 and September 20, 2016.

2.5.3.2 Adoption of the Plan by the Eureka County Planning Commission and the Board of County Commissioners

The Eureka County Planning Commission held a public hearing August 1, 2016 to receive public comment on the plan. Written public comments were received and the Planning Commission deliberated to respond to the comments. The public's comments and the commissioners' responses are provided in the Appendix. Upon completion of the public hearing the Planning Commission approved the draft of the Master Plan and forwarded it to the Board of County Commissioners.

The Eureka County Board of County Commissioners held a public hearing September 20, 2016 to receive public comment on the plan. No public comments were received and the Plan was approved by a unanimous vote of the Commissioners. A copy of the resolution adopting the Plan is incorporated into this document.

3.0 SUMMARY OF WATER RESOURCES IN EUREKA COUNTY

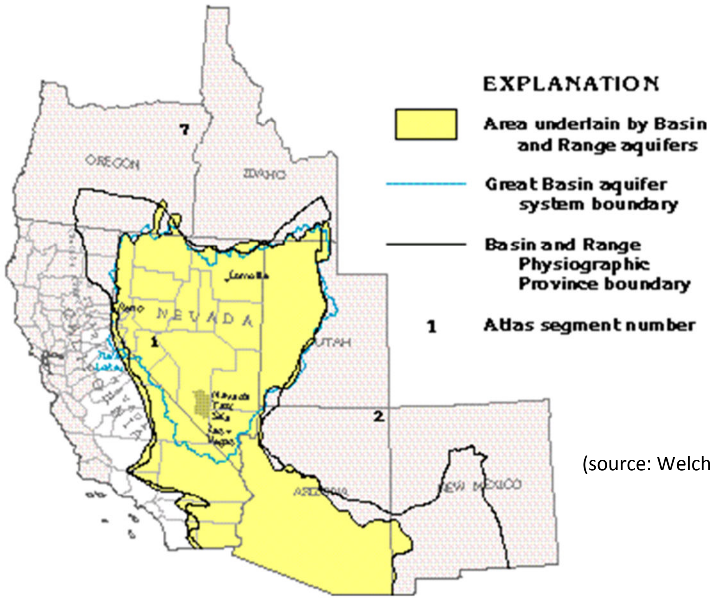
Objective: Quantify the water resources available for use in the 16 hydrographic areas which comprise the County's Water Resource Master Plan planning area.

3.1 GEOLOGIC FRAMEWORK

Eureka County is located within what is referred to as the Basin and Range Physiographic Province (see Figure 3-1). The following description of the defining characteristics of the Basin and Range is extracted from the Ground Water Atlas of the United States California, Nevada HA 730-B (Planert and Williams, 1995).

> *"The part of Segment 1* [referring to area designations in the Atlas] *east of the Southern Cascade Mountains, the Sierra Nevada, and the smaller mountain ranges east of the Los Angeles-San Diego area is called the Basin and Range Physiographic Province . . .* [Figure 3-1] *and contains three principal aquifer types collectively referred to as the "Basin and Range aquifers." These aquifers underlie most of Nevada and parts of eastern and southern California, western Utah, southern Arizona, southwestern New Mexico, and southern Oregon and Idaho; their extent is approximately, but not exactly, the same as that of the physiographic province. The aquifers are formed of volcanic and carbonate rocks and unconsolidated to consolidated basin-fill deposits. The basin-fill deposits form the most productive aquifers and are generally in individual alluvial basins that are drained internally and are separated by low mountains . . . Except for small areas that drain to the Colorado River, no streams that rise within the Basin and Range Province carry water to the oceans. Practically all the precipitation that falls in the area is returned to the atmosphere by evapotranspiration, either directly from the soil or from the lakes and playas that occupy the lowest points within the basins and that are discharge areas for the alluvial aquifers."*
>
> *"The Basin and Range Province is the most arid area in the Nation; the potential annual water loss through evapotranspiration exceeds the annual water gain from precipitation even at the higher elevations . . . Clear skies and low humidity cause extreme daily and seasonal temperature ranges as the sparsely covered land surface is heated quickly by solar radiation and then rapidly cools at nightfall. In more humid climates, the denser vegetative cover uses energy derived from solar radiation to drive the process of evapotranspiration, thus moderating diurnal and seasonal temperature variations.*
>
> *Each of the large desert basins has an area where the land slopes toward a central depression, and each has a main drainageway that is dry most of the time. Many of the valleys have playas in their lowest depressions . . . The playas are left by the evaporation of intermittent lakes. Parts of some of the valleys have become encrusted to a depth of*

several inches with alkaline salts, which cover the surface as a powdery crust. However, in some valleys, permanent lakes that have no outlets are fed by surface drainage and contain saline or alkaline water, produced when dissolved minerals are concentrated by evaporation of the lake water.



(source: Welch and Bright, 2007

Figure 3-1. Basin and Range Physiographic Province.

GEOHYDROLOGIC UNITS

Within the Basin and Range Province, aquifers are not continuous, or regional, because of the complex faulting in the region[1]. Three principal aquifer types collectively called the Basin and Range aquifers in this report are volcanic-rock aquifers, which are primarily tuff, rhyolite, or basalt of Tertiary age; carbonate-rock aquifers, which are primarily limestones and dolomites of Mesozoic and Paleozoic age; and basin-fill aquifers, which are primarily unconsolidated sand and gravel of Quaternary and Tertiary age . . . Any or all three aquifer types may be in, or underlie, a particular basin and constitute three separate sources of water; however, the aquifers may be hydraulically connected to form a single source. Other rock types within the region have low permeability and act as boundaries to the flow of fresh ground water. The aquifers in the Great Basin part of the Basin and Range Province [Figure 3-1] were studied as part of the U.S. Geological Survey's Regional Aquifer-System Analysis (RASA) Program.

[1] The Basin and Range Carbonate Aquifer System (BARCAS) is recognized to exist in eastern Nevada. It extends into western Utah and southeast Idaho (see also Figure 3-6) and is made up of several regional flow systems incorporating adjacent hydrographic areas.

<u>Volcanic-Rock Aquifers</u>

> *The volcanic-rock aquifers . . . can be separated into three categories - welded tuffs, bedded tuffs, and lava flows. The different characteristics for the storage and transmission of water in each category depend on the presence of primary and secondary porosity. Physical characteristics that affect the movement of ground water include the number and degree of interconnection of joints, the relation of joint density to degree of welding and compaction, the horizontal partings within tuffs, the development of rubble zones between lava flows, and the interconnection of vesicles in the lavas.*
>
> *Ash-flow tuffs are consolidated deposits of volcanic ash, which were emplaced by flowage of a turbulent mixture of gas and pyroclastic materials. Ash-flow deposits consist principally of glass shards and pumice fragments that are usually less than 0.15 inch in length, although some flows consist of ejecta of larger size. Typically, the deposits are nonsorted and do not exhibit bedding, in contrast with the generally pronounced bedding of ash-fall tuff deposits. In general, ash flows are tens of feet thick, but some are only a few feet thick, whereas others are hundreds of feet thick. After emplacement of an ash flow, compaction or welding of the ash can result in an average 50-percent reduction in the porosity of the original flow.*
>
> *Welding within a single ash flow is variable, and each ash flow can be categorized by three distinct orders of welding-none, partial, or dense. Commonly, a zone of dense welding is underlain and overlain by zones of partial welding, which are, in turn, underlain and overlain by zones of no welding . . . However, in some thin, exceptionally hot flows, the entire unit of tuff can be densely welded. The degree of welding directly affects the interstitial porosity of the ash-flow tuff. In the nonwelded base or top of a fresh ash flow, the interstitial porosity can be greater than 50 percent; in the densely welded part, it can be less than 5 percent.*
>
> *Columnar jointing characterizes the zones of dense and partial welding; these joints form in response to tensional forces that develop as the flow cools. Columnar-joint spacings range from a few tenths of an inch to many feet; the more closely spaced joints are usually in the zone of most intense welding. The joints are usually vertical, but departures from the vertical are common. Cooling joints are not common in the nonwelded parts of the ash flow . . .*
>
> *The joints in outcrop in the ash-flow tuffs are polygonal joints that formed as the flow cooled and other joints that formed after cooling as a result of compaction of underlying, porous, bedded tuff or from regional tectonic stresses. Both types of joints are restricted mostly to the dense, brittle, welded tuff and die out or markedly decrease within the underlying and overlying partially welded zone . . . The polygonal structure is generally obscured by the joints that formed after cooling, except in the youngest welded tuffs. Horizontal partings are locally a few tenths of an inch wide and tens of feet long.*

Because the partings parallel the foliation within the welded zone or the contact between flows, they may represent breakage along a plane of primary weakness after the removal of overburden; therefore, the partings are not likely to be open at depth and are limited in extent.

The bedded-tuff aquifers are ash-fall tuffs that consist of poorly to well sorted, friable [easily crumbled] *particles the size of fine sand to granules. Locally, the ash-fall tuffs either have been reworked by running water or were originally deposited in standing water. The friable nature of these rocks prevents the formation of open joints or faults within them; as an example, open fractures were not seen in hundreds of feet of tunnels dug through these rocks beneath Rainier Mesa on the Nevada Test Site near Las Vegas. Where glass shards are altered to clay minerals, the permeability of the ash-fall tuffs is reduced by several orders of magnitude.*

The lava-flow aquifers consist of basalt or rhyolite and have not been studied in detail. No laboratory determinations for porosity and permeability have been done on these aquifers because the movement of ground water through them is controlled mostly by porosity developed along cooling joints and in rubble zones between individual lava flows. Basalt flows might be a texturally heterogeneous mass that laterally and vertically ranges from congealed, dense, impermeable lava to highly porous zones that consist of loosely consolidated cinders. The texture depends, for the most part, on the amount of gas present in the lava when the flow erupted. Permeable zones, which consist of masses of basalt rubble, are at the tops of some dense lava-flow surfaces and are overlain by subsequent flows or by sediments. The dense lava flows, which have minimal primary permeability, might be fractured by regional stresses, resulting in high secondary permeability. When fracture systems interconnect with highly permeable rubble and cinder zones, the rock mass tends to be highly transmissive.

Carbonate-Rock Aquifers

Thick sequences of Mesozoic [65.5 to 251 million years before present, mybp] *and Paleozoic* [251 to 542 mybp] *carbonate rocks underlie many of the alluvial basins in southeastern California and eastern Nevada within the Basin and Range Province; these rocks also extend into western Utah and southeastern Idaho. Results of deep drilling indicate that intervals of cavernous carbonate rock are as deep as 5,000 feet and might locally extend to depths of 15,000 feet. In some test wells, circulation of drilling fluid has been extremely difficult to maintain and, in a few, the downhole drilling equipment has suddenly dropped. Both conditions indicate that the carbonate rock is cavernous.*

Quartzite, shale, siltstone, sandstone, and some limestone and dolomite of Early Cambrian [513 to 542 mybp] *and late Precambrian age underlie the carbonate rocks in the eastern part of the Basin and Range Province. However, these rocks have minimal primary and secondary permeability, and probably form the lower boundary of the carbonate-rock aquifers.*

The carbonate-rock aquifers can be divided into two parts - an upper rock sequence of Late Triassic [199.6 to 228.0 mybp] *to Early Mississippian* [345.3 to 359.2 mybp] *age that consists primarily of limestone with minor amounts of dolomite, interbedded with shale and sandstone, and a lower sequence of limestone and dolomite of Middle Devonian* [385.3 to 397.5 mybp] *to Middle Cambrian* [501 to 513 mybp] *age that contains little clastic material. The total thickness of carbonate rocks may be greater than 15,000 feet, but, as a result of the combination of deep erosion and structural deformation, this thickness is rare in any one location. The saturated thickness of the carbonate strata ranges from a few hundred to more than 10,000 feet and depends on the combined influence of geologic structure, erosion, and depth to water. In general, because of the great aggregate thickness and stratigraphic position of the rocks that compose the carbonate-rock aquifers, several thousand feet of an individual aquifer is within the zone of saturation throughout most of the areal extent of the aquifers. Such an aquifer is completely unsaturated only in the vicinity of its outcrop area and is totally absent only atop buried structural highs.*

The carbonate rocks are highly fractured and are locally brecciated [formed of angular fragments] *. . . Individual outcrops of the aquifers can exhibit three or more sets of joints, one or more high-angle faults, and one or more brecciated zones. For example, in the Nevada Test Site area near Las Vegas, Nev., the joints and most of the faults in the carbonate rocks are steeply inclined fractures. Brecciation commonly occurs along faults showing only a few feet of displacement and does not necessarily reflect movement of large magnitude. Joint density bears a strong relation to rock type; fine-grained carbonate rocks have the greatest joint density. Generally, the joints divide the rock into blocks that range from 1 inch to a few inches on a side. Medium-grained carbonate rocks are divided into blocks that range from a few inches to 1 foot on a side, whereas blocks of coarse-grained carbonate rocks commonly range from 6 inches to 2 feet on a side.*

In outcrop, secondary openings are locally along bedding planes in the carbonate rocks, but no widespread connection of such openings is known. Some of the bedding-plane openings might have formed entirely by subaerial mechanical and chemical weathering, but some might have formed by partial dissolution of the rock. Dissolution, presumably in the subsurface, has created small, smooth, tabular openings along otherwise tightly closed bedding and joint planes . . .

Basin-Fill Aquifers

Before the most recent period of tectonic activity, which began in middle Miocene time [about 17 mybp]*, the Basin and Range region was characterized by moderate relief, and streams in the region did not have enough power to transport large volumes of sediments. As the mountains were uplifted, however, stream gradients increased and the transporting power of the streams greatly increased. Steep, narrow canyons and gulches were incised into the sharp escarpments that bounded the mountain ranges and* *enormous volumes of material were eroded from the mountains. In some places, blocks of sandstone greater than 10 feet in diameter were transported several miles from their outcrop areas onto flat areas beyond the mouths of canyons. The sediments eroded, transported, and deposited by the streams are the principal material of basin-fill aquifers . . . Some of the older basin-fill deposits (Miocene and Pliocene age) are consolidated; however, the basin fill consists mostly of unconsolidated deposits of Pliocene through Holocene age.*

The most permeable basin-fill deposits are present in the depressions created by late Tertiary to Quaternary [2.588 mybp to present] *block faulting and can be classified by origin as alluvial-fan, lake-bed, or fluvial deposits. At the time of major deposition, the climate was more humid than the modern climate. Lakes were in most of the closed basins and some basins were connected by streams. In general, the coarsest materials (gravel and boulders) were deposited near the mountains, and the finer materials (sand and clay) were deposited in the central parts of the basins or in the lakes. Occasionally, torrential storms produced heavy runoff that carried coarse material farther from the mountains and resulted in the interfingering of fine and coarse material. The distribution of sediment size is directly associated with distance from the mountains. Three geomorphic landforms can be distinguished on the basis of the gradient of the land surface. Alluvial fans border the mountains and have the steepest surface slopes and the coarsest sediments . . . Basinward, individual alluvial fans flatten, coalesce, and form alluvial slopes of moderate gradient. A playa, or dry lake bed with a flat surface, is present in the lowest part of the basin, usually at or near the center of the basin . . . , and most of the sediment deposited on the playa is fine grained.*

The most important hydrologic features of the basins are the alluvial fans. The basin fill receives most of its recharge through the coarse sediments deposited in the fans. These highly permeable deposits allow rapid infiltration of water as streams exit the valleys that are cut into the almost impermeable rock of the surrounding mountains and flow out onto the surface of the fans. The coarse and fine sediments within the alluvial fans are complexly interbedded and interfingering . . . because the position of the distributary streams that transported the sediments continually shifted across the top of the fan.

Material deposited in perennial lakes or in playas consists principally of clay and silt with minor amounts of sand and is present in all of the basins. In most places, these sediments include some salts deposited by evaporation. The clay and salt deposits merge laterally into coarse-grained deposits of the alluvial slopes. Minor well-sorted beach sand and gravel locally are in the subsurface near the shores of once perennial lakes.

Fluvial deposits of Holocene age in the basins consist primarily of alluvial sand and gravel and are present along the courses of modern or ancestral streams that generally parallel the long axes of the basins. Quaternary fluvial deposits in stream channels usually exhibit a greater degree of sorting than the alluvial-fan deposits."

Most of the geohydrologic units described above are present within Eureka County. The distribution of geologic units in the county is depicted in Figure 3-2, a geologic map of Eureka County. Community water supply wells in Eureka County derive groundwater from alluvial deposits. For the most part, irrigation wells exploit the alluvial aquifers in Eureka County and the surrounding counties. Figure 3-2 shows the many wells, primarily irrigation wells, (blue dots primarily south of the playa) that tap the alluvial aquifer (colored yellow and labeled Qal) in Diamond Valley in southeastern Eureka County and the other alluvial deposits scattered throughout the county. In northern Eureka County, Figure 3-2 shows the large number of wells drilled for the mining industry, primarily completed in bedrock units. The carbonate rocks in the northern part of the county produce large quantities of groundwater necessary to dewater open-pit and underground mine workings.

3.2 GROUNDWATER RESOURCES

Chapter 2 introduced the concept of the hydrographic area or basin as the basic water resource management unit in the State of Nevada. The footprint of Eureka County overlies 16 of these administrative areas to varying degrees as illustrated in Figure 3-3.

Estimates of the groundwater resources for each of the 16 hydrographic areas are available from the Nevada Division of Water Resources. These estimates are primarily based on reconnaissance-level investigations undertaken in the 1960s and 1970s by the United States Geological Survey in cooperation with the Nevada Division of Water Resources. Generally speaking, the amount of groundwater in a particular hydrographic area that can be put to use in perpetuity is equivalent to the amount of natural groundwater discharge that can be captured by wells. This is the *perennial yield* of a basin as the term is applied In Nevada. Table 3-1, below, lists estimates of perennial yield for the 16 hydrographic areas touched by Eureka County, the total of which is 180,900 acre-feet per year.

An *acre foot* is the amount of water it takes to cover an acre of land with water to a depth of 1 foot. It is equivalent to approximately 325,900 gallons of water. A residence served by a domestic well may use up to 2 acre-feet per year. In northern Nevada, crops such as alfalfa consume approximately 3.2 to 3.5 acre-feet per acre per year. Precipitation falling on crops reduces the amount of irrigation water that must be applied.

Not all hydrographic areas in the County's Water Resources Planning Area are hydraulically closed; therefore, many are not truly independent of each other. That is, in a closed basin all recharge to the basin is discharged within the basin. Instead, in many instances there is some underground flow between adjoining basins. Often, inter-basin flow must be inferred, but some inter-basin connections are evidenced by drawdown in a basin arising from pumping to dewater a mine in an adjacent basin. Figure 3-4 illustrates different classes of flow systems – 1) a single-valley closed-basin system and 2) a regional system comprising multiple adjacent basins, where inter-basin flow is depicted by solid blue arrows.

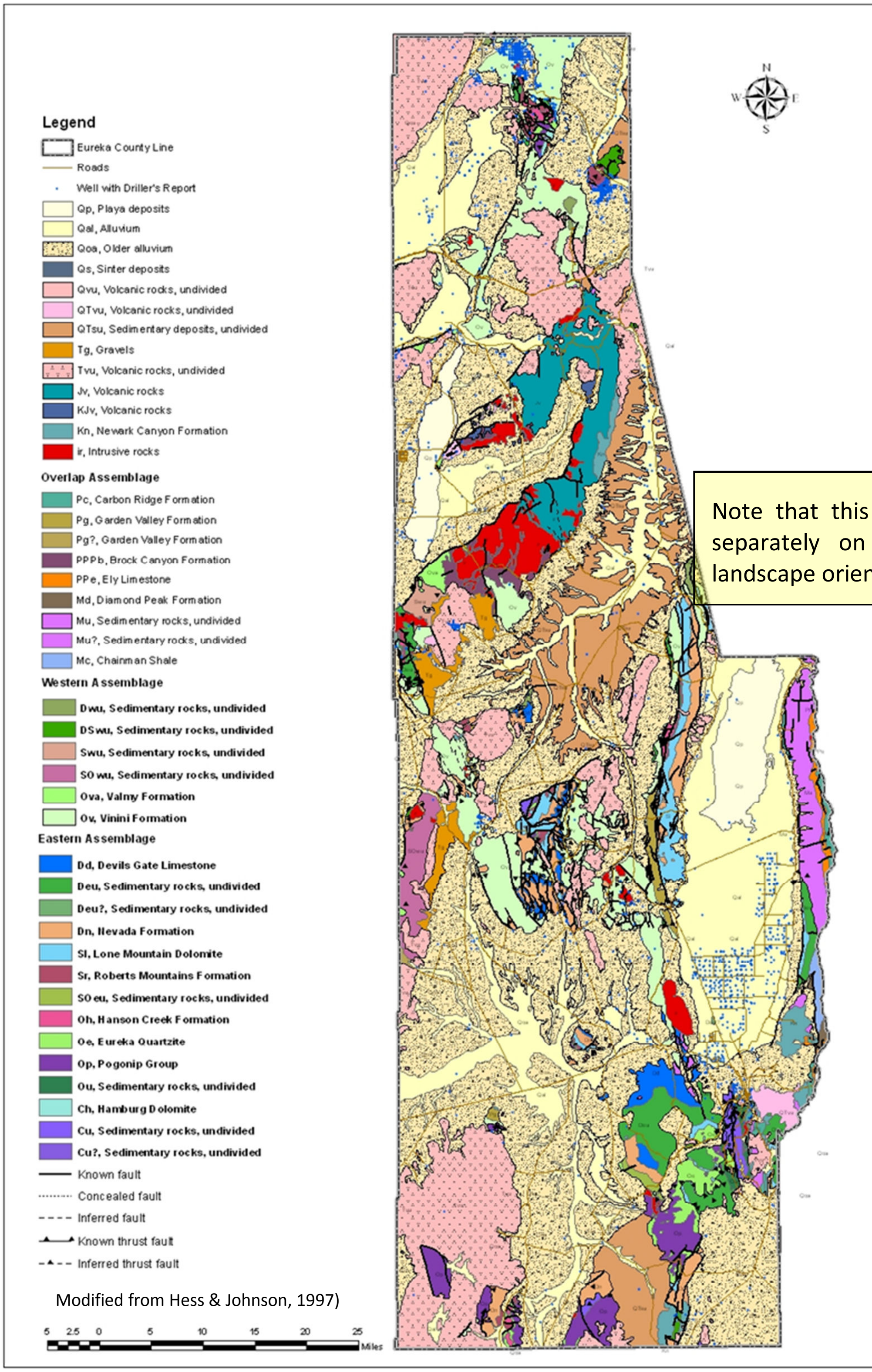


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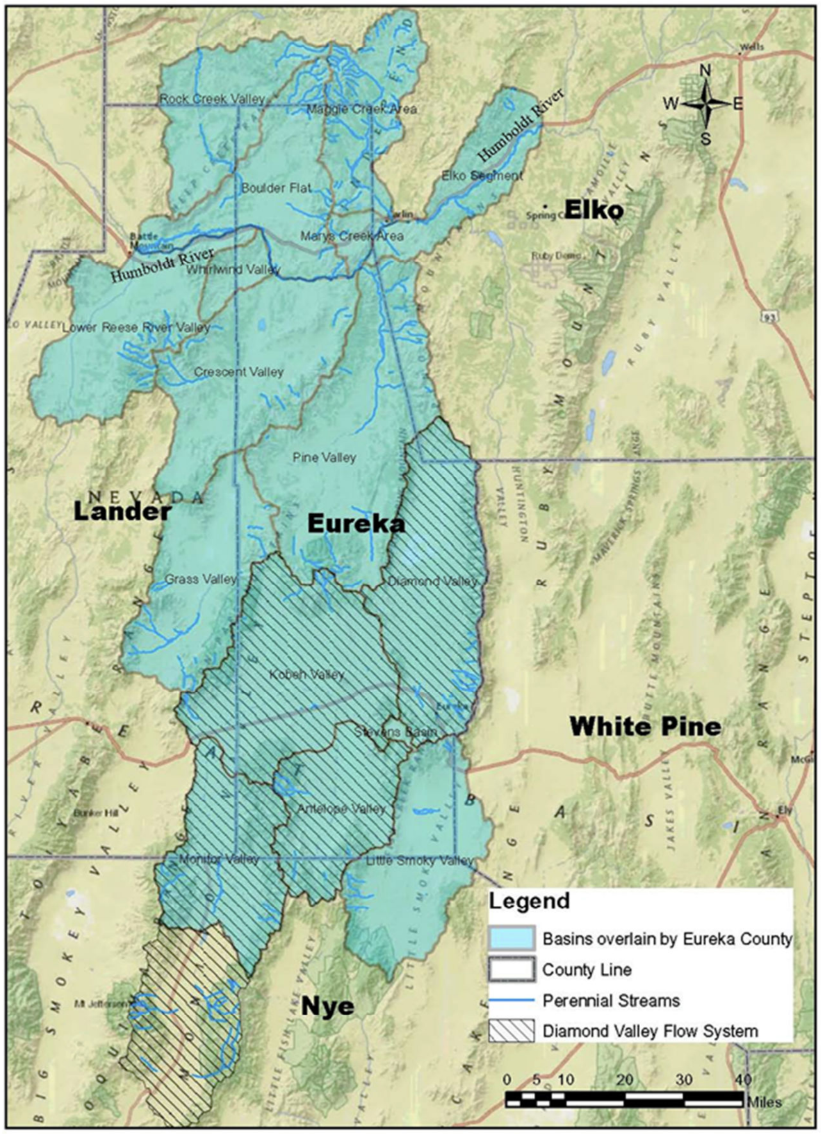
Figure 3-2. Geologic Map of Eureka County.



Note that Monitor Valley (southern part) is outside of the Eureka County Water Resource Master Planning Area, but is included in the figure because it is part of the Diamond Valley Flow System.

Figure 3-3. Hydrographic Areas within the Eureka County Water Resource Planning Area.

Table 3-1

Summary of Perennial Yield for Hydrographic Areas in the Eureka County Water Resource Planning Area

Hydrographic Area Number	Hydrographic Area Name	Estimated Perennial Yield [a] (Acre-feet/year)
Humboldt River Basin		
49	Elko Segment	13,000
52	Mary's Creek	
51	Maggie Creek	4,000
53	Pine Valley [b]	20,000
54	Crescent Valley	16,000
59	Lower Reese River Valley	20,000
60	Whirlwind Valley	
61	Boulder Flat	30,000
62	Rock Creek	2,800
Central Region		
138	Grass Valley	13,000
139	Kobeh Valley[,e]	15,000
140A	Monitor Valley (North) [c]	8,000
151	Antelope Valley [c]	4,000
152	Stevens Basin [c,d]	100
153	Diamond Valley [c]	30,000
155A	Little Smokey Valley (North)	5,000
	Total	180,900

a) Source: http://water.nv.gov
b) Although not included in the Diamond Valley Flow System, the Garden Valley portion of Pine Valley is believed to provide a source of inter-basin flow to northern Diamond Valley.
c) Part of the Diamond Valley Flow System
d) Only basin entirely within Eureka County
e) Perennial yield adjusted by the NSE in 2012

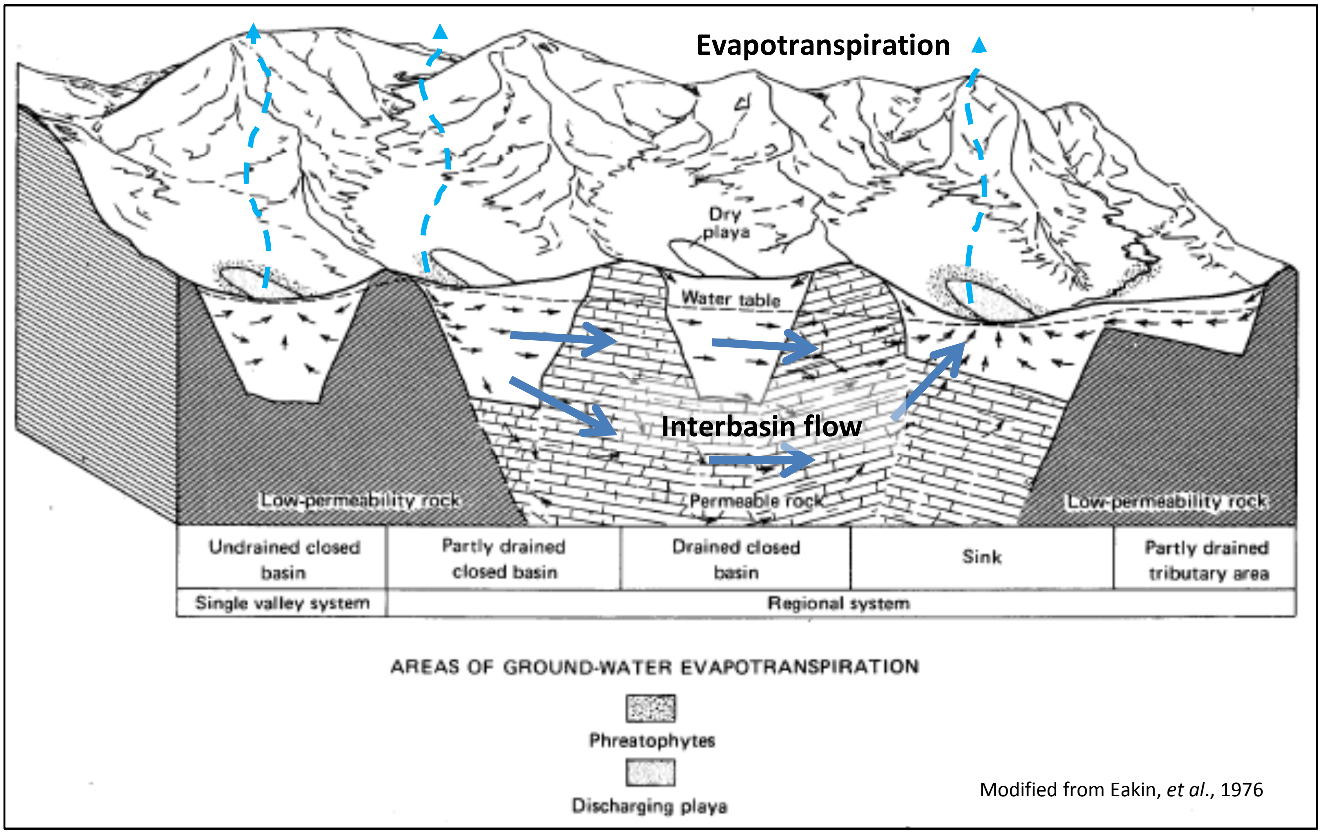


Figure 3-4. Types of Groundwater Flow Systems.

The Diamond Valley flow system is one example of a regional flow system. It is comprised of Monitor Valley (northern and southern parts), Antelope Valley, Kobeh Valley and Diamond Valley (Figure 3-5) wherein there is inter-basin flow in the alluvial deposits. Groundwater in the alluvial deposits of the various basins flows toward Diamond Valley such that prior to groundwater development, the playa area of northern Diamond Valley represented the discharge area for the entire flow system. Recent investigations for the Mount Hope Project indicated it is likely that there is inter-basin flow between Kobeh Valley and Diamond Valley through the bedrock north of Whistler Peak (dashed blue arrow in Figure 3-5). Although not considered part of the Diamond Valley Flow System, there is also evidence to support inter-basin flow from Garden Valley (a portion of the Pine Valley Hydrographic Area) to northern Diamond Valley (dotted blue arrow in Figure 3-5). Irrigation pumping in southern Diamond Valley has created a groundwater sink south of the playa. In response, groundwater levels and spring discharge along the margin of the playa have declined.

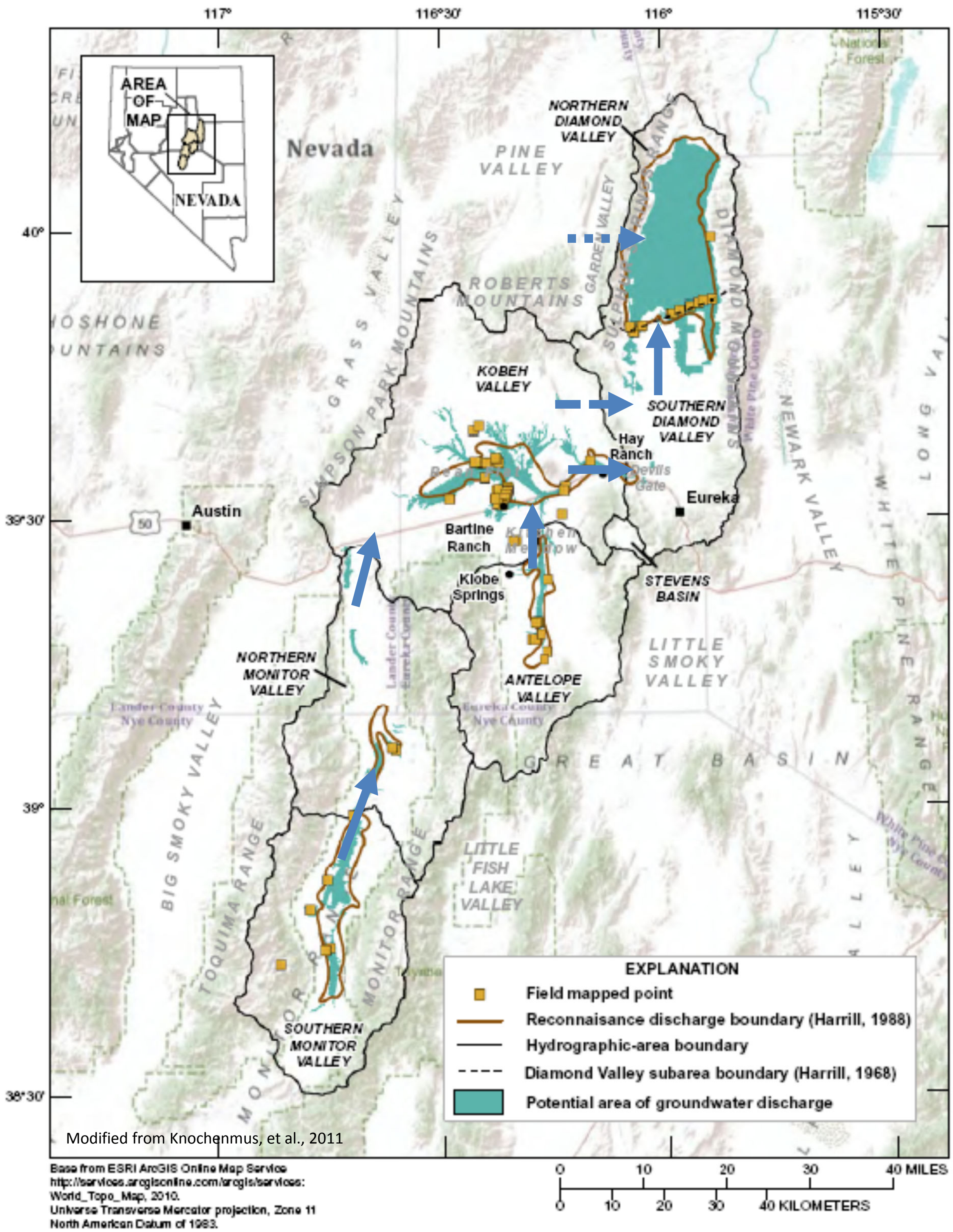


Figure 3-5. Diamond Valley Flow System.

Much of this inter-basin flow occurs at depth in the carbonate rocks described in Section 3.1, although groundwater does flow through other rock types, albeit typically to a lesser degree. Carbonate rocks underlie the eastern half of Nevada, including a large portion of Eureka County, extending into the western half of Utah and southeast corner of Idaho. Within the carbonate rock province of the Great Basin (Figure 3-6) are several regional flow systems in addition to the Diamond Valley Flow System. A subdivision of the carbonate rock province comprising portions of several regional flow systems has been studied in some detail through the Basin and Range Carbonate Aquifer System (BARCAS) Study (Welch & Bright, 2007). The BARCAS extends into southeastern Eureka County beneath Little Smoky Valley, which in turn is part of the Newark Valley Regional Flow System. Carbonate rocks extend westward beneath the southern half of Eureka County, but carbonates in this area were not reflected in the BARCAS Study. Although not depicted in Figure 3-6, carbonate rocks are encountered at depth in northern Eureka County (Boulder Flat, Maggie's Creek and Crescent Valley HAs) where many major mining projects are located and these units are a source of large amounts of groundwater pumped to dewater the mines.

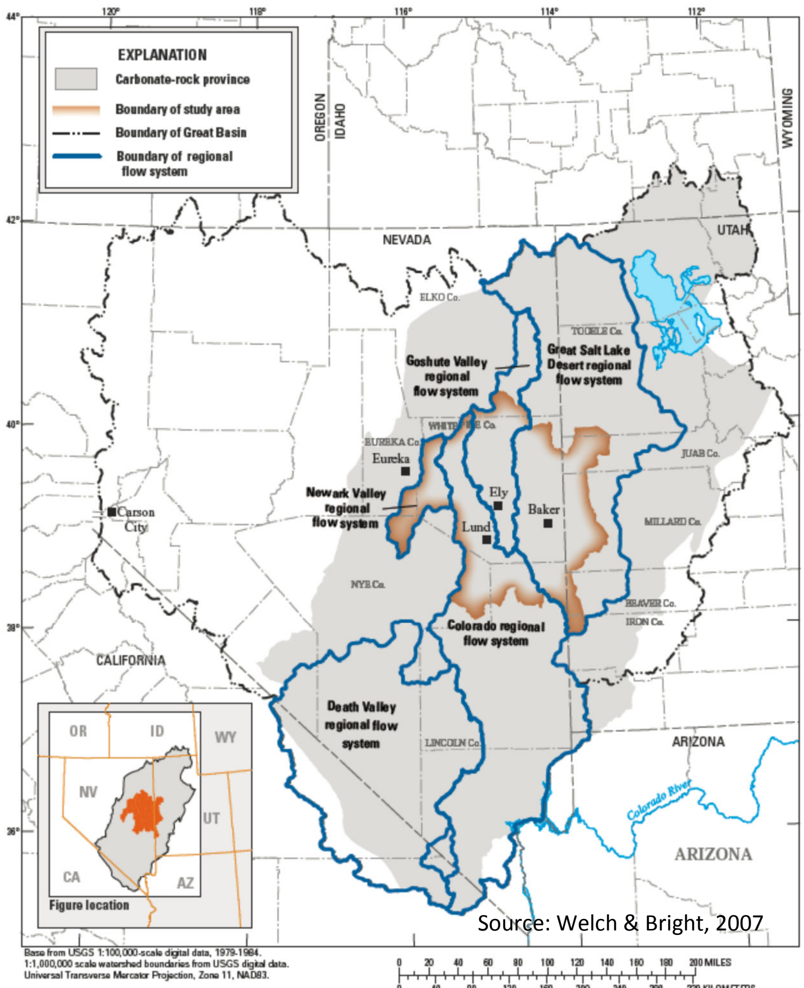


Figure 3-6. Regional Flow Systems and the BARCAS Study Area.

3.2.1 Precipitation

The concept of a basin water budget was introduced in Section 2. In short, a water budget is the sum of all water going into and coming out of the groundwater flow system(s) of a basin or hydrographic area. Prior to water resource exploitation, the groundwater recharge to a basin is in balance with the discharge from it, a situation referred to as steady state or equilibrium.

Precipitation, primarily as rain or snow, is the source of all water in Eureka County as it is virtually everywhere else on the planet. Of the precipitation that falls on the land surface, the vast majority almost immediately returns to the atmosphere via evaporation, a large amount is transpired by plants, some runs off to become stream flow, and the remainder infiltrates the soil to recharge the groundwater flow system. Within Nevada, only about three to four percent of the total precipitation that falls on the land surface becomes groundwater recharge that is potentially available for beneficial use. Figure 3-7 illustrates this hydrologic cycle, albeit in a very simplistic manner.

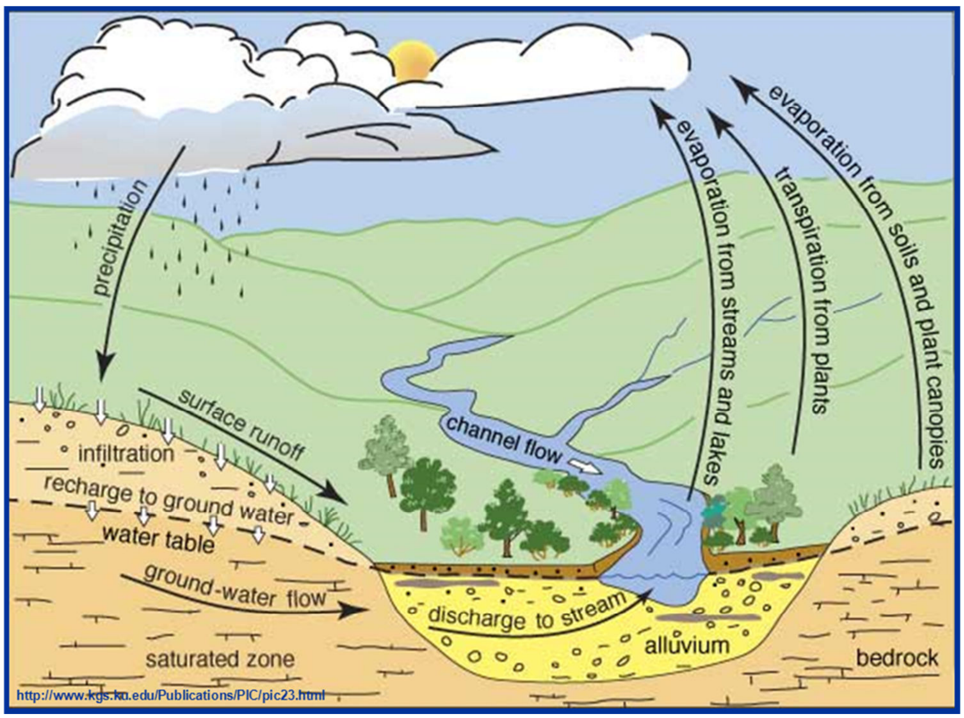


Figure 3-7. The Hydrologic Cycle.

Precipitation data are available from four weather stations in Eureka County – Eureka, Diamond Valley, Pine Valley (Bailey Ranch) and Beowawe. The period of record varies from 1979 through 2013 to 1888 through 2012. The average monthly and annual totals for these stations are given in Table 3-2 and monthly averages are plotted in Figure 3-8. These data show the majority of precipitation falls between the months of January and May, mainly as snow, but, on average, measurable precipitation falls throughout the year. The precipitation that falls in the winter occurs when moist air masses from the

Pacific move easterly under the prevailing winds. The precipitation in the summer is influenced by monsoonal flow of moisture from the south.

Table 3-2

Monthly Precipitation in Eureka County

Station	Average Total Precipitation (in.)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Eureka [1]	1.07	1.05	1.34	1.34	1.41	0.83	0.68	0.78	0.78	0.89	0.78	0.89	11.83
Beowawe [2]	0.78	0.62	0.64	0.77	1.02	0.71	0.29	0.33	0.38	0.55	0.70	0.75	7.53
Diamond Valley Agrimet Station[3]	0.74	0.63	0.95	0.80	1.24	0.69	0.60	0.77	0.64	0.75	0.66	0.61	8.95
Pine Valley (Bailey Ranch)[4]	0.78	0.78	1.15	1.21	1.41	0.85	0.28	0.58	0.83	0.82	1.07	0.88	10.63

Notes: 1) Period of Record : 4/ 1/1888 to 9/30/2012
2) Period of Record : 1/ 1/1893 to 9/30/2012
3) Period of Record : 8/ 1/1979 to 4/4/2013
4) Period of Record : 7/ 1/1982 to 8/31/2012
Source: NOAA National Climatic Data Center, Climate Data Online "www.ncdc.noaa.gov/cdo"

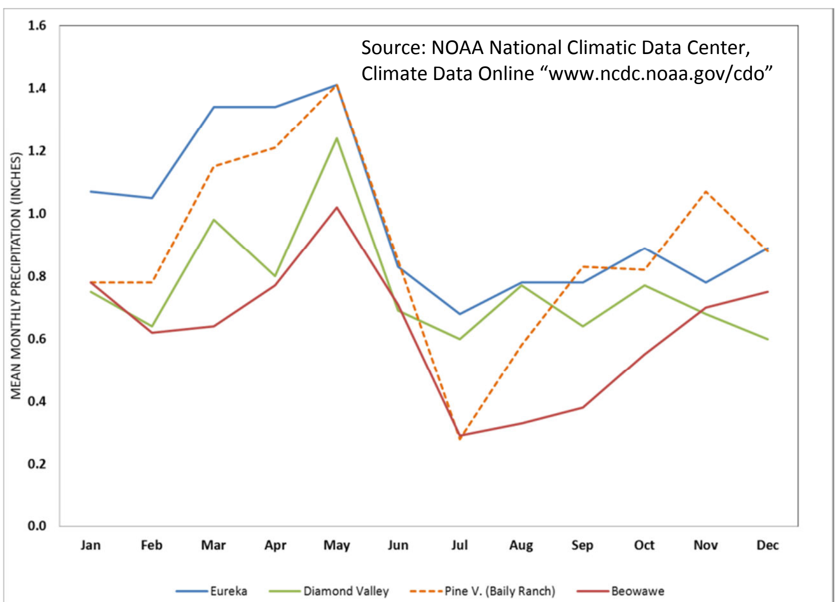


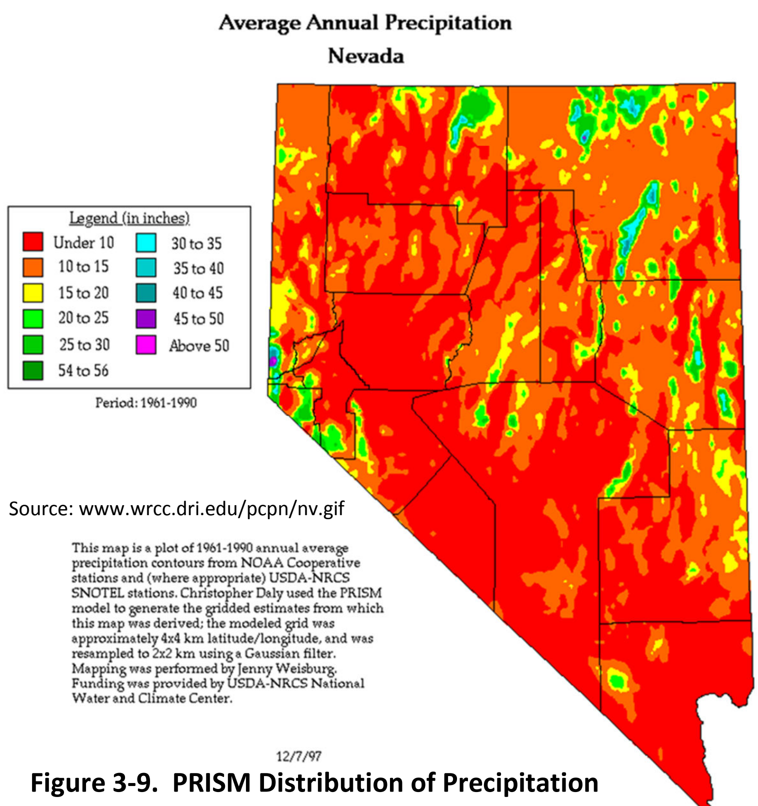
Figure 3-8. Average Monthly Precipitation within Eureka County.

An understanding of how precipitation is distributed throughout Eureka County and the surrounding hydrographic areas is necessary for a quantitative assessment of the water resources available for sustainable use consistent with common sense, Eureka County policies and the State's water law. The estimates of the perennial yields for the hydrographic areas in Nevada, including those associated with

Eureka County provided in Table 3-1, above, are derived from a method developed specifically for hydrographic basins in eastern Nevada. The Maxey-Eakin Method (Maxey and Eakin, 1949) estimated groundwater recharge on a hydrographic-area or basin scale assuming a distribution of precipitation based on data from precipitation stations prior to 1936 (Hardman, 1936). Hardman established a series of precipitation zones based on vegetation communities which are influenced to a large degree by elevation. The Maxey-Eakin Method employed empirical recharge coefficients (that is, percentages of precipitation that become groundwater recharge) for each precipitation zone to calculate an estimate of the groundwater recharge to a basin. This methodology continues to provide reconnaissance-level estimates of groundwater recharge that often are the starting point for more detailed water resource investigations today, but more importantly are the primary basis for estimates of perennial yield used by the Nevada State Engineer in the groundwater appropriation process.

However, since Hardman's time, in response to intensified groundwater resource exploitation and greater competition for the resource, significant effort has gone into improving estimates of precipitation as additional data have become available, particularly in areas of higher elevations. The rationale for improving estimates of precipitation is that more accurate estimates may increase the level of confidence in the amount of recharge to Nevada's hydrographic basins, which in turn should improve efforts to sustainably manage the State's precious finite water resources. These improvements recognize factors other than elevation (fundamental to Hardman's 1936-era precipitation distribution), such as the direction of prevailing winds and storm tracks, the presence of orographic barriers (mountains that block the prevailing winds), slope of the land surface, *etc.* that influence the amount of precipitation at any one location.

Perhaps the greatest contribution of these enhancements is a realization that more precipitation falls at higher elevations than was accounted for by earlier methods. For example, the maximum precipitation zone defined by Hardman (1936) was "greater than 20 inches." In contrast, the more recent precipitation data and subsequent analysis shows up to 50 inches or more of precipitation in the Sierra Nevada and as much as 40 inches of precipitation at high elevations in eastern Nevada. Figure 3-9 provides a more recent distribution of precipitation that incorporates these newer data and more inclusive analysis. This map was calculated using a method referred to as PRISM



Source: www.wrcc.dri.edu/pcpn/nv.gif

Figure 3-9. PRISM Distribution of Precipitation in Nevada.

(Parameter-elevation Regressions on Independent Slopes Model). While viewed by many as an improvement over previous methods, PRISM is not perfect in that it may underestimate precipitation in some areas compared to measured data and overestimate it in others. However, it is presently widely used in water resource investigations and its accuracy is expected to improve as more data become available and the method itself is refined.

3.2.2 Groundwater Discharge

Groundwater discharge is the other half of the basin water budget equation. Prior to exploitation of the resource, it comprises evapotranspiration by phreatophytes, bare soil evaporation, evaporation from water bodies such as playa lakes, groundwater discharge to streams, groundwater discharge from springs, and subsurface inter-basin flow to an adjoining basin. In many respects, accurate estimates of discharge, with the exception of inter-basin flow, are easier to obtain than estimates of recharge because it is possible to make direct measurements of the various components. Because evapotranspiration can account for a major portion of discharge, new methods to directly measure evapotranspiration are being evaluated. Some of this work in Eureka County by the United States Geological Survey is partially funded by Eureka County as part of the Diamond Valley Flow System studies. An expectation of these studies is that more refined measurements of evapotranspiration will provide a basis for more accurate estimates of perennial yield with which to diligently manage the water resources within the County.

Evidence of subsurface outflow to an adjacent basin is more often than not the result of an imbalance between estimates of recharge and discharge within a basin. For example, if recharge is estimated to be greater than discharge or measured discharge is greater than estimates of recharge; one possible cause can be inter-basin flow. In fact, the first indications of regional flow systems in Nevada were water budget imbalances between adjacent basins.

Human activity can cause another type of groundwater discharge. Anthropogenic (human caused) groundwater discharge primarily results from extracting groundwater via wells.

3.2.3 Current Estimates of Groundwater Resources

Water-resource planning on the State level consists of an attempt to balance groundwater appropriations (committed water rights) with the perennial yield in each hydrographic area in order to prevent mining the groundwater in a basin, *i.e.*, pumping more water than can be sustainably pumped. As stated above, current estimates of perennial yield are largely based on decades-old estimates developed using the Maxey-Eakin Method (Eakin, *et al*., 1951), but, in some instances, the perennial yield has been adjusted by the Division of Water Resources in response to new information or further analysis. Table 3-3, below, compares the estimates of perennial yield for the 16 hydrographic areas in Eureka County's planning area to the committed underground water rights. It is important to realize that, even though the State administers the groundwater resources on a basin-by-basin basis, in a number of instances there is groundwater flow between adjacent basins, but there is no means of measuring this inter-basin flow. Rather it is implied by water budget imbalances for adjacent basins and further supported when there are differences in water level elevations between basins. Hydraulic communication between adjacent basins is further supported by data collected in Eureka County by the mining industry. These data show a drawdown response in deep aquifers in basins outside of those currently being pumped by the mining industry.

Table 3-3

Comparison of Perennial Yield and Committed Underground Water Rights for Hydrographic Areas in the Eureka County Water Resource Planning Area

Hydrographic Area Number	Hydrographic Area Name	Estimated Perennial Yield [a] (Acre-feet/year)	Committed Underground Water Rights [a] (Acre-feet/year)	Committed Geothermal Water Rights [a] (Acre-feet/year)	Total Committed Underground Water Rights [a] (Acre-feet/year)
Humboldt River Basin					
49	Elko Segment	13,000	20,341.52	4,459.42	**24,800.94**
52	Mary's Creek				
51	Maggie Creek	4,000	14,263.18		**14,263.18**
53	Pine Valley	20,000	17,083.59[f]		17,083.59
54	Crescent Valley	16,000	82,391.51		**82,391.51**
59	Lower Reese River Valley	20,000	42,709.65		**74,316.04**
60	Whirlwind Valley			31,606.39	
61	Boulder Flat	30,000	73,117.14		**73,117.14**
62	Rock Creek [b]	2,800	2,260.43		2,260.43
Central Region					
138	Grass Valley	13,000	13,317.96[e]		13,317.96
139	Kobeh Valley [c]	15,000	12,667.02[g]		12,667.02
140A	Monitor Valley (North) [c]	8,000	280.78		280.78
151	Antelope Valley [c]	4,000	3,080.21		3,080.21
152	Stevens Basin [c, d]	100	19.27		19.27
153	Diamond Valley [c]	30,000	134,152.60		**134,152.60**
155A	Little Smokey Valley (North)	5,000	5,055.65		5,055.65
	Total	180,900	420,740.53	36,065.81	**456,806.34**

a) Source: http://water.nv.gov
b) Combined total of Rock Creek Valley and Willow Creek Valley (not within Eureka County)
c) Diamond Valley Flow System
d) The only hydrographic area entirely within Eureka County
e) Applications for 7,500 afa of water rights for industrial use (cooling water for a geothermal plant) are ready for action and not included in this total. These applications have been protested by the BLM.
f) Does not include applications filed in March 2013 by Barrick to appropriate all the remaining unappropriated water in Pine Valley.
g) Does not include applications by Kobeh Valley Ranches and others for irrigation that, if approved, would fully appropriate the basin.

Red text indicates total committed underground rights exceed estimated perennial yield in an individual hydrographic area

Table 3-3 suggests the hydrographic areas within Eureka County's water resource planning area, in aggregate, have been over-allocated by a factor of about 1.5. That is, the committed water rights are about 2.5 times the estimated perennial yield. In some basins, such as Crescent Valley and Diamond Valley the committed water rights are 4.5 to 5 times the perennial yield. For most of the seemingly over-allocated basins, such as the Elko Segment, Mary's Creek, Maggie Creek, Boulder Flat and Crescent Valley hydrographic areas – Diamond Valley being the exception - a significant portion of the committed groundwater rights are associated with mine dewatering. A large percentage of the water pumped to dewater open pits and underground workings returns to the groundwater system via infiltration and the apparent basin overdrafts are not as onerous as they seem. However, even with these artificial recharge programs or water management strategies, the effect of some dewatering operations in northern Eureka County is extending well into adjacent hydrographic areas, particularly where the pumped water is not returned to the same geohydrologic unit from which it originated. In other words, the water is pumped from deep fractured-rock aquifers and recharged to shallower alluvial aquifers. The significance of these effects and means to mitigate them, if they can be mitigated, are the subject of on-going investigations by the mining industry and are of interest to the State as well as Eureka County.

Likewise, a large proportion of the groundwater exploited for geothermal purposes is re-injected to the geothermal aquifer or reservoir such that geothermal resource utilization has a potential not to consume large quantities of groundwater. However, in some instances, it is difficult to precisely determine the effectiveness of these geothermal re-injection programs because of the potential for measurement error (source: Dr. Lisa Shevanel, Nevada Water Resource Association, 2011). Some geothermal energy production processes require cooling water to enhance the efficiency of electrical energy generation. These operations have a potential to consume significant quantities of groundwater. The geothermal resource development in Grass Valley is one such project as it is requesting to appropriate groundwater that, if approved, would result in over-appropriation of the basin.

In many instances, geothermal aquifers are hydraulically connected to non-thermal aquifers. In fact, it can sometimes be difficult to show any distinction between them other than temperature because thermal and non-thermal waters may simply represent a hydrogeological facies[2] change within a single flow system. Additionally, some geothermal facilities use groundwater for cooling purposes and can consume significant quantities of groundwater through evaporation. As a result, exploitation of a geothermal resource can have a real potential to affect a non-thermal resource and vice versa.

Some water uses such as irrigation return a portion of the water pumped back to the aquifer. This returned water is referred to as *secondary recharge*. For example, irrigation water applied to crops in excess of the water the crops can consume can infiltrate the soil and recharge the groundwater system. The state often incorporates this secondary recharge in their allocation of water. Other sources of secondary recharge include percolation of residential septic tank effluent, infiltrated effluent from a wastewater treatment plant, and infiltration of water pumped for mine dewatering. For this reason, it is possible for the amount of committed water rights to exceed the perennial yield without over-appropriating a basin. Crescent Valley is a good example where infiltration of water pumped to dewater the mines has resulted in no decline in water levels in the alluvial aquifer of the basin beyond the mine areas. A well-known exception is Diamond Valley, where present-day consumption of water is

[2] In geology, facies represent gradual lateral changes in the depositional environment of sediments that affect the character of the sediments. The concept can be extended to hydrogeology to represent lateral changes within a groundwater flow system.

known to exceed the perennial yield, committed water rights are approximately four times the available resource, and water levels have been steadily declining for decades.

From a water-planning perspective, it can be more important to know what portion of the committed water rights is *consumed* as opposed to *committed* because the difference between the perennial yield and consumption provides an estimate of the quantity of water resources potentially available for future uses. The Division of Water Resources, however, does not maintain up-to-date estimates of the consumptive use for most basins in Nevada and local planners must be left to their own devices to determine how much water is being consumed.

3.3 SURFACE WATER RESOURCES

Surface water resources include both springs and streams, although springs blur the distinction between surface water and groundwater because they represent discharge of groundwater. Surface water and groundwater interact with each other and Nevada's regulatory scheme attempts to recognize this relationship.

A spring exists where the groundwater table intersects the land surface, such that the spring represents groundwater discharge similar to a flowing artesian well. Where springs are located on the valley floor they may represent a portion of the groundwater discharge for an entire basin's groundwater flow system. A spring can be defined as "A concentrated discharge of ground water coming out at the surface as flowing water; a place where the water table crops out at the surface of the ground and where water flows out more or less continuously." (source: http//water.nv.gov). The definition of a spring can be expanded to include seasonal springs or seeps. While seasonal springs and seeps may not be regionally significant, they constitute important local sources of water to livestock, wildlife, and wild horses. The water from a seep may support vegetation that provides wildlife habitat.

3.3.1 Springs and Seeps

The National Hydrography Dataset (NHD) identifies nearly 2,700 springs and seeps within Eureka County's Water Master Plan study area (http://nhd.usgs.gov last accessed 01/09/13) and these are shown in Figure 3-10. Of this total, approximately 1,600 are identified within Eureka County.

There are approximately 1,600 springs and seeps catalogued within Eureka County.

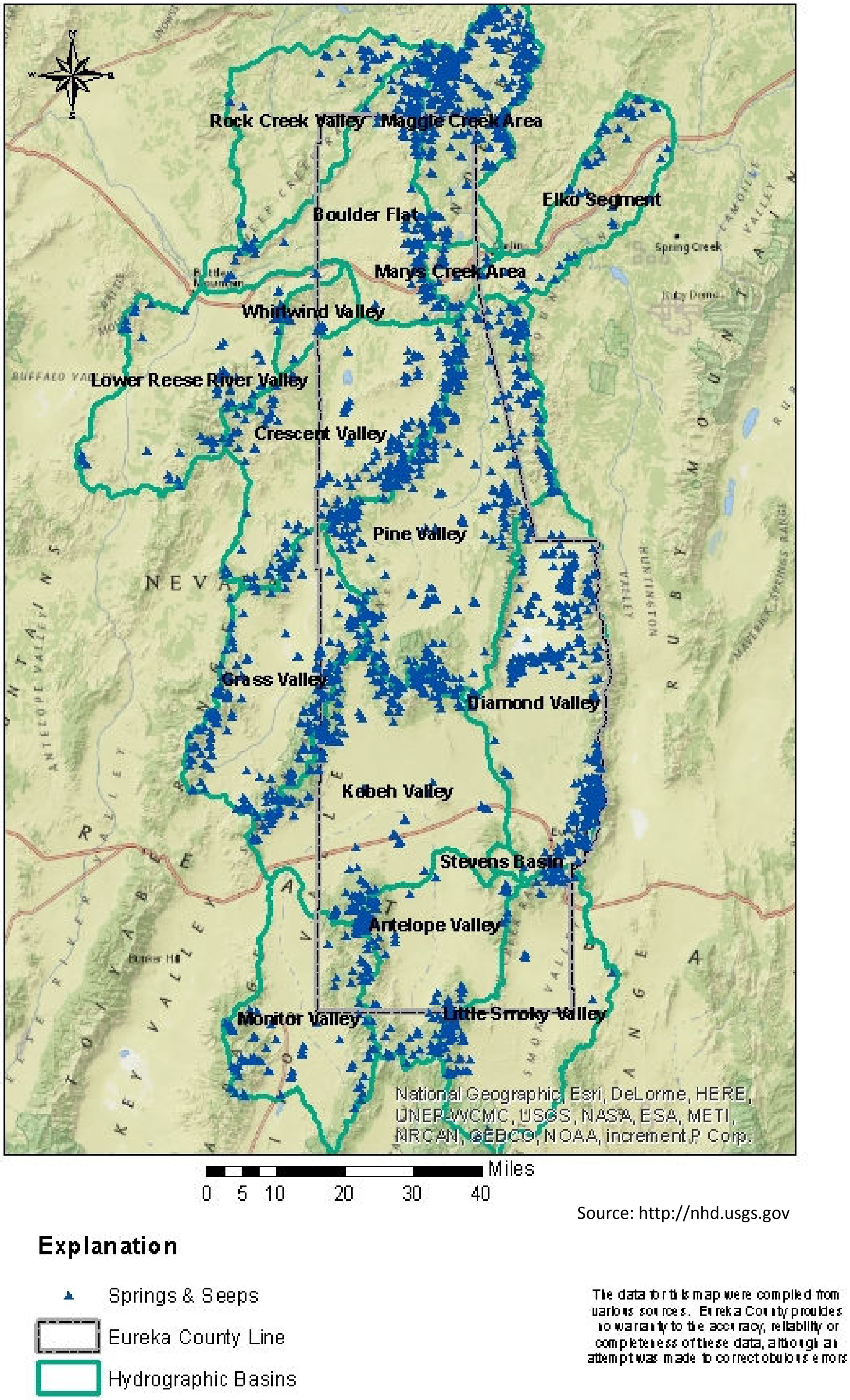


Figure 3-10. Springs and Seeps in the Eureka County Water Resources Planning Area.

The actual number of springs and seeps is potentially more than the number listed in the NHD because very small discharge springs and seeps may not have been mapped, particularly those that flow only seasonally. However, even the smallest spring or seep may provide an important water supply or support wildlife habitat even if only for a brief period each year. The vast majority of springs in the planning area are located in the mountains or above the range front. An obvious departure from this pattern is northern Diamond Valley, where, at least historically, a large number of springs were concentrated in the northern half of the basin within or near the valley-floor playa, the discharge area for the Diamond Valley Flow System (see Figure 3-10). Following the onset of irrigated agriculture beginning in the 1950s and 1960s, the discharge of these springs has declined and some have ceased to flow altogether. This decline in spring discharge was to be expected given the gross over-appropriation of the resource and is consistent with Nevada's beneficial use ideology. However, even if Diamond Valley was not over appropriated, many of these springs would ultimately have ceased to flow because the groundwater flow to the discharge area was or will be intercepted by wells. The principal difference is that pumping at high rates has accelerated the process.

Springs located in the valleys may be situated at the discharge area for a hydrographic area's groundwater flow system, particularly where the basin is internally drained and there is no surface or subsurface avenue for water to exit the basin. Springs in the mountains may serve as the source of flow to a stream. The streams in Roberts Mountain provide good examples of places where springs give rise to streams. Either way, a spring or seep occurs where the water table intersects the land surface.

Springs may represent the discharge from a localized flow system within a single watershed, the discharge area for the groundwater flow system for an entire hydrographic area, or a large regional flow system encompassing several adjoining hydrographic areas. The discharge from regional springs typically shows only small seasonal variations. Springs indicative of smaller-scale flow systems (either on basin scale or small watershed scale) generally show seasonal variations in flow. Hot or warm springs indicate deep circulation of groundwater and may or may not be related to a regional flow system.

3.3.2 Streams

Approximately 325 miles of perennial streams are listed in the NHD for the County's Water Resource Planning Area (http://nhd.usgs.gov last accessed 01/09/13). The perennial streams identified within the County's Water Resource Planning Area are depicted in Figure 3-11. Streams are also classified as intermittent and ephemeral. Intermittent streams are also depicted in Figure 3-11, but ephemeral streams are not. A single stream may include perennial and intermittent sections

> There are approximately 325 miles of *perennial* streams in Eureka County.

> *Perennial* streams flow year round.
> *Intermittent* streams flow only part of the year.
> *Ephemeral* streams flow only for a short time after a precipitation event.

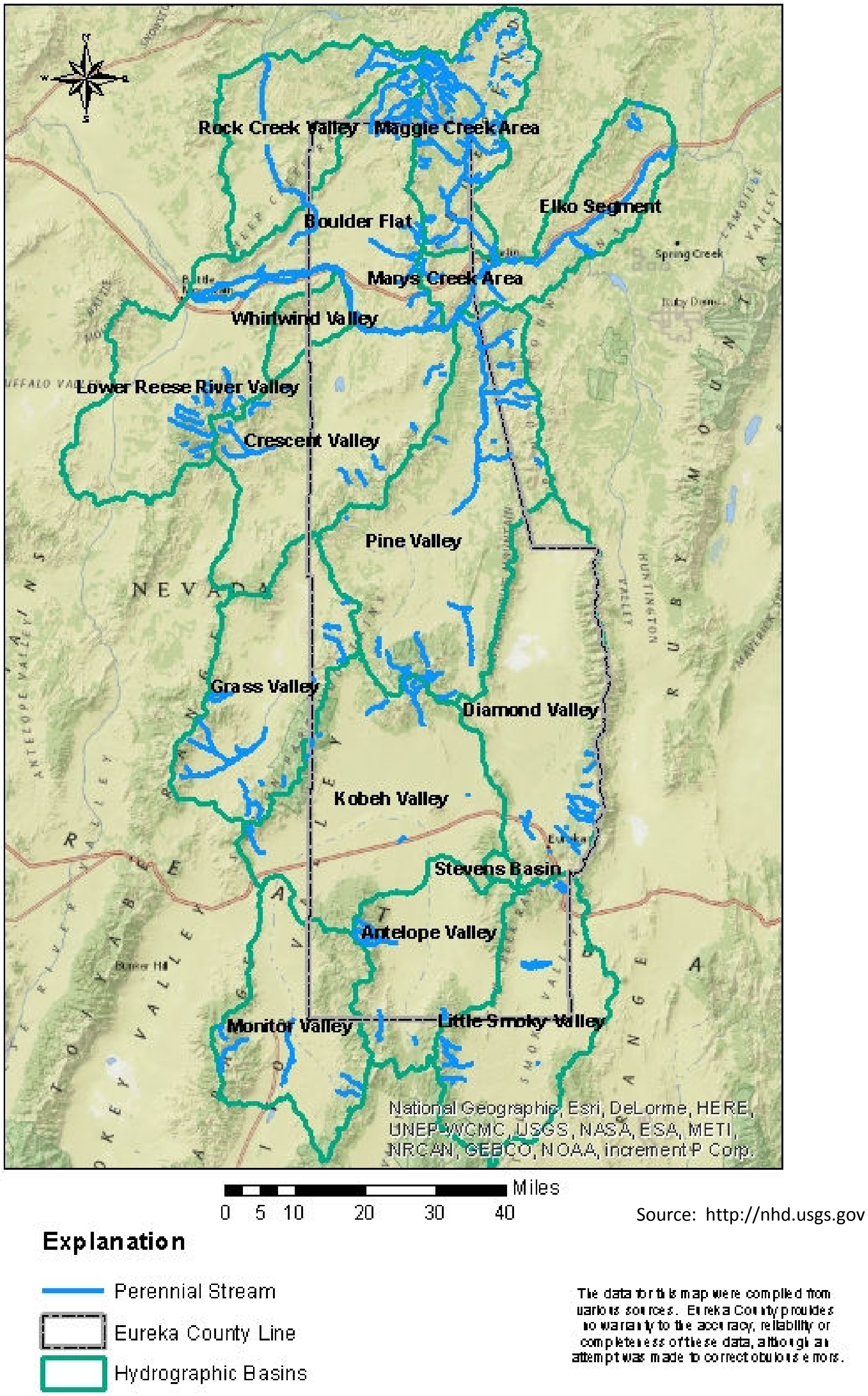


Figure 3-11. Streams in the Eureka County Water Resources Planning Area.

or "reaches" and these can vary from year to year depending on whether a year is wetter or drier than average.

The Humboldt River is the principal stream in Eureka County, transecting the northern portion of the county, flowing from east to west. The annual flow of the Humboldt River measured at the Palisade gage downstream of Carlin is 291,900 af/yr (Prudic, *et al*., 2006).

The majority of perennial streams within the county and its Water Resources Master Plan planning area are located in the mountains and only a few reach the valley floor; even fewer flow to the Humboldt River. Most streams cease to flow a short distance below the range front because the stream flow infiltrates the land surface where the streams cross the permeable deposits comprising alluvial fans. This infiltrated stream flow represents a major source of groundwater recharge to the alluvial aquifer in a basin.

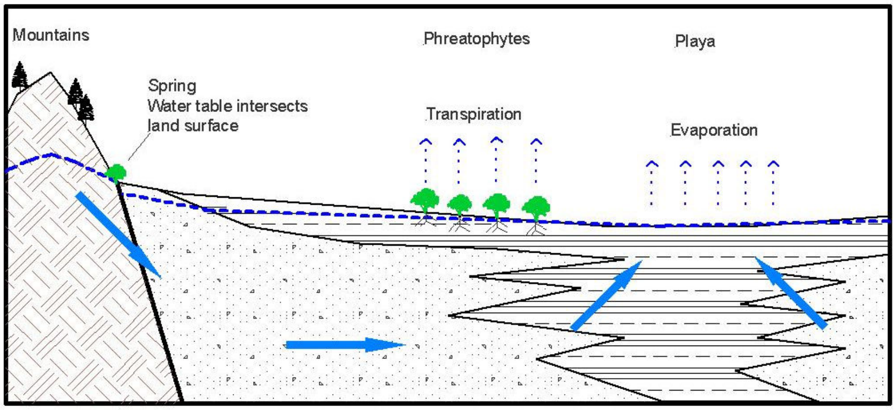
The only stream entirely within Eureka County that flows to the Humboldt River is Pine Creek in Pine Valley, flowing northward from its headwaters in Roberts Mountain. However, Pine Creek is not perennial its entire length and is interrupted by reaches where flow is intermittent. Roberts Mountain gives rise to other perennial streams such as Roberts Creek, Birch Creek, Pete Hansen Creek, Denay Creek, Willow Creek, Henderson Creek, and Vinnini Creek. Elsewhere in Eureka County's Water Resource Master Plan study area, most streams are perennial primarily in the mountain block. The water in these streams provides a source of irrigation and stock water and a source of supply to wildlife or supports wildlife habitat. They also provide recreation opportunities highly valued by the residents of the county.

Virtually all surface water in streams and many springs Eureka County are either fully appropriated or adjudicated. Additionally, springs have provided sources of water supply prior to the enactment of the state's water law. Even if claims of vested water rights have not yet been filed, it is likely numerous springs can someday be proven to provide pre-statutory sources of supply. Consequently, there is no surface water available for further appropriation.

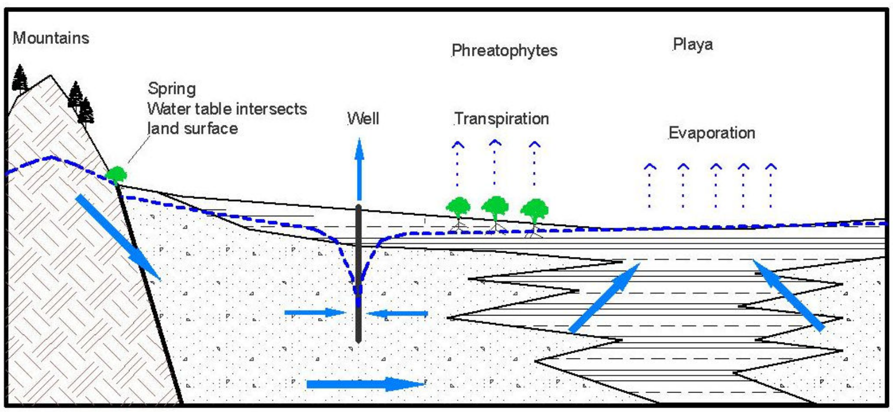
3.4 THE EFFECT GROUNDWATER DEVELOPMENT HAS ON THE WATER RESOURCES WITHIN A BASIN

The exploitation of groundwater resources via wells has a predictable effect on the basin in which development occurs. That is, use of the resource will capture natural discharge. In fact, it is a tenet of Nevada groundwater law that encourages the capture of natural discharge via wells and the water be put to beneficial use.

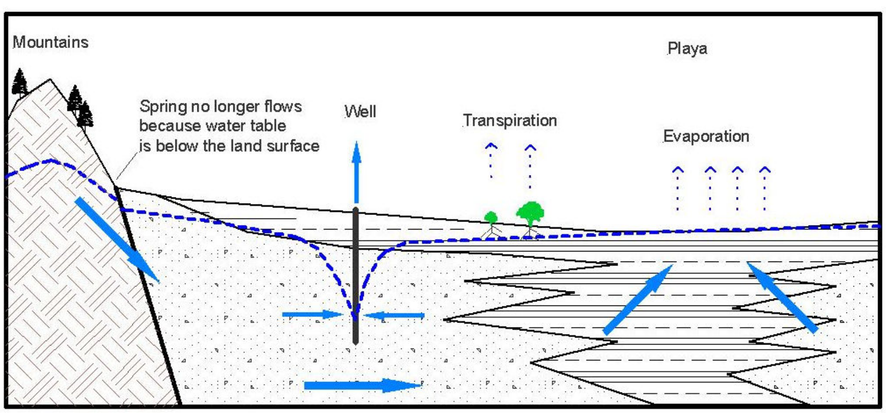
Groundwater pumped from an aquifer is derived from two sources – the water stored in the aquifer and the flow of groundwater through it. Initially, the water pumped from a well is released from storage in the aquifer, but given enough time the well ultimately captures groundwater flowing from the area where recharge occurs to the point of discharge. If groundwater extractions are small compared to the magnitude of resource, changes in the aquifer may be imperceptible. Alternatively, if the amount of groundwater pumped is large, then the effect will be measurable. The most common manifestations of groundwater development are a lowering of the water table and a decline in spring discharge, more commonly for springs on or near the valley floor. These changes in water level or spring discharge may be accompanied by a transition from phreatophyte to non-phreatophyte vegetation communities; for instance, a change from grease wood to sage brush.



Prior to development, groundwater flows from areas of recharge (mountains) to the discharge area (playa). Groundwater discharge also occurs at springs (where the water table – the dashed blue line – intersects the land surface) and via transpiration by phreatophytes. Discharge is in equilibrium with recharge.



Drawdown from pumped wells creates a localized cone of depression. Groundwater is initially derived from storage, but as time passes, the well increasingly intercepts groundwater flow toward the discharge areas. Drawdown at phreatophytes reduces transpiration and can affect vegetation communities. There may be little or no change to discharge at the playa in the early stages of development.



As time passes, the cone of depression continues to expand, further affecting phreatophyte discharge and may cause phreatophyte die off. Drawdown at the mountain front causes spring to cease to flow. Drawdown at the playa reduces discharge from evaporation. As long as pumping does not exceed natural discharge a new equilibrium condition will be reached and water levels will eventually stabilize.

Figure 3-12. Effect of Pumping on the Groundwater Regime.

So long as the amount of water pumped from the aquifer is less than the perennial yield, at some point in time the basin will achieve a new equilibrium condition, sometimes referred to as a new steady state, where total discharge remains in balance with recharge. It can take decades or even hundreds of years for this new equilibrium condition to be achieved. If the amount of water pumped exceeds the perennial yield, the water will effectively be mined and water levels will continue to decline until it is no longer economical to pump or the State begins to regulate groundwater withdrawals to bring the budget back into balance. Diamond Valley is the classical example of groundwater over development in Eureka County.

4.0 CURRENT WATER USAGE IN EUREKA COUNTY

Objective: Estimate the amount of water currently being consumed within the planning area.
Objective: Identify areas where water use currently exceeds the supply or may someday outstrip supply if all approved water rights were to be put to beneficial use.

Eureka County's Water Resource Master Plan planning area incorporates the 16 Hydrographic Areas introduced in Sections 2 and 3. These are:

Humboldt River Basin

- The Elko Segment Hydrographic Area
- The Mary's Creek Hydrographic Area
- The Maggie Creek Hydrographic Area
- The Pine Valley Hydrographic Area
- The Crescent Valley Hydrographic Area
- The Lower Reese River Valley Hydrographic Area
- The Whirlwind Valley Hydrographic Area
- The Boulder Flat Hydrographic Area
- The Rock Creek Valley Hydrographic Area
- The Grass Valley Hydrographic Area

Central Region

- The Kobeh Valley Hydrographic Area
- The Monitor Valley (Northern Part) Hydrographic Area
- The Antelope Valley Hydrographic Area
- The Stevens Basin Hydrographic Area
- The Diamond Valley Hydrographic Area
- The Little Smoky Valley (Northern Part) Hydrographic Area

These basins are displayed in Figure 4-1.

4.1 WATER RIGHTS

The records of the Nevada State Engineer show more than 1,700 points of diversion for water rights in Eureka County as of September 2014. The points of diversion (PODs) for these rights are displayed in Figure 4-1.

The State Engineer's records shows more than 1,700 water rights within Eureka County.

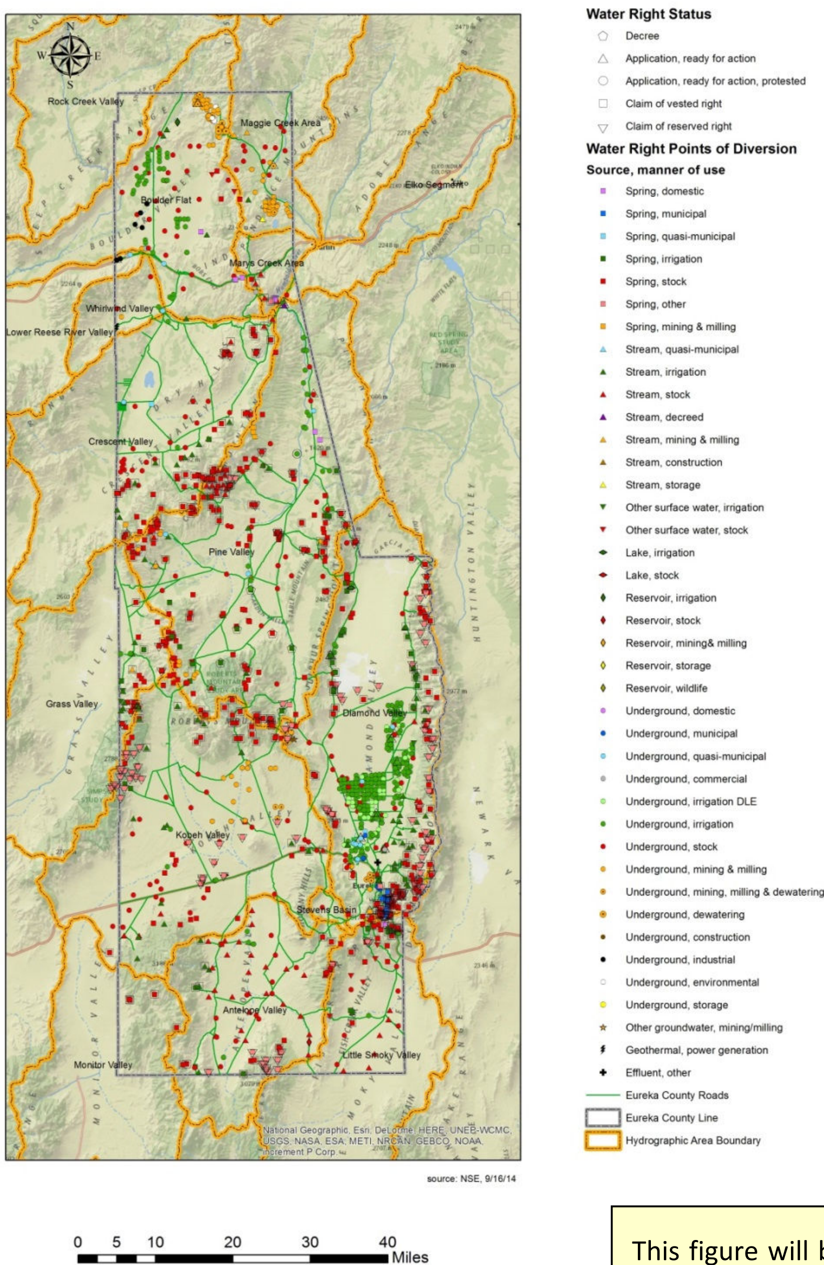


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Figure 4-1. Points of Diversion for Water Rights in Eureka County.

The PODs are categorized by source (spring, stream, underground, *etc.*) and manner of use in Table 4-1. The status (application, permit, certificate, reserved or claim of vested use) of water rights in the county is summarized in Table 4-2.

Table 4-1

Summary of Water Rights in Eureka County by Source and Manner of Use

Source	Number of Water Rights by Manner of Use (as of September 2014)																
	Domestic	Municipal	Quasi-Municipal	Commercial	Construction	Industrial	Irrigation, DLE	Irrigation	Stock	Mining & Milling	Mining, Milling & Dewatering	Dewatering	Environmental	Storage	Power Generation	Other	Wildlife
Spring	10	19	1					64	436	12						105	
Stream			1		1			91		7				1			
Other surface water								3									
Reservoir								5	5	5				1			1
Lake								1	1					1			
Underground	1	11	33	7	1	11	53	349	202	182	45	6	7	1			
Other Groundwater										1							
Geothermal															1		
Effluent																1	
Notes	"Other" manner of use includes Public Reserve 107 water rights claimed by the BLM. "Other groundwater" is groundwater discharge from a tunnel. "Other surface water" includes storm runoff. Source: NSE 9/16/14																

Table 4-2

Summary of Water Rights in Eureka County by Status

Status Source: NSE 9/16/14	Decree	Application	Application, Ready for Action	Application, Ready for Action, Protested	Permit	Certificate	Claims of Vested Right	Claims of Public Water Reserve
Number	9	3	29	7	354	939	295	126

From Table 4-1, it is clear that the category with largest *number* of water rights in Eureka County is for agricultural use (irrigation and stock watering). The mining industry, however, accounts for the largest water *use* in the county. Table 4-2 illustrates that proofs of beneficial use have been filed for more than 50 percent of the water rights in the County and certificates for these rights have been issued by the

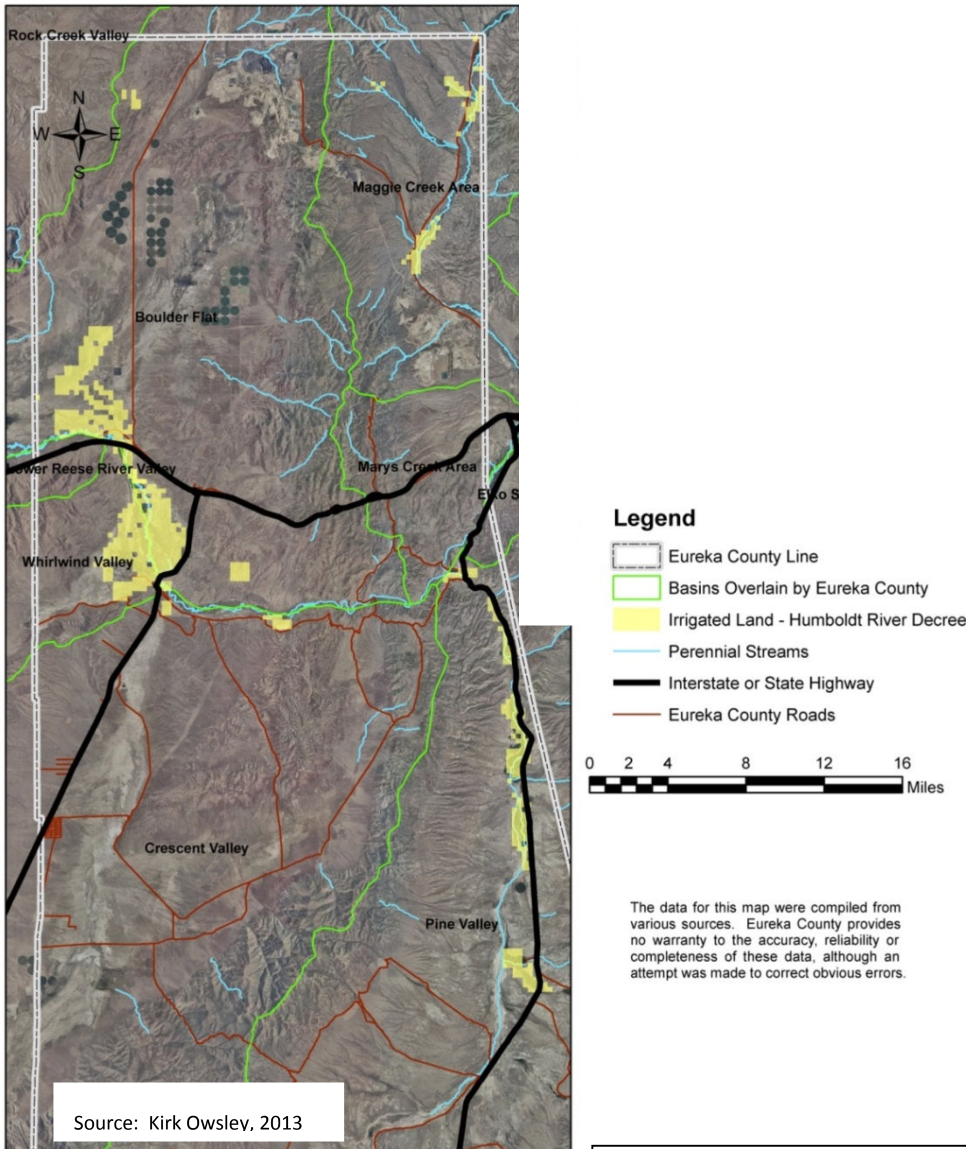
NSE. Table 4-2 also shows that 295 claims of vested water rights have been filed for water sources in Eureka County as of early 2016. Many more claims have been filed in 2016 in response to the NSE re-opening adjudication proceedings in Diamond Valley. These claims have the potential to total a significant amount of water, but have yet to be validated through the adjudication process. Additionally, Table 4-2 indicates 126 claims of Public Reserve 107 Water Rights filed by the BLM.

Surface water irrigation rights are acquired either through appropriation or the adjudication process. Water of the Humboldt River and its principal tributaries Pine Creek and Maggie Creek has been adjudicated through the Humboldt River Decree. In Eureka County there are currently approximately 20,000 acres of land eligible to receive approximately 35,000 acre-feet of water from the Humboldt River Decree (see Figure 4-2). The largest use of surface water for irrigation within the county occurs along the Humboldt River in portions of Boulder Flat and Whirlwind Valley, followed by land along Pine Creek and its tributaries in Pine Valley. Lesser amounts of surface water are used for irrigation in the other basins within the County. The waters of Pete Hanson Creek and its tributaries, which are all tributary to Pine Creek, including all springs that contribute to the flow in the creeks, were adjudicated through the Pete Hanson Creek Decree. The decree allows irrigation of 1,589.19 acres of land in Pine Valley, used primarily for hay and meadow pasture, with an annual duty of 3,529.27 acre feet plus stock watering for more than 1,100 head of cattle and 2,000 sheep (see Figure 4-3).

It is common for groundwater and surface water to be hydraulically connected and interact with each other. That is, the flow of many streams originates as groundwater discharge through the stream bed. Conversely, seepage from streams provides significant recharge to an aquifer. Accordingly, groundwater use can affect surface water flows and *vice versa*. A recent U.S. Circuit Court decision (United States v. Orr Water Ditch Co LLC, Ninth Circuit No. 07-1700L, April 7, 2010) addressed the status of senior adjudicated surface water rights with respect to junior appropriated groundwater rights. The Court ruled the Nevada State Engineer cannot approve new groundwater appropriations that conflict with or impair senior adjudicated surface water rights.

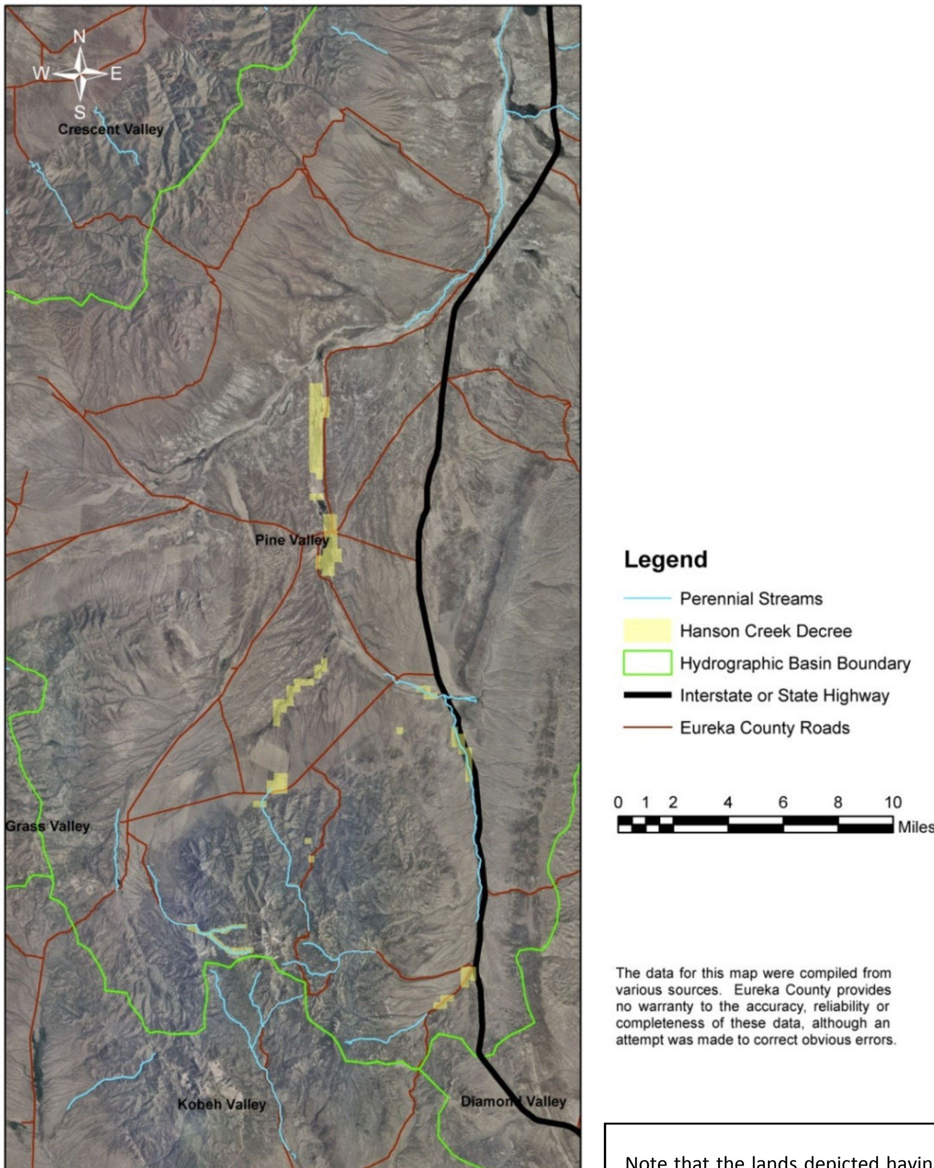
Another facet of surface water rights in Nevada is that springs are regulated as surface water although they represent discharge of groundwater much like a flowing artesian well. This idiosyncrasy might arise from the fact that exploitation of a spring source often, but not always, occurs by diverting water some distance downstream of the source. However, for springs for which there is no defined channel or where the water is diverted at the point where it issues from the ground, it makes more sense to regulate them as groundwater.

There are more than 300 of claims to pre-statutory water use or vested water rights within Eureka County on file with the NSE that have not been confirmed through the adjudication process. It seems likely that the flow of most springs in the county could be subject to claims of vested water rights. In addition, the BLM has claimed reserved rights on more than 100 springs in the county.



Note that the lands depicted as irrigated with water under the Humboldt River Decree are plotted to the nearest quarter-quarter section.

Figure 4-2. Lands in Northern Eureka County Irrigated by Surface Water Adjudicated under the Humboldt River Decree.



Source: : water.nv.gov/data/streamadjudication/results

Note that the lands depicted having water rights under the Pete Hanson Creek Decree are plotted to the nearest quarter-quarter section.

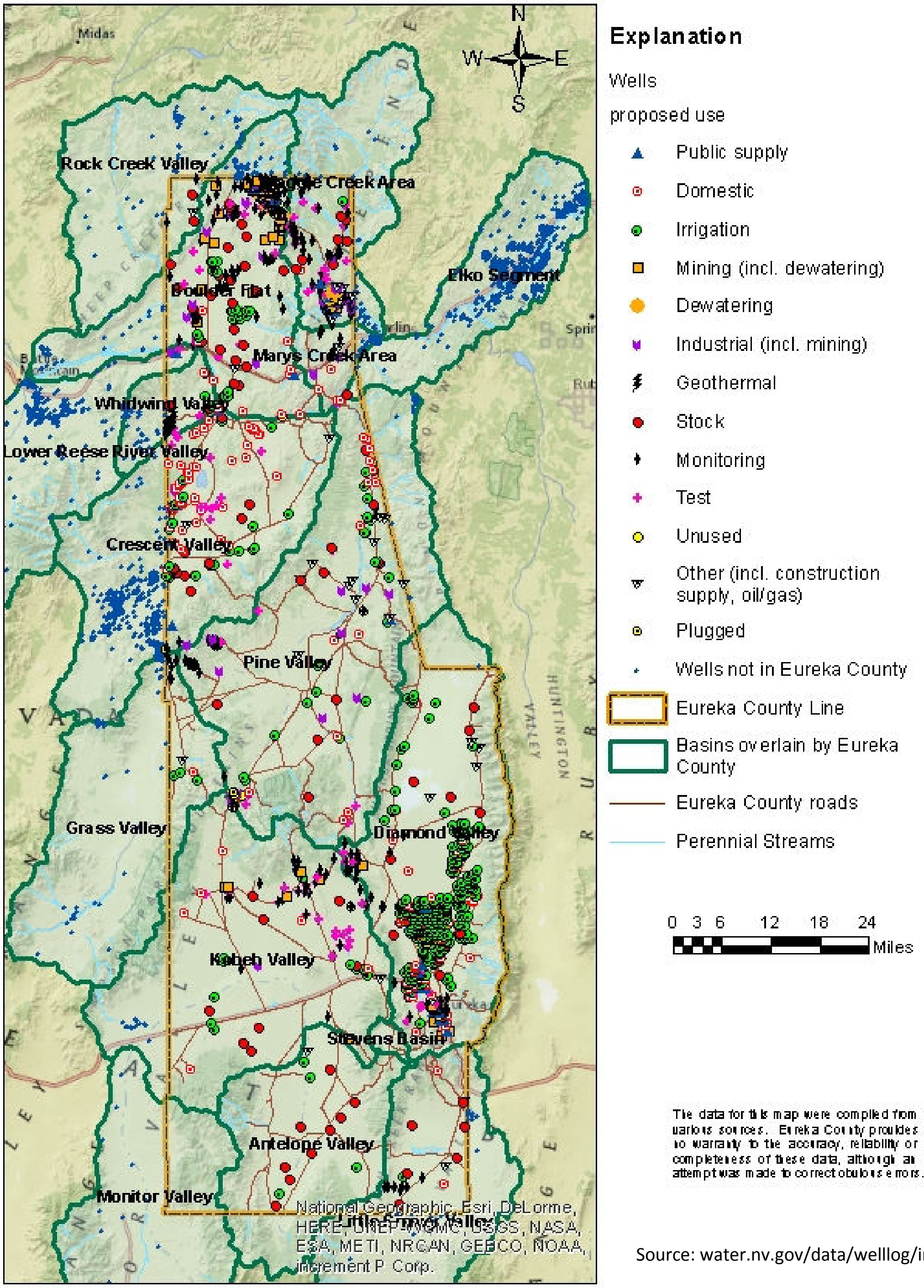
Figure 4-3. Lands in Pine Valley with Stock Water and Irrigation Rights from Surface Water Adjudicated under the Pete Hanson Creek Decree.

4.2 GROUNDWATER

The State Engineer's well log database shows more than 3,100 wells have been drilled within Eureka County.

The well log database available on line from the office of the Nevada State Engineer (http://water.nv.gov/data/welllog/index.cfm) shows driller's reports (well logs) for more than 7,000 wells drilled within the 16-basins addressed in Eureka County's Water Resources Master Plan (Figure 4-4). These wells, categorized by proposed use, are summarized in Table 4-3. Of this total, approximately 40%, or more than 3,100 wells, are reported for Eureka County. The "proposed use" information from the database, however, is imprecise and can lead to erroneous inferences regarding how many wells have been drilled for a specific purpose. For example, many wells in the database whose proposed use was labeled as "industrial" were drilled for mining and milling purposes and numerous wells labeled as "public water supply (municipal)" were drilled for mining, milling and/or dewatering purposes. Obvious errors in proposed use were corrected by cross checking driller's reports with water right permits, but the sheer number of well logs preempted affirming whether the proposed use was correctly reported for each and every well. Additionally, well locations, particularly before 2004 when the State began requiring GPS coordinates for wells to be provided on the driller's reports, occasionally are inaccurate and the locations of many wells plot hundreds to thousands of feet from their correct location on a GIS platform. Despite these shortcomings, the state's well log database provides useful information regarding the gross distribution of wells, well depths and estimates of well water pumping rates for the various geologic formations within the county.

Figure 4-4 suggests several trends in the locations of wells within Eureka County. In the northern portion of the county north of the Humboldt River, many wells are clustered along a northwest-southeast trending band extending from eastern Rock Creek Valley (outside the county) through northern Boulder Flat and the Maggie Creek areas. These wells are associated with the gold mines of the Carlin Trend and pumped wells derive groundwater primarily from bedrock aquifers. Another cluster of wells in southern Crescent Valley just west of the county line is related to the gold mining operations there and is associated with the Battle Mountain - Eureka Trend. The group of wells near the south end of Diamond Valley along the Battle Mountain - Eureka Trend is associated with the Ruby Hill Mine. This association, many of which are dewatering wells, derives groundwater from fractured rocks. Irrigation wells comprise another cluster in the southern half of Diamond Valley. These irrigation wells exploit the highly productive alluvial aquifer in the basin. A group of wells situated where Diamond Valley, Pine Valley and Kobeh Valley coalesce, plus wells in eastern Kobeh Valley are related to the Mount Hope Project molybdenum mine. From Table 4-3, it is clear that wells drilled for the mining industry dominate the number of wells drilled within Eureka County followed by wells drilled for irrigation purposes. The mining industry's wells include those reportedly drilled to develop mining and milling supplies, mine dewatering, industrial use and monitoring purposes.



Source: water.nv.gov/data/welllog/index.cfm

Figure 4-4. Wells in the Hydrographic Basins of Eureka County Water Resource Master Plan Study Area.

Table 4-3

Wells, by Proposed Use, in the Eureka County Water Resource Master Plan Study Area

Basin Number	Study Area Basin Name	Wells, by Proposed Use																					
		Public water supply (1)		Domestic		Irrigation		Stock		Mining (2)		Industrial (3)		Monitoring		Other (4)		Unused		Test		Total (by basin)	
		Entire Basin	Eureka County	Entire Basin	Eureka County	Entire Basin	Eureka County	Entire Basin	Eureka County	Entire Basin	Eureka County	Entire Basin	Eureka County	Entire Basin	Eureka County	Entire Basin	Eureka County	Entire Basin	Eureka County	Entire Basin	Eureka County	Study Area	Eureka County
49	Elko Segment	45	0	1135	0	24	0	37	1	1	0	17	0	179	0	38	0	4	0	72	0	1551	1
51	Maggie Creek	0	0	13	1	7	2	17	9	124	122	36	34	310	290	25	16	17	13	84	76	633	563
52	Mary's Creek	3	0	16	5	4	0	3	0	0	0	5	3	98	8	2	1	4	0	3	0	138	17
53	Pine Valley	0	0	18	18	24	24	14	14	1	0	20	20	123	105	16	5	5	5	38	12	259	203
54	Crescent Valley	4	3	72	56	45	22	15	13	103	1	87	1	544	25	8	3	3	1	49	19	930	144
59	Lower Reese River Valley	4	0	334	0	38	0	5	0	48	0	16	2	302	0	8	0	8	0	18	0	781	2
60	Whirlwind Valley	0	0	4	3	4	4	3	3	5	1	1	0	46	8	16	12	0	0	14	2	93	33
61	Boulder Flat	1	1	15	10	35	30	31	24	459	442	84	70	842	612	20	12	33	31	126	115	1646	1347
62	Rock Creek	0	0	1	0	0	0	5	2	12	0	7	0	83	4	3	2	0	0	8	0	119	8
138	Grass Valley	1	0	2	1	8	3	5	0	3	0	3	0	49	11	1	1	0	0	3	0	75	16
139	Kobeh Valley	0	0	7	6	24	12	9	8	3	3	7	7	38	38	0	0	1	1	24	24	113	99
140A	Monitor Valley (North)	0	0	4	0	1	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0
151	Antelope Valley	0	0	1	1	4	4	9	9	0	0	1	1	0	0	0	0	0	0	0	0	15	15
152	Stevens Basin	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1
153	Diamond Valley	12	12	117 [7]	117	437	437	21	21	10	10	1	1	70	70	14	13	5	5	24	24	711	710
155A	Little Smoky Valley (North)	0	0	12	2	11	1	10	9	0	0	0	0	12	12	1	1	0	0	1	0	47	25
	Total (by use)	70	16	1751	220	666	539	192	114	768	579	285	139	2696	1183	152	66	80	56	464	272	7124	3184

Notes:

1. Many well logs for mining use also list a municipal use and these are listed in the State well log database as "Public water supply." Public water supply in this table does not include these wells. Nor does it include the public water supply aspect of wells at industrial or commercial facilities.
2. Includes water supply and dewatering wells.
3. Also includes mining water supply wells.
4. Includes geothermal wells; water supply for road construction, oil well exploration, etc.
5. Table does not consider wells that have been plugged.
6. source: State of Nevada Well Log Database available from http://water.nv.gov
7. source: Eureka County Assessor

Public Water System Use in Eureka County

There are currently 13 regulated public water systems within Eureka County, of which four are operated by Eureka County. These are listed in Table 4-4.

The Bureau of Safe Drinking Water considers disseminating information regarding public water supplies to be a risk to national security. Consequently, the Bureau does not provide system details, even for purposes of the County's Water Resources Master Plan. Only limited information is provided in the Master Plan for this reason.

Table 4-4
Active Public Water Systems in Eureka County

System Name	System Type	Population served
Barrick Gold Strike (Meikle Mine)	Non-transient, non-community [b]	2,100
Barrick Ruby Hill Mine	Non-transient, non-community	125
Crescent Valley Water System [a]	Community [c]	350
Devils Gate GID (District 1) [a]	Community	65
Devils Gate GID (District 2) [a]	Community	70
Eureka Water Association (Town of Eureka) [a]	Community	450
Leeville Potable Water System	Non-transient, non-community [d]	147
NDOT Beowawe Roadside Park	Transient non-community	200
Newmont Gold Quarry Mine	Non-transient, non-community	700
Newmont North Area Leach	Non-transient, non-community	300
The Lodge at Pine Valley	Non-transient, non-community	320
TS Power Plant	Non-transient, non-community	62
Total Population Served		4,889

Source: Nevada Division of Environmental Protection, Bureau of Safe Drinking Water

a. Public water system operated by Eureka County Public Works Department.
b. Water system that serves the same people, but not year-round.
c. Water system that serves the same people year-round.
d. Water system that does not consistently serve the same people.

All of these public water systems currently exploit groundwater derived from wells as their source of supply. However, the Town of Eureka historically exploited springs in the mountains south of town as their source of supply until 1989. Around that time, problems with source reliability, the collection works and transmission pipeline incited the Town to develop wells in southern Diamond Valley about three miles north of the community. Eureka has recently reactivated the spring sources because they represent a substantial proportion of the Town's average demand. New collection works were installed at six springs in 2012 and construction of the works for the remaining four springs was completed in 2013, for a total of 10 spring sources. A new transmission line from the springs to the town and a chlorination facility were also completed in 2013 and water from the springs was once again delivered to the town beginning in early 2014.

Domestic Water Use

Residential water supplies not served by the public water systems listed above are primarily supplied by individual domestic wells. Typically, but not always, a domestic well serves one single-family residence. The Nevada well log database identifies 220 domestic (single-family residential) wells drilled in Eureka County. Some domestic supplies are also provided by irrigation wells. More than half of all domestic wells in the study area are located in Diamond Valley. The next largest concentration of domestic wells is situated in Crescent Valley. Springs also provide sources of domestic water supply, but there are no published data on the number of households in the county served by springs. Additionally, some irrigation wells provide domestic supplies through installation of a second pump installed in the well dedicated to domestic usage.

Irrigation Water Use

Groundwater provides a source of irrigation water supply to all but one of the 16 hydrographic areas throughout the County's water resource planning area. Within Eureka County, the largest use of groundwater for irrigation occurs in Diamond Valley.

Mine Water Use

Use of water by the mining industry may be divided into two broad categories. The first is water consumed in the mining process, mainly as part of the methods used to recover gold, in particular through cyanide heap leach circuits. Also included in this category are incidental uses such as dust control, equipment washing, and reclamation of heap leach pads and waste rock facilities. The second broad category of mine use includes dewatering of open pits and underground facilities where mining extends below the water table. In many of the mines within Eureka County's water resource planning area, mine dewatering accounts for the vast majority of water pumped by the mining industry. It is not unheard of for mine dewatering to extract quantities of groundwater far in excess of the perennial yield for an individual basin and for the effects of dewatering to extend beyond basin boundaries into adjacent hydrographic areas. Mining is often viewed as a temporary use of water and that the water may be available for appropriation once the mining activities cease. However, many temporary mining rights have been active for decades. Furthermore, pit lakes that form after dewatering ceases at some mines will continue to consume groundwater through evaporation, such that the use will continue in perpetuity and this water becomes unavailable for any other use. Additionally, many mines have purchased farming and ranching operations in order to acquire water rights either to meet operational needs or to minimize conflicts with other existing rights. Once mining ceases, these rights are available for other uses and do not revert back to the basin for appropriation by others under the temporary use concept.

The Nevada State Engineer established a mitigation process of preferred uses for the groundwater pumped for dewatering purposes. To every extent possible, this process attempts to either minimize or localize the effects of dewatering, or allow water to be substituted for other existing groundwater withdrawals. A large proportion of this water is returned to the groundwater system through infiltration facilities. However, not all the water is returned to the aquifer of origin and drawdown impacts propagate across basin boundaries particularly in the deeper carbonate aquifers. Some is used for irrigation and in three hydrographic areas of the county (Boulder Valley, Maggie Creek and Crescent Valley HAs) much of the irrigation using groundwater as the source originates from mine dewatering. Where other use or infiltration is not practical, the groundwater is discharged to streams where it may be used by downstream water right holders (source: Nevada Division of Water Planning, 2000.

Humboldt River Chronology An Overview and Chronological History of the Humboldt River and Related Water Issues Volume 1 - Overview).

One consequence of large mine dewatering projects is drawdown arising from dewatering in one hydrographic area propagating into adjacent hydrographic areas. This inter-basin drawdown typically is limited to the deeper bedrock aquifers and there has yet to be any firm indication that water rights in adjacent basins have been affected. Impacts or conflicts, though, could take years or decades to manifest themselves and likely may continue for years after pumping ceases.

One consumptive use of groundwater by the mining industry that the State has yet to come to grips with is pit lake evaporation. There are presently 30 pit lakes in Nevada and at least 9 pits that will ultimately become pit lakes (Holmgren, 2013). Within the Eureka County water planning study area, several pit lakes will form once active dewatering ceases and the pits fill with groundwater. These are located at Barrick's Crescent Valley operations, Barrick and Newmont's Boulder Valley operations, Newmont's Maggie Creek operations, and the Ruby Hill Mine near the Town of Eureka. Due to the cumulative surface area of the lakes and moderately high surface water evaporation rates, a measureable quantity of groundwater will be consumed by evaporation in perpetuity. These evaporative losses will amount to several thousand acre-feet of water each year that forever will be unavailable for beneficial use by residents of the county or other appropriators and has the same effect on the populace in the originating basin as exporting groundwater from the basin.

Monitoring

Monitoring wells represent the single largest category of wells completed in the County's water resource planning area. However, monitoring consumes only a miniscule amount of groundwater related to collection of water samples for laboratory analysis. A large number of monitoring wells exist only to provide water-level data and, as such, result in no consumptive use of water. Many monitoring wells have been plugged and formally abandoned as monitoring programs evolve over time.

Industrial Water Use

Industrial water supplies include water used for cooling at power-generating facilities. These comprise the TS Ranch power plant in Boulder Valley and the geothermal power plant in Whirlwind Valley. Lesser industrial water use occurs at commercial facilities along the Interstate 80 corridor near Argenta and Dunphy and scattered gravel pit operations in the county. Groundwater is also periodically used for road construction activities throughout the County.

Geothermal Water Use

Within the Whirlwind Valley Hydrographic Area of Eureka County, geothermal fluids (hot water and steam) are used to generate power. A significant proportion of the geothermal effluent (heat-spent water) from the process is re-injected into the geothermal aquifer or reservoir, but some water is consumed when the hot fluid is flashed to steam. Consumptive use of geothermal fluids is regulated by the office of the Nevada State Engineer. In instances where only heat is extracted and no geothermal fluids are consumed, the use is under the purview of the Nevada Division of Minerals. While it is convenient to assume that geothermal reservoirs are separate and distinct from aquifers exploited by other users, the fact is in many areas there is a degree of communication between non-thermal (cool) and geothermal aquifers. As competition for the water resources escalates, more attention to the interaction between thermal and non-thermal aquifers may be warranted.

Stock Water Use

Surface water (springs and streams) and groundwater provide sources of drinking water to livestock. Water rights from these sources have been established through the appropriation and adjudication processes. Within the planning area, there are many claims to vested water rights from springs for stock watering purposes that have yet to be adjudicated. The total use for these claims adds up, but they are not considered in the State's tallies of committed water rights for each basin. There are also many springs for which vested claims have not been filed, but for which there likely are valid claims of vested water rights. Many of these stock water sources permit the usual and customary use of the water by wildlife. There is virtually no information regarding the actual amount of water actually used for stock watering purposes.

Environmental Use

The primary use of groundwater for environmental purposes is related to "pump and treat" systems that remove contaminants from groundwater. That is, contaminated groundwater is pumped and conveyed to a range of treatment technologies. The treated effluent is either re-injected or infiltrated back to the aquifer. For the most part, the quantity of groundwater consumed is small although moderate amounts of water may need to be pumped for a relatively large contamination problem, such as existed at the Carlin rail yards in Elko County, just east of the Eureka County line. There are a small number of sites in northern Eureka County where groundwater contamination has been or is currently being treated to remove contaminants from the groundwater.

Hydraulic Fracturing

Hydraulic fracturing or "fracking" is a well stimulation process by which fluids (water, chemicals and other components) are introduced under high pressure into oil- and gas-bearing formations to liberate and enhance the removal of hydrocarbons. Several hundred thousand to more than a million gallons of water may be needed for a single fracking episode. The process results in a large amount of "blow back" fluids that flow or are pumped from the well after they have been pumped into the well under pressure. These blow-back fluids comprise a mixture of the residual chemicals and formation water. They are regulated by state and federal agencies and must be treated to remove the various chemical additives or, alternatively, are disposed of in deep injection wells or through evaporation. The current trend is to reuse these fluids so as to reduce the total amount of water needed for fracking. No water rights have yet been acquired specifically for fracking purposes in Eureka County. To date, only one well at the Blackburn oilfield in Pine Valley, Eureka County has been stimulated by hydraulic fracturing. However, since oil-bearing geologic formations and producing oil wells are present in Eureka County, water use for fracking cannot be ruled out in the future.

4.3 SURFACE WATER

Surface water sources include streams, springs, and seeps. These are primarily used for irrigation and stock watering in Eureka County. Surface water also constitutes important sources of water to wildlife, horses and provides wildlife habitat and recreation. There are at least 1,600 mapped springs and seeps (refer to Section 3.3.1 and Figure 3-10) and approximately 325 miles of perennial streams (refer to Section 3.3.2 and Figure 3-11) in the County. Virtually all surface water in streams has been fully appropriated or adjudicated, such that there is no new water available from streams for future development.

4.4 CURRENT WATER USE IN EUREKA COUNTY'S HYDROGRAPHIC AREAS

Available water resources, water use and water rights in each of the 16 hydrographic areas in the County's Water Resource Master Plan study area are discussed in the following sections.

4.4.1 Rock Creek Hydrographic Area (HA 062)

The Rock Creek Hydrographic Area (HA 062) is located near the extreme northwest corner of Eureka County, north of the Humboldt River (Figure 4-4 and 4-5) and is shared with Lander and Elko Counties. The basin encompasses 444 square miles, of which only 32 square miles is within Eureka County.

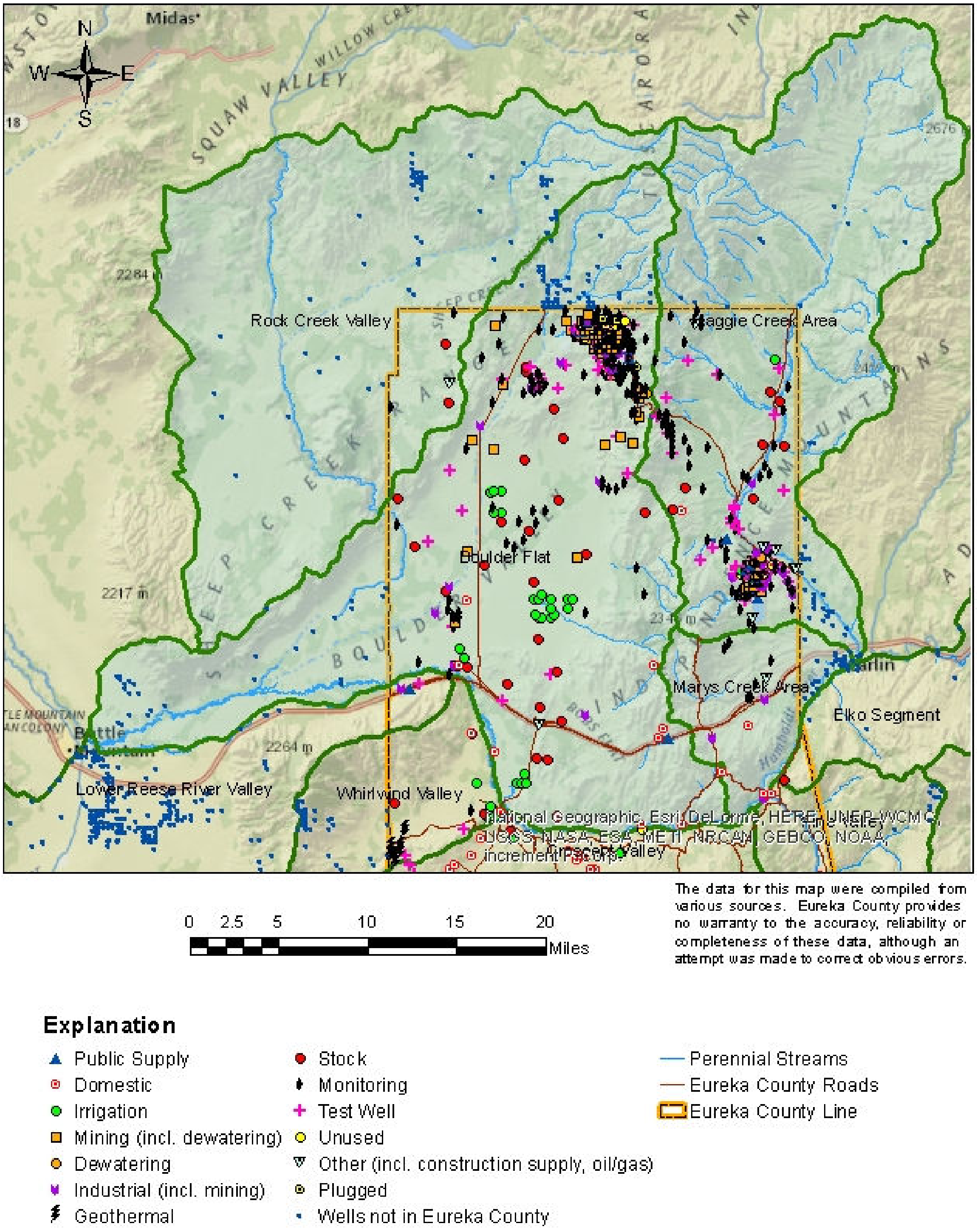
4.4.1.1 Rock Creek HA Groundwater Use

<u>Wells</u>

Only five wells are identified in the Eureka portion of the basin from the State Engineer's well log database (Figure 4-5); two of which are for stock water, two are monitoring wells, and the fifth well was drilled but does not appear to have been completed. These wells are moderately deep, greater than 500 feet (Figure 4-6).

<u>Perennial Yield and Water Rights</u>

The estimated perennial yield of the basin in combination with the Willow Creek Hydrographic Area (HA 063) is 2,800 af/yr. The total system yield (combined surface water and groundwater resources) is estimated at 30,000 af/yr. Committed groundwater rights in the basin total 2,260.43 af/yr and are summarized in Table 4-5. Comparing the estimated perennial yield of 2,800 af/yr with the committed groundwater rights in the basin shows groundwater use is less than the estimated perennial yield. The PODs for water rights in the Eureka County portion of the Rock Creek HA are depicted in Figure 4-7.



Source: water.nv.gov/data/welllog/index.cfm

Figure 4-5. Wells in the Rock Creek Valley, Boulder Valley, Maggie Creek and Mary's Creek Hydrographic Areas.

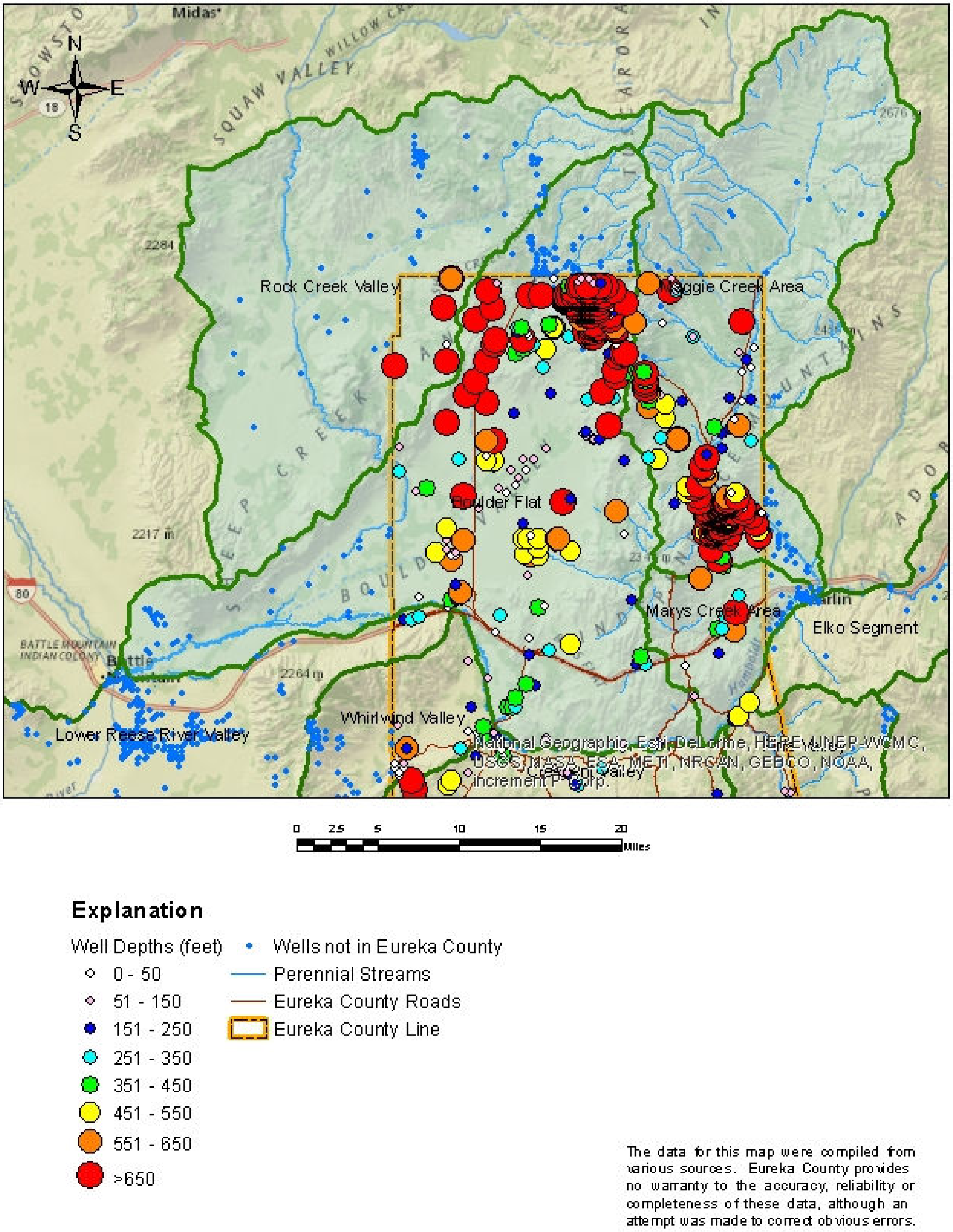


Figure 4-6. Depths of Wells in the Rock Creek Valley, Boulder Valley, Maggie Creek and Mary's Creek Hydrographic Areas.

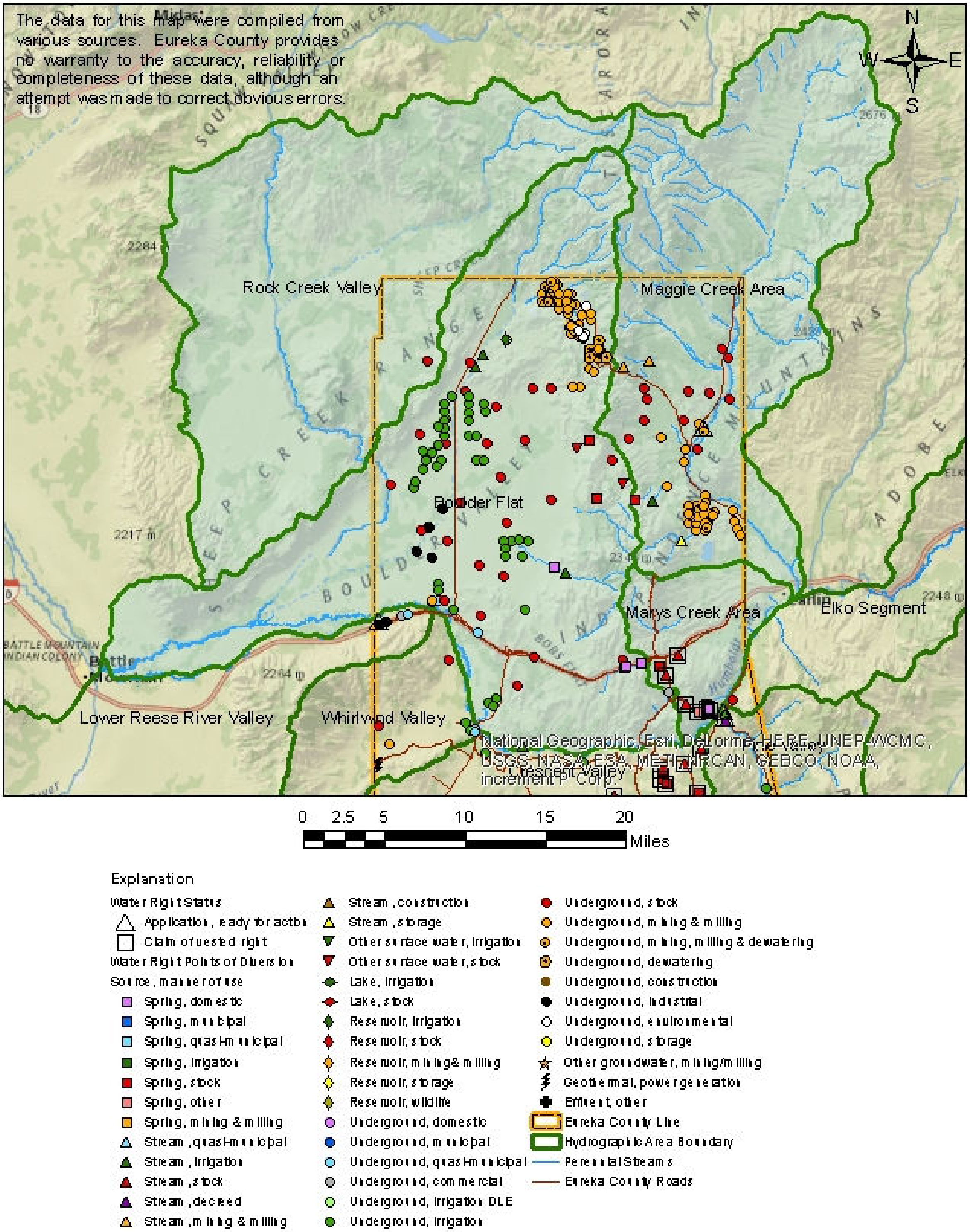


Figure 4-7. Points of Diversion for Water Rights in the Eureka County Portion of the Rock Creek Valley, Boulder Valley, Maggie Creek and Mary's Creek Hydrographic Areas.

Table 4-5
Committed Groundwater Rights in the Rock Creek Valley Hydrographic Area (HA 062)

Manner of Use	Committed Water Rights (af/yr)
Mining and Milling	2,237.14
Stock water	23.29
Total	2,260.43
Source: NDWR Hydrographic Area Summary	

Groundwater Use

From Table 4-5, mining and milling represent the vast majority of the committed water rights in the entire basin. Only one underground water right is recorded in the water right abstract for the Eureka County portion of the basin and it is for stock water, with an annual duty of 12.88938 af/year.

4.4.1.2 Rock Creek HA Surface Water Use

Surface water resources in the basin total approximately 27,200 af/yr (system yield minus perennial yield). Rock Creek and its tributaries, Squaw Creek and Antelope Creek, are the major streams in the basin and there are surface water rights associated with the streams. However, these streams and the use of water from them are outside of the Eureka County portion of the basin.

No surface-water rights (springs or streams) are listed in the NSE water right abstract for the Eureka County portion of the basin. Likewise, no springs, perennial or ephemeral streams are identified from the National Hydrography Dataset (NHD) within the Eureka County portion of the basin.

4.4.2 Boulder Flat Hydrographic Area (HA 061)

The Boulder Flat Hydrographic Area (HA 061) is located in northernmost Eureka County north of the Humboldt River (Figure 4-4 and 4-7) and is shared by Lander and Elko Counties. The basin, situated east of the Rock Creek HA, encompasses 544 square miles, of which 383 square miles are within Eureka County.

4.4.2.1 Boulder Flat HA Groundwater Rights and Use

Wells

The State well log database provides records for approximately 1,650 wells in the basin of which 623 reportedly have been plugged and formally abandoned (Figure 4-5). Within the Eureka County portion of the basin, there are reports for approximately 1,350 wells, of which 438 have reportedly been plugged and formally abandoned. The vast majority of wells is related to the mining industry and includes wells for mining and milling purposes, dewatering of open pit and underground operations, and monitoring. Well depths vary from 50 feet or less for monitoring wells constructed in the alluvial deposits on the valley floor to more than 650 feet for wells (water supply, dewatering, and monitoring) near active mining operations, with many wells drilled to depths greater than 1,000 feet (Figure 4-6).

Perennial Yield and Groundwater Rights

The estimated perennial yield of the Boulder Flat HA is 30,000 af/yr. The total system yield (combined surface water and groundwater resources) is estimated at 300,000 af/yr primarily due to the flow of the Humboldt River through the basin.

Committed groundwater rights in the basin total 73,117.14 af/yr. These are summarized in Table 4-6a and Figure 4-7 displays the locations of the PODs in the Eureka County portion of the basin. Not included in Table 4-6a are seven claims of vested water rights for stock water totaling 40.53 af/yr. From Table 4-6a, irrigation represents the largest block of groundwater rights in Boulder Flat, followed by mining and milling. However, irrigation and mining are currently inexorably linked because much of the groundwater used for irrigation in this part of the county takes place on land owned by Elko Land and Livestock Company, a subsidiary of Newmont Gold Company, and is supplied largely by water that is pumped to dewater mines of the Carlin Trend located in the basin that are operated by Barrick Goldstrike Mines, Inc. and Newmont Gold Company. Likewise, the majority of water rights for industrial purposes other than mining are related to power generation at Newmont's TS Power Plant, such that much of the industrial use is also associated with mining.

Table 4-6a

Committed Groundwater Rights in the Boulder Flat Hydrographic Area (HA 061)

Manner of Use	Committed Water Rights (af/yr)
Commercial	34.37
Environmental	1,089.62
Industrial	9,286.22
Irrigation	39,333.29
Mining and Milling	22,772.20
Stock water	592.13
Total	73,117.14

Source: NDWR Hydrographic Area Summary

Groundwater Use

The vast majority of water pumped from the Boulder Flat HA is derived from groundwater pumped to dewater open-pit and underground mining operations. Mine water usage in Boulder Flat, including the portion of the water used for irrigation, is currently documented in semi-annual monitoring reports prepared by Barrick. Since the start of dewatering in 1989, a total of approximately 1,348,000 acre-feet of groundwater has been pumped, or an average of approximately 56,000 acre-feet per year. From the fourth quarter of 2011 through the third quarter of 2012, in aggregate, Barrick and Newmont, in combination, pumped approximately 61,000 acre-feet of groundwater from the basin. In 2012, consumptive use for mine operations, irrigation, and power generation totaled approximately 28,000 acre-feet, which is less than the State Engineer's estimate of perennial yield of 30,000 acre-feet per year. Additional consumptive use due to evaporation of water from the TS Reservoir and the infiltration facilities and stock water increases total consumptive use to near the estimate of perennial yield, but at present groundwater recharge and discharge in the basin are approximately in balance.

Public Water System Use

There are no *community* water systems in the Boulder Flat HA, but three *public* water systems are associated with Barrick's and Newmont's operations in the basin (see Section 2 for definitions of the classifications of public water supplies). These are the Barrick Goldstrike (Meikle Mine), Newmont North Area Leach and TS Power Plant. All three are *nontransient, noncommunity* water systems. In combination, these systems serve a work force of approximately 2,900 persons. The fourth public water system in the basin is the NDOT Beowawe Roadside Park. The total amount of water consumed by these systems is relatively small compared to other uses in the basin likely less than 100 acre-feet per year.

Domestic Water Use

The NSE well log database chronicles only 15 individual domestic wells in the entire basin. Assuming that each well utilizes the entire two (2.0) acre-feet to which they are entitled, domestic well use in the basin is minor, perhaps in the range of 30 acre-feet per year, less than 0.1% of the current water use.

Mine Water Use

61,000 acre-feet of groundwater was pumped from Barrick's and Newmont's operations in the Boulder Flat HA over the period spanning the fourth quarter 2011 through the third quarter 2012. Of this amount, approximately 7,400 acre-feet was reportedly consumed in mining operations.

Irrigation Water Use

The water pumped from the basin and not used in the mining process at Barrick's and Newmont's mining operations is delivered to the TS reservoir where it is stored for irrigation of land owned by Elko Land and Livestock Company (ELLC), a subsidiary of Newmont. A significant amount of the water leaks from the reservoir and infiltrates back into the aquifer through fractures in the rocks at the reservoir site. ELLC has 71 center pivots in the basin with which to irrigate land totaling approximately 10,000 acres for the production of alfalfa hay, grass hay and grain (http://www.tsranch.com/tshay.htm). Assuming a net irrigation water requirement of 2.8 feet per year, (http://water.nv.gov/mapping/et) there is a potential for Newmont's irrigation usage to consume 28,000 af/year from the Eureka County portion of the basin. However, irrigation is primarily an artifact of mine dewatering and varies from year to year. In 2012, approximately 15,000 acre-feet of water pumped from the mines were applied to the 30 or so fields using center pivots at a rate of approximately 3.5 acre-feet per acre. Assuming a Net Irrigation Requirement for alfalfa hay of 2.8 acre-feet per year, perhaps as much as 0.7 acre-feet per acre, or a total of approximately 3,000 acre-feet in 2012, infiltrated the land surface to become secondary recharge to the alluvial aquifer. The groundwater mound that has developed beneath the TS Ranch hay fields is an indication that not all of the irrigation water is consumed and that secondary recharge to the alluvial aquifer in this area does occur.

The TS Ranch has four operational irrigation wells within their Boulder flat operations, but these were not pumped during the 2011 or 2012 irrigation seasons. They were last pumped in 2010. From 2008 through 2010, irrigation well pumpage ranged from 131 to 932 af/yr and averaged 574 af/yr (Bryce Vorwaller, 2013; personal communication). There are other irrigation wells on TS Ranch property but these are currently unused.

Industrial Water Use

The primary use of water for industrial purposes is for cooling water at Newmont's TS Power Plant. The plant consumes an estimated 9,000 acre-feet of water per year. Other small uses of water for industrial purposes take place at commercial properties along the Interstate 80 corridor near Dunphy.

Stock Water Use

The NSE does not track the use of groundwater to water livestock. There are currently 592.13 af/yr of groundwater rights for stock watering purposes in the basin. For purposes of the Master Plan, it is assumed that all of these rights are in use.

Water Level Trends

Because of the large quantities of groundwater pumped to dewater mining operations, the Boulder Flat HA is one of the most intensely studied basins in the state. Groundwater and surface water (streams and springs) monitoring has been required since 1991. Barrick's and Newmont's monitoring data are reported semi-annually the Nevada Division of Water Resources and Division of Environmental Protection. Since the start of dewatering in 1987, Barrick Goldstrike and Newmont Leeville operations have combined to pump more than 1,300,000 acre-feet of groundwater from the basin. Mine dewatering has caused localized drawdown of more than 1,500 feet in the deeper carbonate aquifer and lesser drawdown in the overlying rocks. Conversely, the alluvial aquifer in Boulder flat has experienced a water level rise as great as 50 feet beneath the land irrigated by Elko Land and Livestock Company. In addition, leakage from the TS reservoir has caused a rise in the water level in the underlying volcanic rocks at this locale. These changes in water level are depicted in Figure 4-8.

4.4.2.2 Boulder Flat HA Surface Water Use

Surface water resources in the basin total approximately 270,000 af/yr (system yield minus perennial yield), essentially the flow of the Humboldt River measured at the Palisade gage, and the flow of Rock Creek and Boulder Creek. The resources of the Humboldt River have been fully adjudicated through the Humboldt River Decree. The lands in the Boulder Flat HA irrigated through the Humboldt River Decree are show in Figure 4-3. The other significant streams within the basin include Rock Creek, Boulder Creek and Mack Creek, none of which flow to the Humboldt River in an average year.

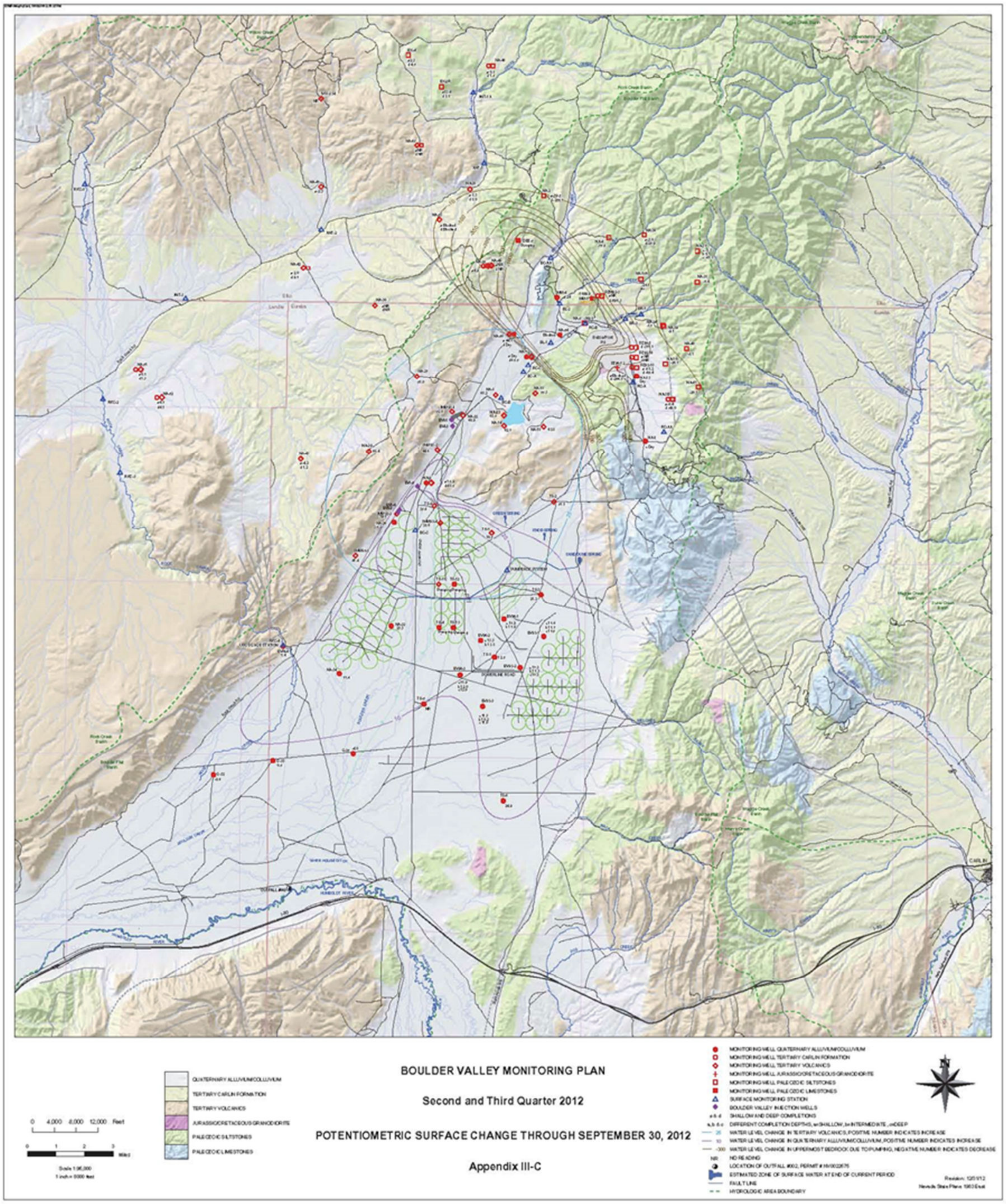


Figure 4-8. Water Level Changes in the Boulder Flat Hydrographic Area.

Surface Water Rights

Appropriated Rights

The NSE's basin abstract for Boulder Flat shows eight spring-source water rights totaling approximately 72 acre-feet per year and seven appropriated stream rights totaling 5,692 acre-feet per year or season. Table 4-6b summarizes the current surface water rights within the basin. Figure 4-7 depicts the points of diversion for the surface water rights.

Table 4-6b

Committed Appropriated Surface Water Rights in the Boulder Flat Hydrographic Area (HA 061)

Manner of Use	**Committed Water Rights** (af/yr or af/season)
Springs	
Domestic	23
Irrigation	17
Stock	32
Streams	
Irrigation	5,692
Source: NDWR Basin 061 Water Rights Abstract Note: all rights rounded to the nearest acre-foot	

All of the spring-source domestic rights are located within Eureka County. None of the irrigation using spring flow within the basin takes place in Eureka County. Stream-source irrigation rights within Eureka County total approximately 3,235 acre-feet annually or seasonally and include rights to flows of Mack Creek, Boulder Creek and the Humboldt River. Not included in Table 4-6b are five claims to vested water rights for stock watering purposes.

4.4.3 Maggie Creek Hydrographic Area (HA 051)

The Maggie Creek Hydrographic Area (HA 061) is located in northeastern-most Eureka County north of the Humboldt River (Figure 4-4 and 4-7) where it is shared with Elko County. The basin, situated east of Boulder Flat and north of the Humboldt River, encompasses 392 square miles, of which 139 square miles are within Eureka County.

4.4.3.1 Maggie Creek HA Groundwater Rights and Use

Wells

The State well log database provides records for approximately 630 wells in the basin of which 165 have been plugged and formally abandoned (Figure 4-5). Approximately 560 wells are reported for the Eureka County portion of the basin and, of these, 153 reportedly were plugged and abandoned such that there are approximately 400 active wells within the Eureka County portion of the basin. The vast majority of wells is related to the mining industry and includes wells for mining and milling purposes, mine dewatering for open pit and underground operations, and monitoring. The largest number of wells has been drilled for monitoring purposes. Well depths vary from 50 feet or less for monitoring wells constructed in the alluvial deposits on the valley floor to more than 650 feet for wells (water supply, dewatering, and monitoring) near active mining operations, with many wells drilled well over 1,000 feet deep (Figure 4-6).

Perennial Yield and Groundwater Rights

The perennial yield of the basin is estimated at 4,000 acre-feet per year. Committed groundwater rights in the basin total 14,263 af/yr and are summarized in Table 4-7a. The PODs for groundwater rights in the Eureka County portion of the basin are displayed in Figure 4-7.

Table 4-7a

Committed Groundwater Rights in the Maggie Creek Hydrographic Area (HA 051)

Manner of Use	Committed Water Rights (af/yr)
Commercial	0.03
Environmental	723.97
Irrigation	1,433.89
Mining and Milling	10,855.63
Municipal	1,054.38
Stock water	195.43
Total	14,263.33
Source: NDWR Hydrographic Area Summary	

Groundwater Use

As is the case for the Boulder Flat HA, nearly all groundwater usage in the Maggie Creek HA is derived from water pumped to dewater open-pit and underground mining operations. Mine water usage in the Maggie Creek area, including groundwater used for irrigation, is currently documented in semi-annual monitoring reports prepared by Newmont, the dominant water user in the basin as a whole and the Eureka County portion of the basin, in particular. From May 1992 through September 2013, Newmont has pumped approximately 504,000 acre-feet of groundwater from the Gold Quarry operations, or an average of approximately 23,000 acre-feet per year. The majority of this water (approximately 57 percent) has been discharged directly to Maggie Creek, augments the flow of the Humboldt River and is used downstream in accordance with the Humboldt River Decree. Approximately 13 per cent has been used for irrigation and the remainder is consumed by various processes related to mining. From the fourth quarter of 2011 through the third quarter of 2012, a total of approximately 32,000 acre-feet of groundwater was pumped, virtually all of which was diverted within the Eureka County portion of the basin. As is discussed below, the water consumed by mining alone in the Eureka County portion of the basin from the fourth quarter of 2011 through the third quarter of 2012 exceeds the perennial yield of the basin. Add to that the consumptive use from irrigation, and groundwater exported from the basin via Maggie Creek and the current consumptive use of groundwater in the basin is nearly five times the estimate of perennial yield.

Public Water Supplies

The City of Carlin exploits groundwater in the basin as a source of public water supply, primarily as backup to their spring source, but their wells and springs are located in Elko County outside of the Eureka County portion of the basin although much of their supply originates from within Eureka County. The only public water supply system in the Eureka County portion of the basin is located at Newmont's Gold Quarry operations. This noncommunity, nontransient system reportedly serves 700 persons (NDEP, BSDW; 2013). Assuming 20 gallons per day per person, perhaps 10 to 15 acre-feet per year may be consumed by Newmont's public supply.

Domestic Use

Only one domestic well within the basin is reported in the NSE well log data base. Consequently domestic water usage in the basin may approach about two acre-feet per year and is infinitesimal compared to the other uses.

Mine Water Use

Of 32,000 acre-feet pumped from the fourth quarter of 2011 through the third quarter of 2012, approximately 6,600 acre-feet was consumed in mining operations. Water not consumed by the mine, by irrigated crops or infiltrated at the reservoir is treated to reduce temperature and discharged to Maggie Creek. Over this same time period, approximately 21,000 acre-feet of water was discharged to Maggie Creek. Once discharged to the creek, the water is effectively exported from the basin and becomes available to down-stream users and use of the water is administered through the Humboldt River Decree.

Irrigation Water Use

The principal source of irrigation water within the basin is groundwater pumped to dewater Newmont's gold mining operations. A portion of the water not used in the mining process is exported from Eureka County and delivered to the Hadley Fields located in Elko County west of Maggie Creek for irrigation purposes April through September. During the 2012 irrigation season, approximately 4,400 acre-feet of water were applied to the Hadley Fields, at a rate of approximately 10 acre-feet per acre. Of this amount, approximately 1,200 acre-feet is expected to be consumed by alfalfa, assuming a net crop water requirement of 2.8 acre-feet per acre, and the remainder serves to recharge the alluvial aquifer. The groundwater mound beneath the Hadley fields incites some water to migrate to Maggie Creek, which is currently a gaining stream in this area, and a portion flows toward the southwest as underflow through alluvial deposits to the Mary's Creek Hydrographic Area (Paul Pettit, 2013; personal communication). There is virtually no use of groundwater for irrigation within the Eureka portion of the basin.

Stock Water Use

Stock water use in the Eureka County portion of the basin is small. If all of the permits for stock water use are put to their maximum use, stock use may be in the range of about 75 acre-feet per year, or approximately 0.2 percent of the water pumped. The vast majority of stock water use within the Eureka County portion of the basin is through Newmont's Elko Land and Livestock Company subsidiary.

Water Level Trends

Similar to the Boulder Flat HA, the Maggie Creek HA has been intensely studied because of the large quantities of groundwater pumped to dewater mining operations. Groundwater and surface water (streams and springs) monitoring has been required since 1991 and Newmont's monitoring data are reported semi-annually. Since the start of dewatering in 1992, Newmont operations have pumped more than 450,000 acre-feet of groundwater from the basin, an average of 22,500 acre-feet per year. Mine dewatering has caused localized drawdown of more than 1,000 feet in the carbonate aquifer near their Gold Quarry operation and more than 250 feet over many square miles. This drawdown has increased infiltration of streamflow from the creek in the "narrows" reach of the stream north of Gold Quarry and that reach of the stream is now dry. Conversely, beneath the Maggie Creek reservoir, near-surface geologic materials have experienced a water level rise of more than 40 feet due to infiltration from the reservoir. Likewise, irrigation at the Hadley fields caused a rise in water level in the alluvial deposits. These changes in water level are depicted in Figure 4-9.

4.4.3.2 Maggie Creek HA Surface Water Use

Surface Water Rights

The basin abstract for Maggie Creek shows seven spring water rights totaling approximately 546 acre-feet per year and 14 stream rights totaling approximately 10,301 acre-feet per year or season. Table 4-7b summarizes the current surface water rights within the basin and the PODs for surface water rights in the Eureka County portion of the basin are displayed in Figure 4-7. Of this total, more than 9,100 acre-feet are within Eureka County, with the largest amount (approximately 9,050 acre-feet) originating from Lynn Creek, a tributary to Maggie Creek, but these rights are not currently exercised. Not included in Table 4-7b are 12 claims of vested water rights, all of which are outside of Eureka County in the northern portion of the basin. Table 4-7b does not include the decreed water rights under the Humboldt River Decree.

Table 4-7b

Committed Surface Water Rights in the Maggie Hydrographic Area (HA 051)

Manner of Use	Committed Water Rights (af/yr or af/season)
Springs	
Irrigation	546
Mining and Milling	434
Stock	53
Streams	
Irrigation	443
Mining and Milling	9,050
Other	726
Storage	84
Source: NDWR Basin 061 Water Rights Abstract Note: all rights rounded to the nearest acre-foot	

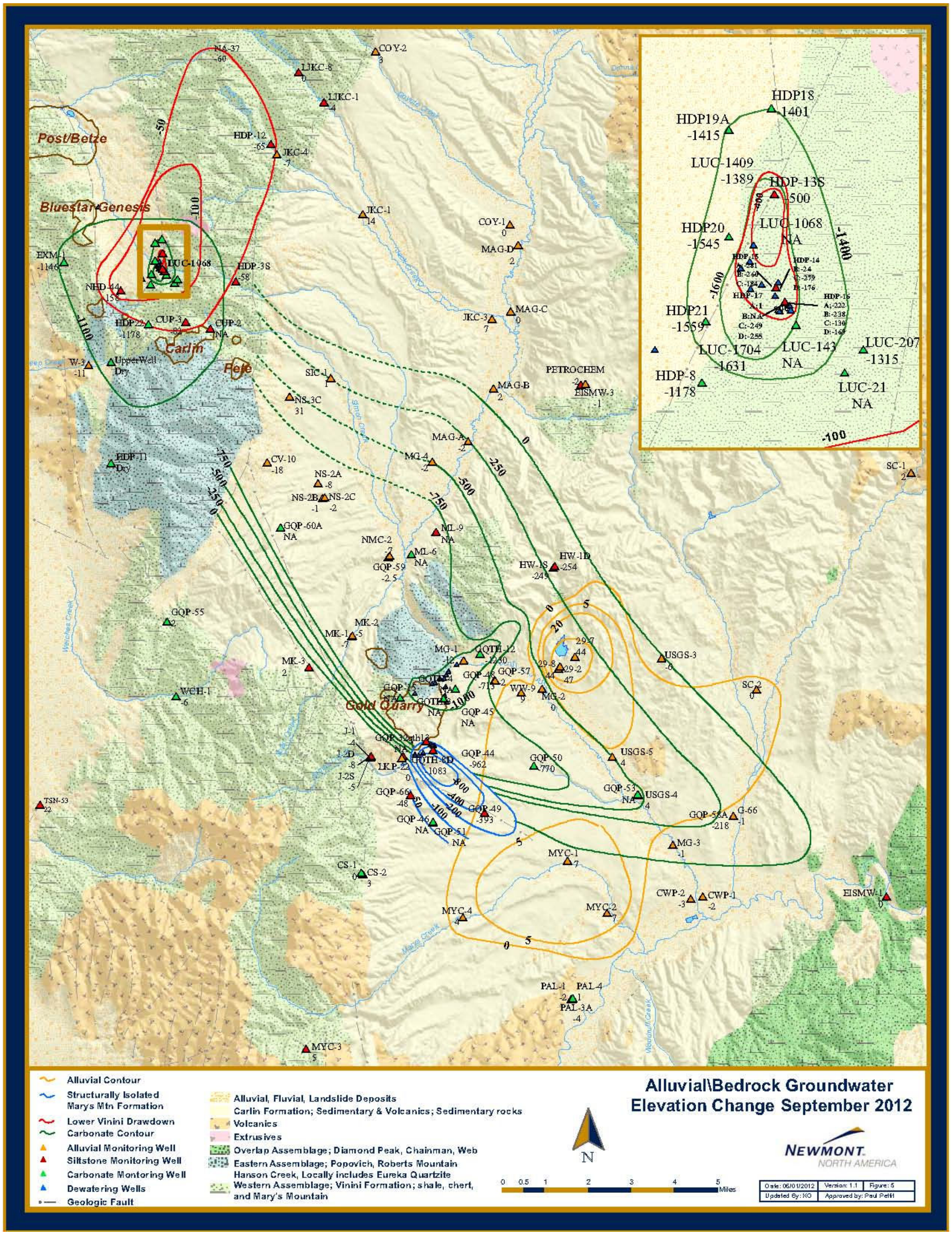


Figure 4-9. Water Level Changes in the Maggie Creek and Mary's Creek Hydrographic Areas.

4.4.4 Mary's Creek Hydrographic Area (HA 052)

The Mary's Creek Hydrographic Area (HA 052) is located in northern Eureka County north of the Humboldt River and west of the Elko County community of Carlin (refer to Figure 4-4 and 4-7). It is south and adjacent to the Maggie Creek HA and Newmont's Gold Quarry gold mining operation there. The basin, which is shared with Elko County, encompasses 67 square miles, of which 56 square miles are within Eureka County.

4.4.4.1 Mary's Creek HA Groundwater Rights and Use

Wells

The State well log database provides records for 138 wells, half of which have been plugged and formally abandoned (Figure 4-5). Most of these plugged wells were associated with assessment and cleanup of contamination at the rail yards in Carlin. A total of 17 wells are reported for the Eureka County portion of the basin and all of these wells appear to be active. Within Eureka County, nine wells were drilled primarily for monitoring purposes (related to Newmont's Gold Quarry Mine), four were drilled for domestic use, and two for industrial purposes. Well depths vary from less than 100 to nearly 1,000 feet (Figure 4-6).

Perennial Yield and Groundwater Rights

The Nevada State Engineer's Basin Summary for the Mary's Creek HA does not provide an estimate of the perennial yield for the basin. Instead, the Mary's River HA is combined with the Elko Segment HA that borders it to the east. The Maxey-Eakin Method was used to estimate the perennial yield of the Mary's Creek Basin for purposes of the County's Water Resource Master Plan and returned an estimate of groundwater recharge of approximately 500 acre-feet per year. However, in addition to recharge originating within the basin, there is underflow from the Maggie Creek HA through the alluvial deposits (Paul Pettit, 2013; personal communication) such that the recharge to the basin is significantly more

than 500 acre-feet per year. This natural and anthropogenic-induced underflow appears to be a major source of the discharge of the springs that provide the public water supply for the community of Carlin as well as the perennial flow of Mary's Creek below the springs and above its confluence with the Humboldt River.

Table 4-8a lists the committed groundwater rights for the entire basin. There are no underground rights in the Eureka County portion of the basin.

Partly because groundwater resources in the Mary's Creek basin are relatively small, the NSE limits new groundwater permits in the Elko County portion of the basin near Carlin to municipal and quasi-municipal use (NSE Order 872).

Table 4-8a

Committed Groundwater Rights in the Mary's Creek Hydrographic Area (HA 052)

Manner of Use	Committed Water Rights (af/yr)
Environmental	723.97
Irrigation	152.92
Municipal	1,049.78
Stock water	13.04
Total	1,939.71
Source: NDWR Hydrographic Area Summary	

Groundwater Use

Groundwater use in the Mary's Creek HA is relatively small compared to the adjacent basins and primarily takes place outside of Eureka County near the community of Carlin in Elko County. Current groundwater use exceeds the estimated groundwater recharge originating from the infiltration of precipitation that falls within the basin. However, underflow from the Maggie Creek HA increases the available water resources of the basin, but by an undetermined amount.

Domestic Use

Within Eureka County, groundwater use may be limited to the five residential wells reported on the State well log database, with an estimated use of up to perhaps 10 acre-feet per year. In addition, there are two water rights for domestic use of springs, totaling approximately 9.5 af/yr. Domestic use represents less than four percent of the estimated perennial yield.

Municipal Water Use

The largest use of groundwater in the basin is municipal use within the community of Carlin. The community utilizes both groundwater from wells and developed springs, which represent groundwater discharge, as sources of water supply. In combination, Carlin is permitted to develop 1,050.5 acre-feet per year in combination from wells and springs. In 2012, the City of Carlin pumped 408 acre-feet of groundwater. However, all of this use is outside of Eureka County.

Environmental Use

Environmental use is associated with groundwater pumped in order to treat groundwater and soil contamination. These include contamination beneath the railroad yards and leaking underground storage tanks. Most of these rights are for "pump and treat" systems and the treated water is returned to the aquifer such that consumption is relatively small. These rights are temporary in nature and will revert back to the basin upon closure of the sites once cleanup and remediation are completed.

Water Level Trends

The Maggie Creek monitoring program discussed above extends south into the Mary's Creek HA. Figure 4-9, above, shows an isolated area in the northern portion of the basin with more than 200 feet of drawdown. This drawdown, depicted as dark blue isopleths (lines of equal drawdown) in the south central portion of the figure, is related to dewatering operations at Gold Quarry that is constrained within an isolated structural block in which dewatering is taking place. Significant drawdown does not extend beyond the boundaries of this block. The water level data in Figure 4-9 also show a rise in water level in the alluvial aquifer caused by infiltration of water from Newmont's Maggie Creek reservoir and irrigation at the Hadley fields west of Maggie Creek. The mound propagates into the Mary's Creek basin and provides additional evidence of the inter-basin flow from the lower Maggie Creek HA to the Mary's Creek HA.

4.4.4.2 Mary's Creek HA Surface Water Use

Surface Water Rights

The basin abstract for the Mary's Creek HA shows eight spring water rights totaling approximately 546 acre-feet per year and seven stream rights totaling approximately 2,437 acre-feet per year or season. Table 4-8b summarizes the current surface water rights within the basin and Figure 4-7 displays the PODs in the Eureka County portion of the basin. In comparison, the average flow of Mary's Creek for the period 1990 through 1998 was approximately 4,200 acre-feet per year.

Existing rights to springs within the Eureka County portion of the basin total approximately 11 acre-feet per year. Claims to vested water rights total approximately nine acre-feet per year. Table 4-8b does not include six claims of vested water rights for domestic, stock water and locomotive power use.

Surface Water Use

Municipal Use

The City of Carlin is permitted to divert a total 1,050.5 acre-feet per year in combination from wells and springs. In 2013, it diverted 325 acre-feet of water from its spring sources. The points of diversion and all of this use are all located outside of Eureka County.

Table 4-8b

Committed Surface Water Rights in the Mary's Creek Hydrographic Area (HA 052)

Manner of Use	**Committed Water Rights** (af/yr or af/season)
Springs	
Domestic	10
Municipal	593
Stock	3
Streams	
Irrigation	2,437
Source: NDWR, 2013; Water Right Abstract for HA 052	

Domestic Use

All domestic use of surface water (springs) in the basin is permitted for use in Eureka County. There are no records indicating how much of the approximately 9.5 af-year of domestic spring water rights are currently in use.

Irrigation Use

Irrigation using surface water as the source originates from the flow of Mary's Creek and the Humboldt River. Current use is not available and for purposes of the water plan it is assumed all of these irrigation rights are exercised. Of the total water stream rights provided in Table 4-8b, approximately 2,305 acre-feet per season are derived from the Humboldt River through the Bartlett Decree (Humboldt River Decree above Palisades) and approximately 132 acre-feet per year originate from the flow of Mary's Creek.

Stock Water Use

No record of the actual amount of water used for stock watering purposes is available. The amount, however, is expected to be small, given that only approximately 3.4 acre-feet per year of stock water rights exist.

4.4.5 Lower Reese River Valley Hydrographic Area (HA 059)

The Lower Reese River Valley Hydrographic Area (HA 059) is primarily located within Lander County west of Eureka County (Figure 4-4 and 4-10) and only a small portion extends into northwest Eureka County. The basin encompasses approximately 594 square miles, of which only about nine square miles are within Eureka County.

4.4.5.1 Lower Reese River Valley HA Groundwater Use

<u>Wells</u>

The State well log database provides records for more than 750 wells in the Lower Reese River Valley, of which three are reported for the Eureka County portion of the basin (Figure 4-10). Of the total wells drilled in the basin, approximately 120 have reportedly been plugged and formally abandoned such that there may be approximately 650 active wells in the Lower Reese River Valley. The three wells drilled in the Eureka County portion of the basin provide sources of supply to industrial operations along the Interstate 80 corridor near Dunphy.

Well depths in the basin vary from less than 50 feet for monitoring wells completed in the alluvium to more than 2,000 feet in the mountains (Figure 4-11). Similar to other basins in northern Eureka County, these deeper wells are related to the mining industry, except for two approximately 1,000 feet deep wells drilled southeast of Battle Mountain for the Town of Battle Mountain water system. Near Dunphy, the wells in Eureka County are in the range of about 200 to 350 feet deep.

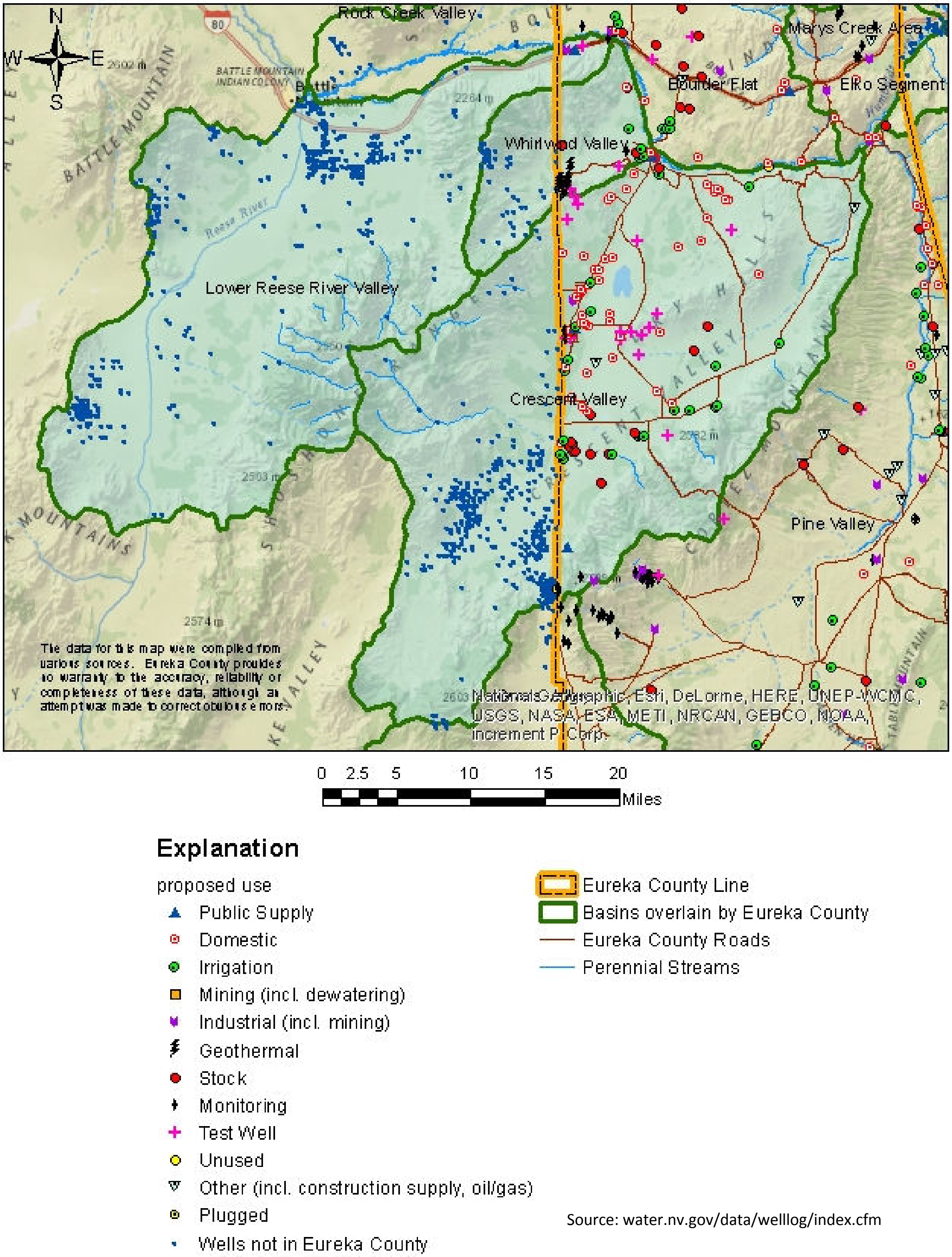
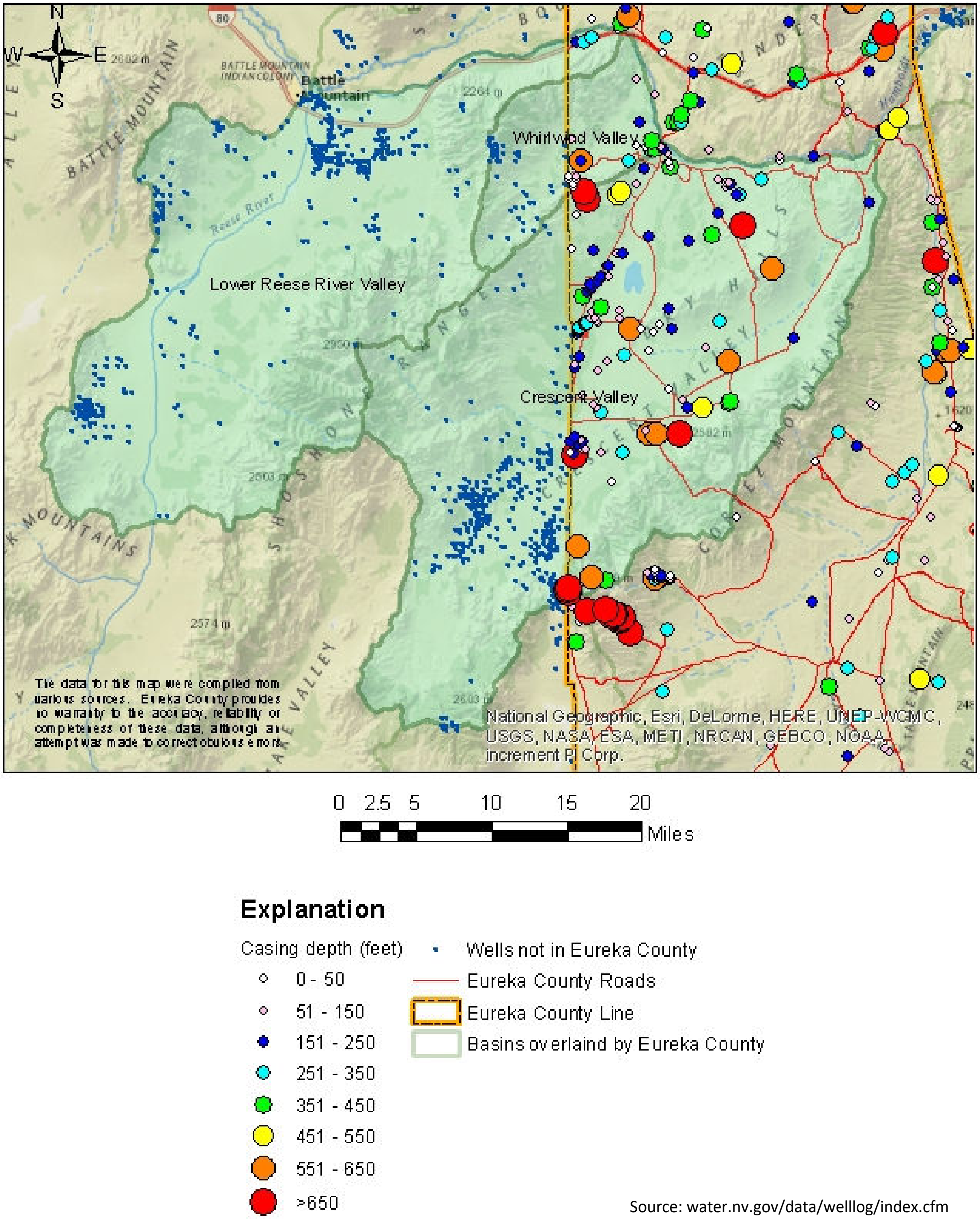


Figure 4-10. Wells in the Lower Reese River Valley, Whirlwind Valley and Crescent Valley Hydrographic Areas.



Source: water.nv.gov/data/welllog/index.cfm

Figure 4-11. Depths of Wells in the Lower Reese River Valley, Whirlwind Valley and Crescent Valley Hydrographic Areas.

Perennial Yield and Groundwater Water Rights

The estimated perennial yield of the basin, 17,000 af/yr (source: Lander County Water Resources Master Plan). The total system yield (combined surface water and groundwater resources) is estimated at 25,000 af/yr. Committed groundwater rights in the basin total 37,805.2 af/yr and are summarized in Table 4-9a. Not included in Table 4-9a are claims of vested water rights or groundwater allocated to domestic wells which do not require a water right. PODs for the water rights in the Eureka County portion of the basin are shown in Figure 4-12.

From Table 4-9a, mining and milling represents the largest block of groundwater rights in the Lower Reese River Valley, followed closely by irrigation. In the Eureka County portion of the basin committed water rights total approximately 363 acre-feet per year, or about one percent of the committed water rights in the entire basin. Table 4-9a does not include water allocated to 334 domestic wells, which in total would be allowed to pump 668 acre-feet per year. The table also does not include dozens of claims of vested water rights from springs. Currently claims to vested surface water and groundwater rights total more than 39 cfs and 2,400 acre-feet per year.

Table 4-9a

Committed Groundwater Rights in the Lower Reese River Valley Hydrographic Area (HA 059)

Manner of Use	Committed Water Rights (af/yr)
Commercial	2.16
Domestic	5.73
Environmental	76.73
Industrial	400.07
Irrigation	16,055.30
Mining and Milling	18,234.16
Municipal	2,895.81
Quasi-Municipal	16.39
Stock water	118.36
Total	37,805.2

Source: NDWR Hydrographic Area Summary

Groundwater Use

The current groundwater use in the Lower Reese River HA totals approximately 23,000 acre-feet per year, which exceeds the estimated perennial yield of 17,000 af/yr. Of this total, the amount of water consumed may be closer to 22,000 af/yr, such that current groundwater *use* exceeds the available recharge by about 30 per cent.

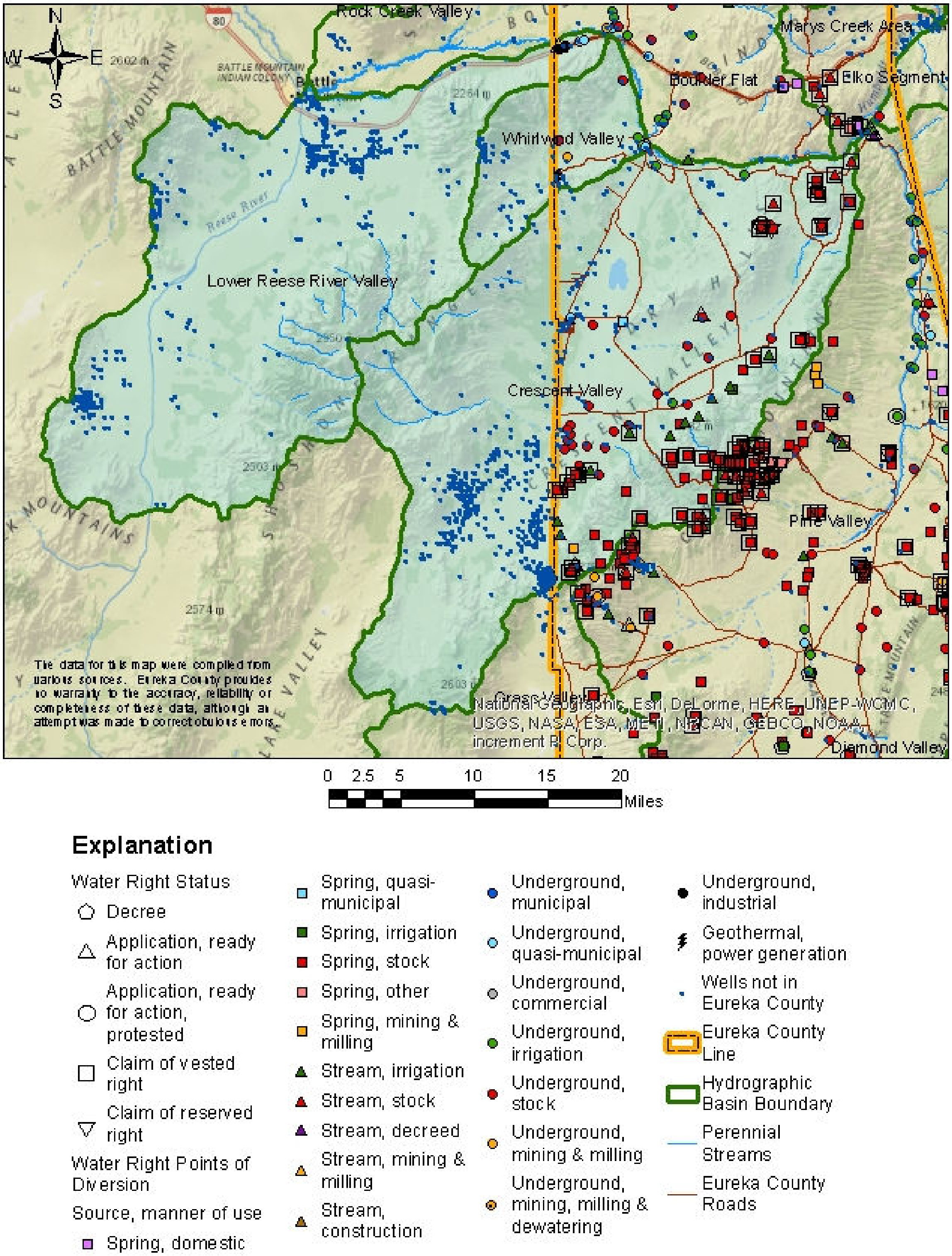


Figure 4-12. Points of Diversion for Water Rights in the Eureka County Portion of the Lower Reese River Valley, Whirlwind Valley, and Crescent Valley Hydrographic Areas.

Public Water Supply Use

The main public water system in the basin is the Town of Battle Mountain water system in Lander County. The 2010 Lander County Water Resource Master Plan shows 1,037 af/yr of municipal water use in the basin. There are no regulated public water systems in the Eureka County portion of the basin. However, the commercial/industrial facilities at Dunphy along the I80 corridor potentially might serve a sufficient number of people to qualify as *non-community, non-transient* water systems (refer to Section 2), but they currently are not regulated as such.

Domestic Well Use

The state well log database lists 334 domestic wells in the basin. Domestic well use is not regulated, but each domestic well is allocated 2.0 af/yr, such that domestic well use could approach 668 af/yr of groundwater. There are no domestic wells identified in the Eureka County portion of the basin.

Irrigation Use

Of the 16,234.16 acre-feet per year of committed irrigation groundwater rights, 12,000 acre-feet were reportedly pumped in 2012 (NSE, 2012; Crop Inventory). Assuming 3,359 acres (ibid.) and a net irrigation water requirement of 3.2 acre-feet per acre, irrigation may currently consume up to approximately 11,000 af/yr of groundwater.

Mining and Milling Use

The 2010 Lander County Water Resources Master Plan estimates mining water use in the basin is approximately 9,200 af/yr.

Industrial Use

The 2010 Lander County Water Resources Master Plan estimates industrial water use in the basin at approximately 38 af/yr.

Water Level Trends

Water levels in the alluvial aquifer near Battle Mountain have declined approximately five to 20 feet (http://webgis.water.nv.gov). Near Dunphy in the small portion of the basin within Eureka County water levels have changed little.

4.4.5.2 Lower Reese River Valley HA Surface Water Use

Within the basin, nine streams primarily above the valley floor in the Shoshone Range, springs, and the Reese River, are exploited as sources of water supply from surface water. Water rights associated with these sources are provided in Table 4-9b. None of these surface water rights employ points of diversion within Eureka County, nor are they appurtenant to land in the Eureka County portion of the basin. Table 4-9b does not include claims of vested water rights from springs and streams totaling approximately 1,100 af/yr that have not yet been adjudicated. No land in the Eureka County portion of the basin is irrigated with water from the Humboldt River Decree.

Table 4-9b

Committed Surface Water Rights in the Lower Reese River Valley Hydrographic Area (HA 059)

Manner of Use	Committed Water Rights (af/yr or af/season)
Springs	
Domestic	1
Irrigation	379
Mining and Milling	197
Stock	47
Streams	
Municipal	72
Irrigation	4,399
Mining and Milling	724
Environmental	2,503

4.4.6 Whirlwind Valley Hydrographic Area (HA 060)

The Whirlwind Valley Hydrographic Area (HA 060) is located in northwest Eureka County, southwest of the Humboldt River; east of the Lower Reese River Valley and west of Crescent Valley (refer to Figure 4-4 and 4-12). The area of the basin is small, approximately 94 square miles and the north-south trending Eureka-Lander County line virtually cuts the basin in half, with the eastern one half located in Eureka County. No Basin Summary is available from the NSE, but the perennial yield of the basin is estimated at 3,000 acre-feet per year (source: Lander County Water Master Plan).

4.4.6.1 Whirlwind Valley Groundwater Use

Wells

The state well log database provides records for 93 wells in Whirlwind Valley (Figure 4-10). Of these, 16 reportedly have been plugged and formally abandoned. Records indicate 21 active wells within the Eureka County portion of the basin. These include geothermal wells located near the border with Lander County and irrigation wells. The irrigation wells are in the range of 200 to 450 feet deep (Figure 4-13). Geothermal wells are much deeper, the deepest of which is reportedly constructed with well casing to a depth of approximately 5,000 feet in order to exploit the deep geothermal source in this area.

Perennial Yield and Ground Water Rights

The NSE's Basin Summary for Whirlwind Valley does not provide an estimate of the perennial yield for the basin. Instead, it is combined with the Lower Reese River Valley (HA059). The 2010 Lander County Water Resources Master Plan lists the perennial yield as 3,000 acre-feet per year. Committed groundwater rights within the basin are summarized in Table 4-10a and the PODs for water rights in the

Eureka County portion of the basin are depicted in Figure 4-13. At face value, Table 4-10a suggests the basin has been grossly over appropriated by a factor greater than 10. However, Whirlwind Valley is fairly unique in Nevada in that the amount of geothermal water rights greatly exceeds the more traditional, non-geothermal groundwater rights. So long as the geothermal usage is non-consumptive, that is, after heat is extracted, the heat-spent geothermal effluent is re-injected back into the geothermal reservoir; geothermal use is outside the purview of the Nevada State Engineer. However, geothermal development in the basin includes a flash plant (the hot fluid flashes to steam, which escapes to the atmosphere) and a portion of the geothermal fluids are consumed. Furthermore, groundwater is used for cooling purposes and that water is also consumed through evaporation. These other uses are regulated by the Nevada State Engineer.

Table 4-10a

Committed Groundwater Rights in the Whirlwind Valley Hydrographic Area (HA 060)

Manner of Use	Committed Groundwater Rights (af/yr)	Committed Geothermal Water Rights (af/yr)
Quasi-Municipal	[a]20.00	
Industrial	500.00	
Irrigation	2,216.55	
Mining and Milling	1,672.00	
Power		26,937.20
Stock water	15.90	
Total	4,424.45	26,937.20

Source: NDWR Hydrographic Area Summary

a. Eureka County holds a quasi-municipal water right which is primarily used to supply water to the County's construction projects. This use is not reflected in the Hydrographic Basin Summary but is included in Table 4-10a.

Groundwater Use

The principal use of groundwater in the basin at present is related to generating electricity from geothermal energy, followed by irrigation. Geothermal uses consume water when the hot water is flashed to steam and through evaporation of water used for cooling purposes. Use by mining operations is currently relatively small. Estimated groundwater consumption may be in the neighborhood of 4,000 af/yr, or more than the estimated 3,000 acre-feet per year perennial yield. However, because a significant portion of the water consumed is derived from geothermal sources, and the degree of hydraulic communication between the geothermal and non-thermal aquifers is not thoroughly documented, it is uncertain whether or not current groundwater consumption exceeds the perennial yield.

Geothermal Energy Production

Geothermal resource exploitation where no water is consumed falls under the purview of Nevada Division of Minerals, not the NSE. The use of water for electrical power generation by far and away represents the largest single use of water within the basin. Table 4-10a distinguishes between water rights for industrial and power uses, but these rights are both related to generating electricity using geothermal energy. The geothermal resource straddles the Eureka-Lander County line and wells are so close to the county line such that it makes little difference which portion of the basin that the wells are completed. Although there are more than 31,000 af/yr of water rights committed to geothermal power production, in 2012 only approximately 7,200 acre-feet of geothermal fluids were produced from the basin. Of this, approximately 5,600 acre-feet of heat-spent effluent was returned to the geothermal system, such that approximately 1,600 acre-feet was consumed (Nevada Division of Minerals, 2013; personal communication).

Industrial Use

The groundwater rights for industrial use in the basin are tied to geothermal power production in the power plant cooling towers. This water use, approximately 500 acre-feet per year in Whirlwind Valley, is typically consumed through evaporation.

Irrigation Use

There are two irrigation groundwater rights in the basin to irrigate a total of 738.85 acres, each with an annual duty of 3.0 acre-feet, or a total of about 2,200 acre-feet per year. Because the annual *net* irrigation requirement of alfalfa hay and pasture grass in the basin is 2.9 to 3.0 acre-feet per year, it is likely that virtually all of the irrigation water applied is consumed.

Stock water use

The Division of Water Resources does not closely monitor the amount of water that is actually put to use for stock watering purposes. For purposes of the Master Plan it is assumed that all of the water rights committed to stock watering purposes, approximately 16 af/yr, are consumed.

Water Level Trends

There are few wells in the basin with which to evaluate water level trends. The limited data indicated water levels have remained relatively constant.

4.4.6.2 Whirlwind Valley HA Surface Water Use

The Humboldt River forms the northeastern boundary of the basin. Water from the Humboldt River adjudicated under the Humboldt River Decree is used to irrigate land near the river (refer to Figure 4-2). Other than the Humboldt River, which forms the boundary between the Whirlwind Valley and Boulder Flat HAs, there are no perennial streams within the basin and the use of appropriated surface water is limited to a few springs. Water rights associated with these sources are provided in Table 4-10b. There is currently only one spring in the basin with a surface water right and it is for stock water. A second spring water right application is ready for action and a claim of a vested right has been filed on a third. None of these surface water rights have points of diversion within Eureka County, nor are they appurtenant to land in the Eureka County portion of the basin. Table 4-10b does not include the claims of vested water rights totaling approximately seven af/yr that have not yet been adjudicated.

Table 4-10b

Committed Surface Water Rights in the Whirlwind Valley Hydrographic Area (HA 060)

Manner of Use	Committed Water Rights (af/yr)
Springs	
Stock	4.48

4.4.7 Crescent Valley Hydrographic Area (HA 054)

The Crescent Valley Hydrographic Area (HA 054) is located in northern Eureka County south of the Humboldt River (Figures 4-4 and 4-12) and is shared with Lander County. The basin, situated east of the Lower Reese River Valley and west of Pine Valley, encompasses 750 square miles, of which 427 square miles are within Eureka County. For the most part, groundwater and surface water flows toward the playa in the central portion of the basin. A relatively small amount of groundwater is believed to flow northward to the Humboldt River.

4.4.7.1 Crescent Valley HA Groundwater Rights and Use

Wells

The State well log database provides records for approximately 930 wells in the basin of which 155 have reportedly been plugged and abandoned. Approximately 140 wells are reported for the Eureka County portion of the basin and, of these, nine reportedly were plugged and abandoned such that there are approximately 130 active wells within the Eureka County portion of the basin (Figure 4-10). The vast majority of wells in the basin is related to the mining industry and includes wells for mining and milling purposes, mine dewatering for open pit and underground operations, and monitoring. The largest number of wells has been drilled for monitoring purposes, followed by wells for mining use and irrigation. Well depths vary from 50 feet or less for monitoring wells constructed in the alluvial deposits on the valley floor to more than 650 feet for wells (water supply, dewatering, and monitoring) near active mining operations (Figure 4-11). Many wells drilled for the mining industry are over 1,000 feet deep with the deepest wells more than 3,000 feet deep.

Perennial Yield and Groundwater Rights

The perennial yield of the basin is estimated at 16,000 acre-feet per year as indicated on the Basin Summary available from the office of the NSE. The results of groundwater modeling performed for Barrick's Pipeline Project suggest it could be higher than this amount, but for purposes of Eureka County's Water Resources Master Plan, the State's estimate will be used. Committed groundwater rights in the basin total 67,296.71 af/yr and are summarized in Table 4-11a. PODs for the rights are shown in Figure 4-12.

At face value, Table 4-11a suggests that the basin is over appropriated by a factor of about five. However, a large percentage of the water rights are associated with mine dewatering, not all of these water rights are currently exercised, and much of the water pumped for mining purposes is returned to the basin via infiltration basins.

Table 4-11a

Committed Groundwater Rights in the Crescent Valley Hydrographic Area (HA 054)

Manner of Use	Committed Groundwater Rights (af/yr)
Commercial	0.06
Irrigation[a]	2,130.26
Mining and Milling	63,309.8
Municipal	260.61
Quasi-Municipal	1,250.63
Stock water	381.48
Total[b]	67,332.84

Source: http://water.nv.gov, accessed 1/08/14

a. A prior Basin Summary (http://water.nv.gov, accessed 1/27/11) showed 5,564.66 af/yr of committed irrigation water rights. The NSE currently views irrigation at the Dean Ranch to be a secondary use of water appropriated for mining purposes.

b. A prior Basin Summary (http://water.nv.gov, accessed 1/27/11) showed total water rights in the basin of 82,392.51 af/yr

Groundwater Use

The largest use of groundwater in the Basin is related to mining, particularly mine dewatering. Although committed groundwater rights far exceed the estimated perennial yield, not all these rights are currently exercised and a large percentage pumped by the mines for dewatering purposes is returned to the aquifer through infiltration facilities. Presently, approximately 12,000 to 13,000 acre-feet per year of groundwater are consumed, less than the estimated 16,000 af/yr perennial yield of the basin.

Public Water System Use

The Town of Crescent Valley is the only public water supply in the Eureka County portion of the basin. However, its primary water source is located just west of the County Line in Lander County. The County holds water rights for Municipal and Quasi-municipal purposes totaling approximately 1,488 acre-feet per year for use in the Town of Crescent Valley. Water use in the Town of Crescent Valley for 2014 totaled 141.5 acre-feet.

Eureka County also holds quasi-municipal water rights for 3.07 acre-feet per year to supply the needs of County facilities (Road Department shop, Library, and others) in the community of Beowawe. However, the system is not regulated as a public water supply because it does not provide water for human consumption, has less than 15 service connections, and serves less than 25 persons.

Noncommunity, nontransient public water systems in the basin, but outside of Eureka County, are located at Barrick's Pipeline and Cortez gold mining operations.

Domestic Water Use

The state well log database shows a total of 71 domestic (single family residential supply) wells in the basin, of which 55 are located in Eureka County. Domestic well use is not regulated, and for purposes of the Master Plan, it is assumed that all of the 2.0 acre-feet per year allocated to a domestic well is pumped, of which 25% is assumed to return to the aquifer as secondary recharge from a septic system[1]. Therefore, current domestic use in the basin is estimated at approximately 100 acre-feet per year, of which approximately 80 acre-feet per year is consumed in Eureka County.

Mine Water Use

Approximately 63,000 acre-feet per year of water rights are committed to mining and milling uses in the basin, which includes dewatering of open pit and underground operations. Barrick's operations in the basin are responsible for the vast majority of water pumped for mining purposes. Between April 1996 and July 2013, nearly 580,000 acre-feet of water has been pumped there. Through 2006, water use has been associated with their Pipeline Project. Pumping at their Cortez Hills operations began in 2006. Over the years, approximately 80% of the water pumped has been infiltrated back to the aquifer, 10% has been consumed in the mining process, and 10% has been utilized for irrigation. Of these rights, approximately 35,000 acre feet were pumped from September 2009 through September 2010 (Geomega, 2011; Table 2). The majority of the water, approximately 25,000 acre-feet was returned to the aquifer via several infiltration facilities south of the Town of Crescent Valley, approximately 7,000 acre-feet were diverted to the Dean Ranch where the water was used for irrigation, and the remainder, about 4,300 acre-feet, were consumed by the mine.

Dewatering at the Cortez Hills open-pit and underground mines in southeastern Crescent Valley began in 2007, and increased substantially in 2010 at the underground operations. Initially, the pumping rate at Cortez Hills underground varied between about 3,000 and 6,000 gpm (averaging about 4,000 gpm) and is expected to increase to 8,000 gpm in the future. The water from the dewatering operations is sent to infiltration beds.

Irrigation Water Use

The largest source of irrigation water is derived from dewatering operations at Barrick's Pipeline project. This water is used for center-pivot irrigation at the Dean Ranch located both in Eureka and Lander Counties in an area north of the mine and southeast of the Town of Crescent Valley. From September 2009 to September 2010, approximately 7,000 acre-feet were estimated by Barrick's consultants to have been delivered to the fields and consumed. The application of irrigation water at the Dean Ranch is managed such that all water applied is believed to be consumed (Geomega, 2011). The 2012 Crop Inventory for Crescent Valley reported 6,591.43 acre-feet of irrigation water usage by Barrick and total irrigation usage for 2012 was reported as 6,671.43 acre-feet, compared to their irrigation rights which total 6,589.62 af/yr. Given the accuracy of meters, the crop inventory is consistent with the 2009-2010

[1] Secondary recharge from septic systems is discussed here and not discussed for other HAs because only Crescent Valley and Diamond Valley include a significant number of residences served by septic systems.

usage reported by the mine's consultant. However, the Crop Inventory assumes an annual duty of 3.9 af/yr per acre and does not rely on metered water deliveries. In contrast, Barrick estimates the amount of mine water consumed through irrigation to be approximately 3,200 acre-feet per year.

The summary of irrigation rights shown in Table 4-11a reflects evolution in how the NSE treats water pumped to dewater Barrick's open pits. The water rights allowing irrigation at the Dean Ranch are presently considered to be a secondary use of water appropriated for mining purposes as opposed to irrigation rights.

Stock Water Use

The use of groundwater as a source of water to livestock is not closely monitored by the Division of Water Resources, such that the actual quantity of water consumed is unknown. For purposes of the Master Plan, it is assumed that all of the approximately 365 acre-feet per year of committed stock water rights are consumed.

Water Level Trends

Large volumes of groundwater have been pumped from bedrock aquifers to dewater the open pit and underground mine workings in Crescent Valley. This has resulted in drawdowns of more than 1,000 feet in the bedrock aquifers in southwest Crescent Valley near Barrick's Pipeline Project. In southeast Crescent Valley, pumping near Barrick's Cortez Hills Project has caused water levels to decline by as much as 800 feet (Zhan, 2014). The portion of the water pumped that is consumed by the mining operations is relatively small and the vast majority is infiltrated to the alluvial aquifer. Consequently, water levels in the alluvial aquifer are generally stable or have increased in elevation near the infiltration facilities.

4.4.7.2 Crescent Valley HA Surface Water Use

A relatively small amount of land along the Humboldt River is irrigated with water from the Humboldt River under the Humboldt River Decree. Elsewhere in the basin, springs and eight streams within the basin, primarily in the mountain block above the valley floor, are developed as sources of water supply. Surface water rights associated with these sources are summarized in Table 4-9b and the PODs for water rights in the Eureka County portion of the basin are shown in Figure 4-12. Of the total water rights to spring flow in the basin, approximately 88 percent relate to points of diversion in Eureka County. Of the total water rights to surface water flow from streams in the basin, approximately 95 percent relate to points of diversion in Eureka County. Table 4-11b does not include claims of vested surface water rights totaling approximately 1,900 af/yr that have not yet been adjudicated.

Table 4-11b

Committed Surface Water Rights in the Crescent Valley Hydrographic Area (HA 054)

Manner of Use	Committed Water Rights (af/yr or af/season)
Springs	
Quasi-Municipal	9
Irrigation	12
Mining and Milling	78
Stock	371
Streams	
Irrigation	5,553
Power	81
Source: http://water.nv.gov accessed 7/03/13.	

Data Trends

Localized drawdown occurs near the dewatering operations at the Pipeline and Cortez Hills mining projects and groundwater mounding is occurring near the infiltration facilities where the water is returned to the aquifer. Near the Pipeline Project in southwestern Crescent Valley, water levels have declined approximately 1,300 feet (Zhan, 2014). Water levels have remained relatively constant in this area as the pumping rates from dewatering have gradually reduced from a peak of approximately 25,000 gallons per minute to the current rate of 17,000 gallons per minute. In the alluvial deposits north of the Pipeline Project, water levels have risen because infiltration of the water has created a groundwater mound. Outside of these localized effects, water levels are relatively constant, which is consistent with the observation that, although groundwater pumping is large, the amount of groundwater consumed in the basin is less than the perennial yield.

Water levels in the deep carbonate rocks at the Cortez Hills Project near the boundary common to the Crescent Valley, Grass Valley and Pine Valley HAs had shown a decline of about 40 feet per year in response to dewatering at the Pipeline Project prior to the start of large-scale dewatering at Cortez Hills in 2010. With the onset of dewatering at Cortez Hills, the decline has increased to approximately 100 feet per year (*ibid.*). Water levels in the northern portion of the basin have changed little, with some wells showing a small rise in the water level elevation (http://webgis.water.nv.gov).

4.4.8 Pine Valley Hydrographic Area (HA 053)

The Pine Valley Hydrographic Area (HA 053) is located in northern Eureka County south of the Humboldt River (Figures 4-4 and 4-13) and is shared with Elko County. The basin encompasses 1,002 square miles, of which 850 square miles (85 percent) are within Eureka County. Groundwater in the bulk of the basin discharges to Pine Creek which flows north to the Humboldt River. In the Garden Valley portion of southeast Pine Valley, groundwater is thought to flow eastward into northern Diamond Valley (Harrill, 1968).

4.4.8.1 Pine Valley HA Groundwater Rights and Use

Wells

The State well log database provides records for approximately 260 wells in the basin of which 68 have been plugged and formally abandoned. Approximately 200 wells are reported for the Eureka County portion of the basin and, of these, 49 reportedly were plugged and abandoned such that there are approximately 150 active wells within the Eureka County portion of the basin (Figure 4-13). The vast majority of wells in the basin are related to the mining industry. Of this group, about 70 percent were drilled for monitoring purposes. 24 irrigation wells have been drilled, but not all were successful. There are 18 domestic wells reportedly constructed in the basin. The well log database reports 14 stock wells drilled in the Eureka County portion of the basin; however, there are twice as many underground water rights for stock watering purposes than there are well logs.

Well depths vary from about 20 feet for monitoring wells constructed in the alluvial deposits on the valley floor to as deep as 3,000 feet in the mountains near Horse Canyon (Figure 4-14). Irrigation wells have been drilled to depths of 700 feet with a median depth of approximately 300 feet. Depths of domestic wells reportedly range from 57 to 500 feet with a median depth of 132 feet. Stock wells reportedly range from 135 to 400 feet with a median depth of 160 feet.

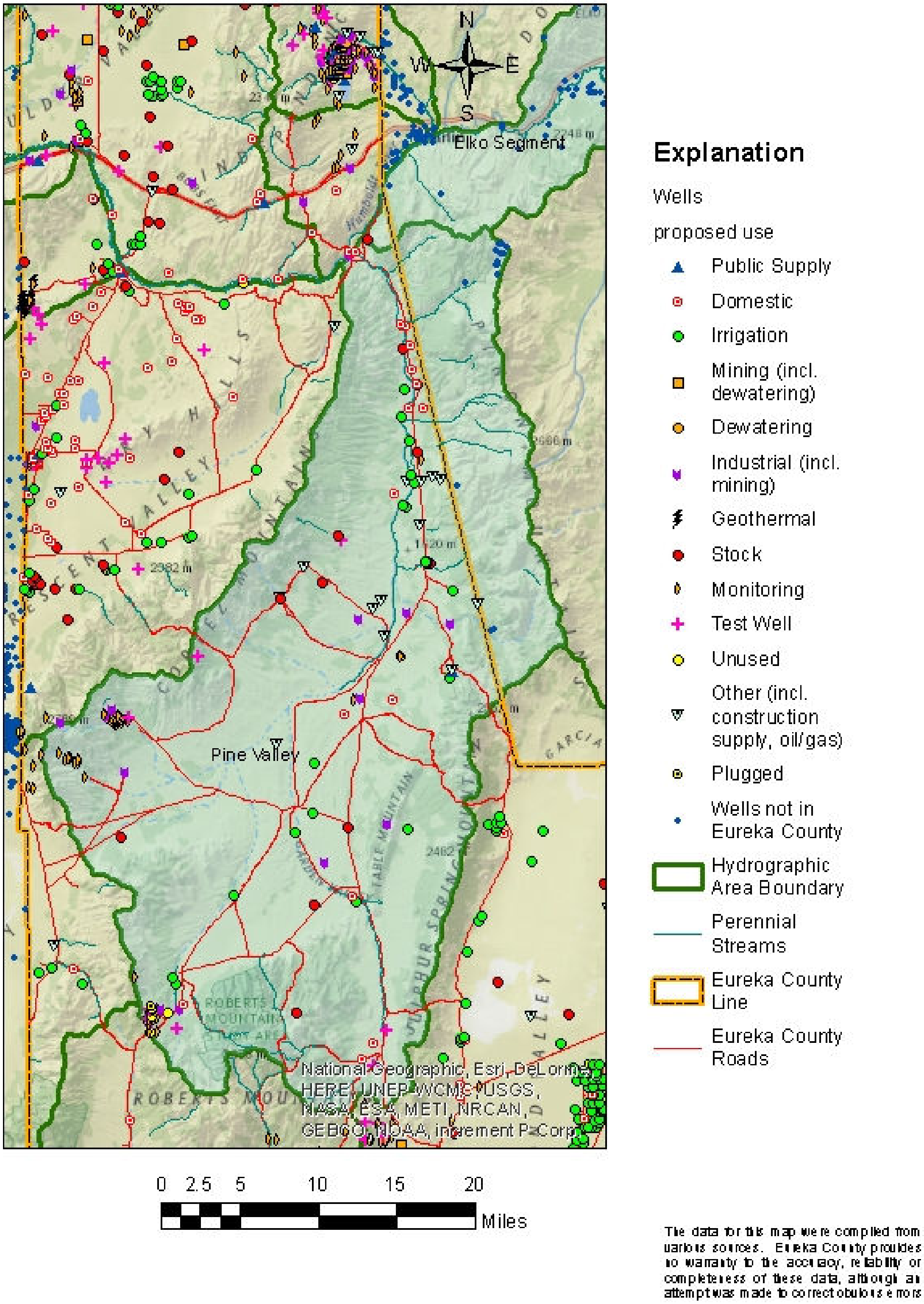
Perennial Yield and Groundwater Rights

The perennial yield of the basin is estimated at 20,000 acre-feet per year on the Basin Summary available from the Nevada State Engineer. When surface water of Pine Creek and its tributaries are considered, the system yield (combined surface water and groundwater resources) approaches 30,000 acre-feet per year. Committed groundwater rights in the basin total 16,324.28 af/yr and are summarized in Table 4-12a and the PODs for water rights in the Eureka County portion of the basin are shown in Figure 4-15. Currently, the basin is not fully appropriated; however, applications have been filed for mining and milling purposes for all the remaining unappropriated groundwater in the basin. Upon approval of these applications the basin will be fully appropriated.

Table 4-12a

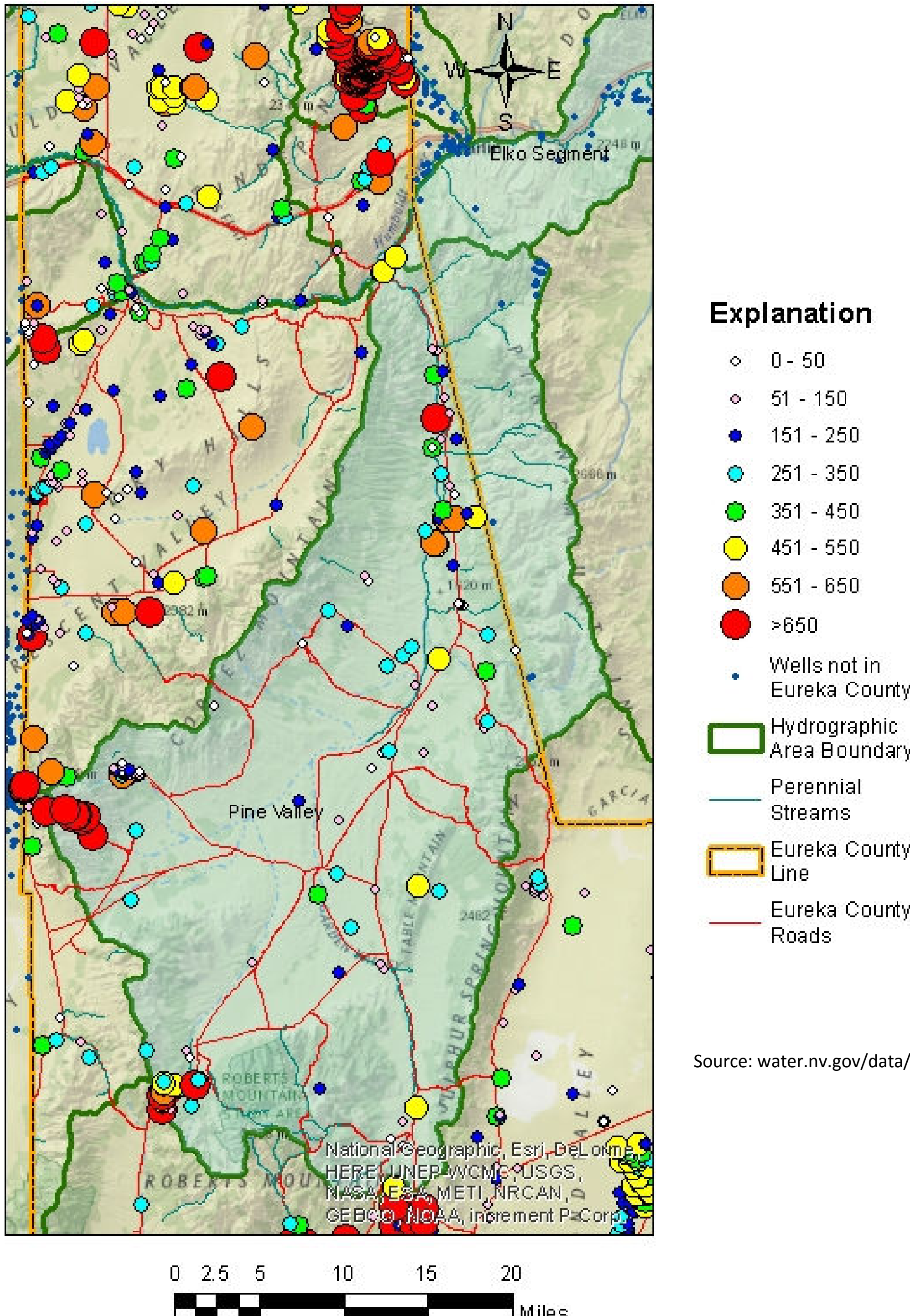
Committed Groundwater Rights in the Pine Valley Hydrographic Area (HA 053)

Manner of Use	Committed Groundwater Rights (af/yr)
Irrigation	14,696.87
Mining and Milling	1,173.32
Quasi-Municipal	165.38
Stock water	288.71
Total	16,324.28
Source: http://water.nv.gov, accessed 12/04/13	



Source: water.nv.gov/data/welllog/index.cfm

Figure 4-13. Wells in the Pine Valley and Elko Segment Hydrographic Areas.



Source: water.nv.gov/data/welllog/index.cfm

The data for this map were compiled from various sources. Eureka County provides no warranty to the accuracy, reliability or completeness of these data, although an attempt was made to correct obvious errors

Figure 4-14. Depths of Wells in the Pine Valley and Elko Segment Hydrographic Areas.

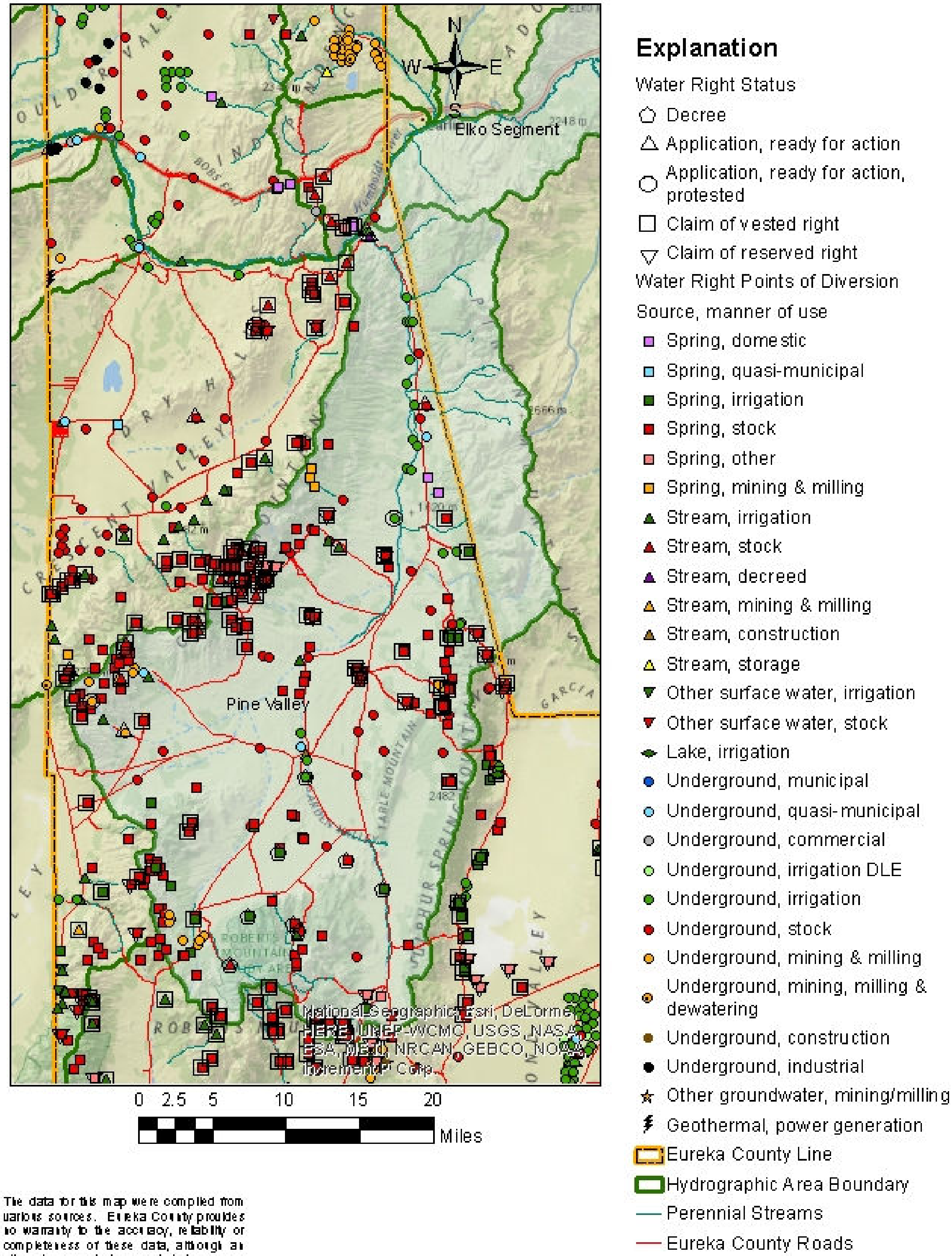


Figure 4-15. Points of Diversion for Water Rights in the Eureka County Portion of the Pine Valley and Elko Segment Hydrographic Areas.

Groundwater Use

The largest quantity of committed groundwater rights in the Pine Valley HA is for irrigation. The actual amount of groundwater currently pumped for irrigation may be substantially less than the amount that has been permitted because much of the groundwater rights are supplemental to surface-water rights and exercised only when surface water is unavailable. Estimates the amount of groundwater currently consumed by irrigation may be as low as 900 af/yr (source: Barrick 2013). Recent applications have been filed for the remaining unappropriated groundwater in the basin. Once these applications are approved, there will be no unappropriated groundwater in the basin.

Barrick is currently exploring for gold in southern Pine Valley at what they refer to as the Goldrush Project. Initial indications are that the deposit is very large and if/when it is developed, water use in the basin might change significantly.

Public Water System Use

The only use of groundwater for quasi-municipal purposes in Pine Valley at this time is the supply for the Lodge at Pine Valley, a housing facility for workers at Barrick's Goldrush Project located in southern Pine Valley. The facility has not been operating long enough to establish how much of the water rights will actually be put to use. Waste water is treated on site and the waste water treatment facilities for the lodge do not discharge any treated effluent, such that all water pumped will be consumed. For purposes of the Water Resource Master Plan, it is assumed that all of the permitted 165.38 af/yr will be consumed in the foreseeable future.

Domestic Water Use

The State well log database reports 18 domestic wells in the basin. Domestic well use is not regulated, and for purposes of the Master Plan, it is assumed that 2.0 acre-feet per year of groundwater is pumped and one-fourth this amount is returned to the aquifer as secondary recharge from septic tank effluent. Therefore, the consumption of water supplied by individual domestic wells in the basin is estimated at approximately 27 acre-feet per year.

Irrigation Water Use

14,696.87 acre-feet per year of groundwater has been appropriated for irrigation use in the basin. Most, but not all, irrigation rights have an annual duty of 3.0 acre-feet per acre. The NSE does not maintain crop inventories for Pine Valley. Approximately one-half of the water right permits or certificates are supplemental to land irrigated with water adjudicated under the Humboldt River Decree and may be used only when there is no surface water available. The total water from all sources for these rights cannot exceed the three to four af/year per acre annual duty. Therefore, the amount of groundwater pumped for irrigation purposes can be expected to vary from year to year dependent upon the availability of the surface water. As a result, there is currently no reliable estimate of the amount of groundwater pumped for irrigation, but it is unlikely that the long-term average consumptive use of irrigation water pumped is close to the amount of the committed ground-water rights. In their regional groundwater flow model, which includes Pine Valley, Barrick's preliminary estimate of groundwater consumed through irrigation use is approximately 900 acre-feet per (Barrick, 2013).

Mine Water Use

1,173.32 acre-feet per year of groundwater are committed to mining and milling uses. Currently, mining uses are related primarily to exploration of Barrick's properties in the basin. For purposes of the Water Resources Master Plan, it is assumed that all of this water for mining is currently consumed.

Stock Water Use

The NSE does not currently closely track the amount of groundwater used to water livestock. For purposes of the Water Resources Master Plan, it is assumed that all 288.71 af/yr of groundwater permitted for stock water use is consumed.

Water Level Trends

Barrick has conducted groundwater investigations in southwestern Pine Valley to investigate the potential for changes in water levels associated with their mine dewatering operations in Crescent Valley to the west. In the Cortez Mountains of southwest Pine Valley near Horse Canyon, the depth to groundwater in the carbonate rocks approaches approximately 2,000 feet below the land surface. To the east and nearing the valley floor, the depth to water in the carbonate rocks is approximately 500 feet below land surface as the land surface elevation decreases. Data from monitoring wells in the Horse Canyon area show a response to dewatering at the Pipeline project in Crescent Valley as well as a response to dewatering at their Cortez Hills project in southeast Crescent Valley. For the westernmost monitoring well, water levels in the deep aquifer are declining at a rate of approximately 50 feet per year. Farther to the east, water levels in the deep aquifer are currently declining at a rate of approximately 20 feet per year. Available data suggest that the effect is not yet seen in the shallower, alluvial aquifer exploited by other users in the basin; nor has any effect on the discharge of springs or stream flow been detected (Zahn, 2014). Barrick is currently developing a regional groundwater flow model comprising Crescent Valley, Grass Valley and Pine Valley to evaluate the observed changes and to assess potential changes in the groundwater regime arising from their existing and future operations in the adjacent basins.

Water level data are available from the Nevada Division of Water Resources (http://webgis.water.nv.gov). These data indicate water levels in the alluvial aquifer in Pine valley have been relatively constant.

4.4.8.2 Pine Valley HA Surface Water Use

Surface water provides sources of supply for domestic, irrigation, mining/milling, stock water and a few other uses within the basin. Table 4-12b shows the appropriated surface water rights for Pine Valley and the PODs are shown in Figure 4-15. It does not include decreed rights or 85 claims of vested surface water rights that have not yet been adjudicated. The largest use of surface water is irrigation followed by stock water and the other uses.

Table 4-12b

Committed Surface Water Rights in the Pine Valley Hydrographic Area (HA 053)

Manner of Use	Committed Surface Water Rights (af/yr or af/season)
Springs	
Domestic	2
Irrigation	249
Mining and Milling	123
Stock	1,017
Streams	
Irrigation	2,624
Stock	81
Source: http://water.nv.gov accessed 7/03/13.	

A relatively small amount of land along the Humboldt River near Palisade is irrigated with water from the Humboldt River under the Humboldt River Decree (see Figure 4-2). Additionally, approximately 3,900 acres of land along Pine Creek and its tributaries in the northern half of the basin are irrigated by surface water rights adjudicated under the Humboldt River Decree (Figure 4-2), in the amount of approximately 11,000 acre-feet per year. In the southern half of the Pine Valley, the Pete Hanson Creek Decree regulates irrigation of approximately 1,600 acres of land used primarily for hay and meadow pasture, with an annual or seasonal duty of approximately 3,600 acre feet (Figure 4-3). The Pete Hanson Creek decree also allows watering of more than 1,100 head of cattle and 2,000 sheep.

4.4.9 Elko Segment Hydrographic Area (HA 049)

The Elko Segment Hydrographic Area (HA 049) is located in northeastern Eureka County and western Elko County (see Figures 4-4 and 4-15) and essentially straddles the Humboldt River from a few miles downstream of Carlin eastward to Rincon (east of Elko). The total area of the basin is 314 square miles, but only about four square miles, or a little more than one percent of its total area, is within Eureka County. Groundwater originating in the basin generally flows toward the Humboldt River.

4.4.9.1 Elko Segment HA Groundwater Rights and Use

Wells

The State well log database provides records for more than 1,500 wells in the basin (see Figure 4-13). Of these, more than 80 have been plugged and formally abandoned, more than 40 have been deepened and at least 20 have been replaced. This leaves approximately 1,400 active wells in the basin. However, in the Eureka portion of the basin, there is a record for only one well.

The vast majority of wells in the basin – more than 1,100 - were reportedly drilled for domestic use to provide water supply to individual residences.

Perennial Yield and Groundwater Rights

The perennial yield of the basin is estimated at 13,000 acre-feet per year. When surface water of the Humboldt River and its tributaries are considered, the system yield (combined surface water and groundwater resources) approaches 280,000 acre-feet per year. Committed groundwater rights in the basin total 20,341.52 af/yr, plus 4,459.42 af/yr of geothermal groundwater rights. These are summarized in Table 4-13a and the POD for the one permit in the Eureka County portion of the basin is shown in Figure 4-15. In combination, committed groundwater and geothermal groundwater rights in the basin exceed the perennial yield by a factor of about 0.9 (perennial yield x 1.9 = committed underground rights) such that the basin is over appropriated. However, because not all rights have been exercised to their maximum permitted amount and there is some secondary recharge from some uses, the basin as a whole does not appear to be in an overdraft condition. Note that individual domestic wells do not require a water right and domestic wells are not accounted for in Table 4-13a.

Groundwater Use

The overwhelming majority of groundwater use in the Elko Segment HA occurs outside of Eureka County in the Elko County portion of the basin. Groundwater is used for public water supply, individual residential water supply, a variety of commercial and industrial purposes including direct use of geothermal energy, irrigation, stock water and recreation. In the Eureka County portion of the basin, there is only one water right and it is for stock watering purposes. Because such a small portion of the basin is within Eureka County, only the more significant uses in the basin outside of Eureka County are discussed below.

Table 4-13a

Committed Groundwater Rights in the Elko Segment Hydrographic Area (HA 049)

Manner of Use	Committed Groundwater Rights (af/yr)	Committed Geothermal Groundwater Rights (af/yr)
Commercial	50.86	3,011.82
Domestic	194.89	
Environmental	56.44	
Industrial	21.61	1,447.60
Irrigation	873.97	
Mining and Milling	55.24	
Municipal	18,220.54	
Quasi-Municipal	623.14	
Recreation	45.00	
Stock water	199.83	
Total	20,341.52	4,459.42
Source: http://water.nv.gov, accessed 12/04/13		

Public Water System Use

Public water use primarily includes municipal and quasi-municipal use. The largest quantity of committed groundwater rights in the Elko Segment HA is for municipal use for the City of Elko municipal water system. In 2012 and 2013, the City pumped approximately 7,400 af/yr, which equates to about 42% of their permitted underground rights. A little more than one-third of the water pumped by the City, or approximately 2,700 af/yr, becomes sewage which is treated at the City's wastewater treatment plant/reclamation facility. A large portion of the reclaimed water is used to irrigate alfalfa and a golf course and the remainder is infiltrated back to the aquifer (Ryan Limberg, 2014; personal communication) where it constitutes secondary recharge to the aquifer.

Elko County holds municipal water rights related tothe industrial area northeast of Elko at the Northeastern Nevada Regional Railport, but the County does not operate a municipal water system there. Instead water rights are conveyed to individual tenants and they develop their own water supplies and water systems as needed (Lynn Forsberg, 2014; personal communication).

Quasi-municipal use includes a number of water systems which serve multiple single-family residences, including small trailer parks, and commercial properties. However, these small systems largely are not regulated as public water systems by the State of Nevada because the number of individuals served by them is less than the thresholds for Nevada's regulations to apply to them.

Domestic Water Use

The 2004 Elko County Water Resources Master Plan inventoried 767 domestic wells in the Elko Segment HA (Elko County, 2004) compared to the approximately 1,100 individual domestic wells presently identified in the state well log database. The actual number is likely somewhere between the two extremes because of double counting of wells that have been deepened or replaced. Assuming an annual groundwater consumption of 180,219 gallons per year per domestic well (*Id.*), consumptive use of groundwater water by domestic well users may range between approximately 400 acre-feet per year to approximately 800 af/yr. Domestic use also includes "cluster wells" which serve more than one single-family residence. These do require water rights and account for about 200 af/yr of groundwater rights. In total, domestic use is likely in the neighborhood of 600 to 1,200 af/yr, or about two and one-half to five percent of the total committed water rights in the basin.

Geothermal Water Use

Although committed geothermal water rights in the basin total approximately 4,500 af/yr, only a portion of these rights are currently exercised. At present, there are two active direct-use geothermal projects in the City of Elko - the Elko County School District system and the Elko Heat System. Together, these account for about two-thirds of the geothermal water rights in the basin. The remainder has not been used for at least a decade. The thermal effluent (water that has had heat extracted from it) from the School District system discharges to the sanitary sewer where it makes up a portion of the water reclaimed by the City. The effluent from the Elko Heat system is infiltrated near the Humboldt River. At present, water consumed by geothermal use is likely less than one-third of the committed rights or in the neighborhood of 1,500 af/yr.

Irrigation Water Use

Considering the size of the basin, committed groundwater rights for irrigation use are relatively small, less than 900 af/yr or about three percent of the total committed groundwater rights. However, irrigation includes re-use of reclaimed water from the City's wastewater treatment facility, totaling 2,700 acre-feet per year.

Stock Water Use

There are records for 37 stock water wells in the basin and approximately 200 af/yr of underground rights committed to stock water use. Only one stock water well is identified within Eureka County in the extreme western tip of the basin, with an annual duty of 11.2 af/yr.

Mine Water Use

Mining utilizes only a small amount of groundwater in the Elko Segment HA. The only mining rights are for Newmont's operations south of Carlin and these holdings total approximately 55 af/yr.

Water Level Trends

Water level data are available from the Nevada Division of Water Resources (http://webgis.water.nv.gov). Data from the few wells in the southwestern-most part of the basin near Eureka County indicate water levels in this area are generally stable.

4.4.9.2 Elko Segment HA Surface Water Use

Surface water provides sources of supply for domestic, irrigation, mining/milling, stock water and a few other uses within the basin. Table 4-13b lists the appropriated surface water rights for the Elko Segment. It does not include the Humboldt River Decree or claims of vested surface water rights that have not yet been adjudicated. The largest use of surface water is irrigation.

Table 4-13b

Committed Surface Water Rights in the Elko Hydrographic Area (HA 049)

Manner of Use	Committed Surface Water Rights (af/yr or af/season)
Springs	
Irrigation	71.33
Stock	11.93
0ther	1
Streams	
Irrigation	1,403.29
Wildlife	664.50
Commercial (ice)	1,030.00

Source: http://water.nv.gov accessed 7/03/13.

4.4.10 Grass Valley Hydrographic Area (HA 138)

The Grass Valley Hydrographic Area (HA 061) is located in western Eureka County south of the Humboldt River and north of U.S. Highway 50 (Figures 4-4 and 4-16) and is shared by Lander and Elko Counties.

The basin, situated approximately 35 miles northwest of the Town of Eureka, encompasses 594 square miles, of which 99 square miles are within Eureka County. It is a closed basin such that no surface water exits the valley.

4.4.10.1 Grass Valley HA Groundwater Use

Wells

The State well log database provides records for 75 wells in the basin of which three have been plugged and formally abandoned. Review of the database suggests that several of the wells are incorrectly located and likely are in Crescent Valley. Wells logs are reported for 16 wells in the Eureka County portion of the basin. Of these, one reportedly encountered no water and one was plugged such that there are 14 active wells in the Eureka portion of the basin (Figure 4-16). The majority of wells in the basin are related to the mining industry, primarily for monitoring. In the Eureka County portion of the basin, wells drilled by the mining industry are primarily for monitoring purposes, with the process and dewatering wells located in Lander County just west of the county line.

The deepest wells in the basin are related to the geothermal resource in the southern one-third portion of the basin, where wells have reportedly been drilled to depths of more than 6,000 feet (www.nacleanenergy. com). However, data on most of the geothermal wells are proprietary and will not be released until the statutory period has elapsed. Barrick completed one monitor well to a depth of more than 2,000 feet near its Cortez Hills gold mining operations. Wells drilled in the Eureka County portion of the basin other than those drilled for the mines typically are less than 400 feet deep (Figure 4-17).

Perennial Yield and Groundwater Rights

The perennial yield of the basin is estimated at 13,000 acre-feet per year. Committed groundwater rights in the basin total 13,317.96 af/yr. These are summarized in Table 4-14a and the PODs for water rights in the Eureka County portion of the basin are depicted in Figure 4-18. From the table, committed underground rights are approximately equal to the perennial yield and the basin is essentially fully appropriated.

Table 4-14a

Committed Groundwater Rights in the Grass Valley Hydrographic Area (HA 138)

Manner of Use	Committed Groundwater Rights (af/yr)	Committed Geothermal Groundwater Rights (af/yr)[a, b]
Irrigation	6,593.48	
Mining and Milling	6,594.83	
Stock water	129.65	
Total	13,317.96	

Source: http://water.nv.gov, accessed 12/04/13

a. Ormat operates a geothermal power plant in southern Grass Valley. There currently is no consumptive use of the geothermal resource; therefore, no water rights are required.

b. Ormat has applications pending for 7,500 af/yr for water for commercial use to provide cooling water to increase the electrical output of the power plant. These are not considered geothermal water rights.

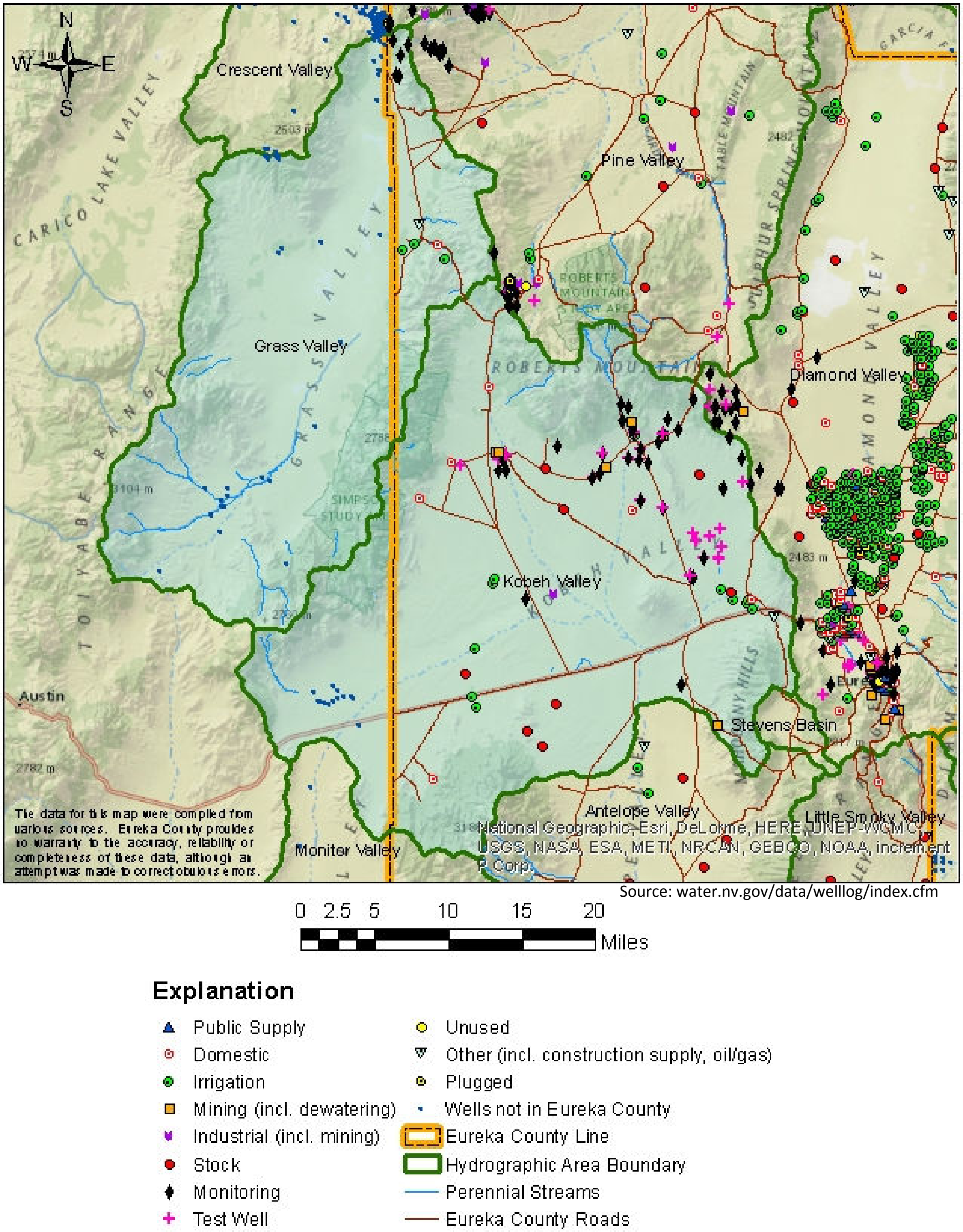


Figure 4-16. Wells in the Grass Valley and Kobeh Valley Hydrographic Areas.

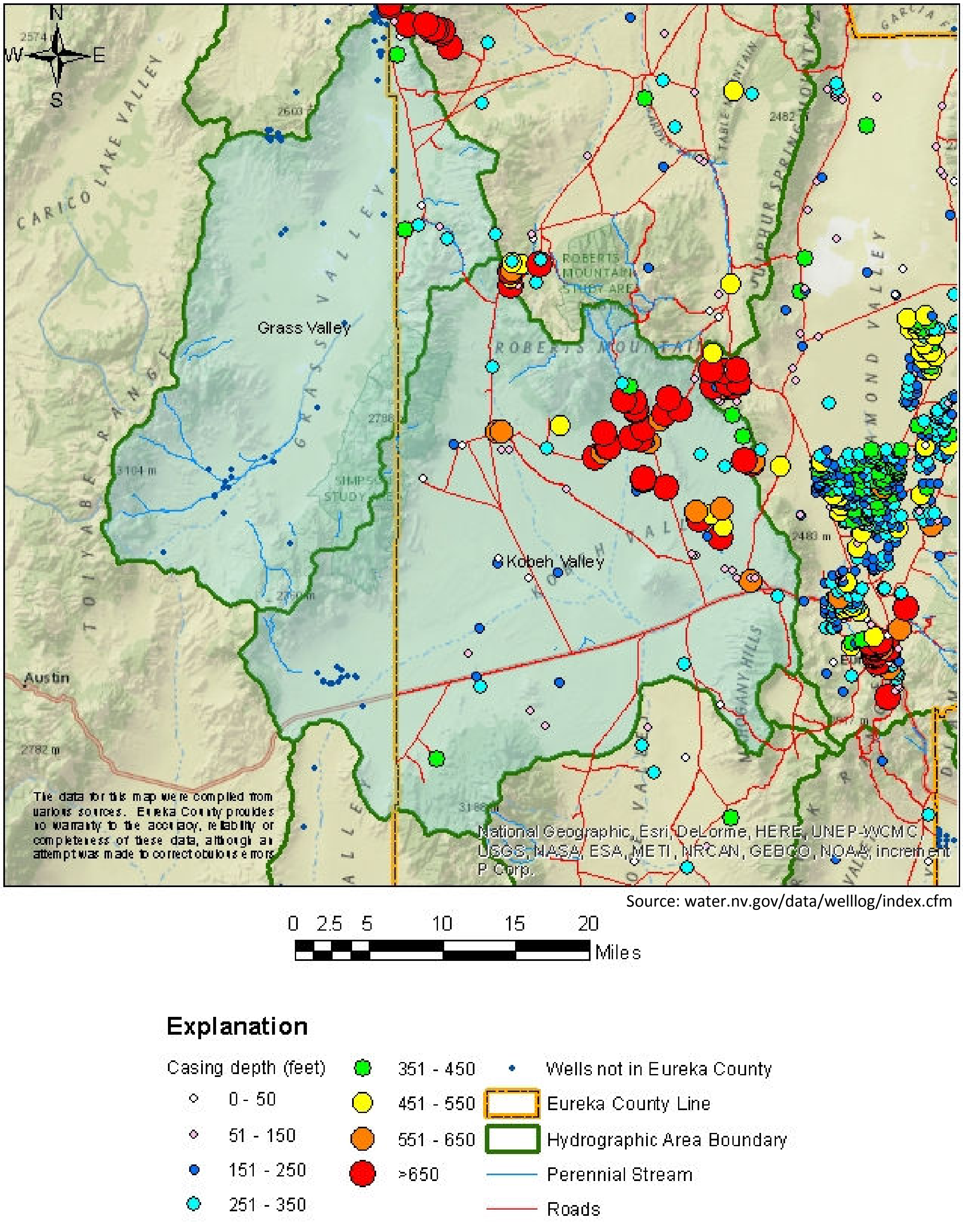


Figure 4-17. Depths of Wells in the Grass Valley and Kobeh Valley Hydrographic Areas.

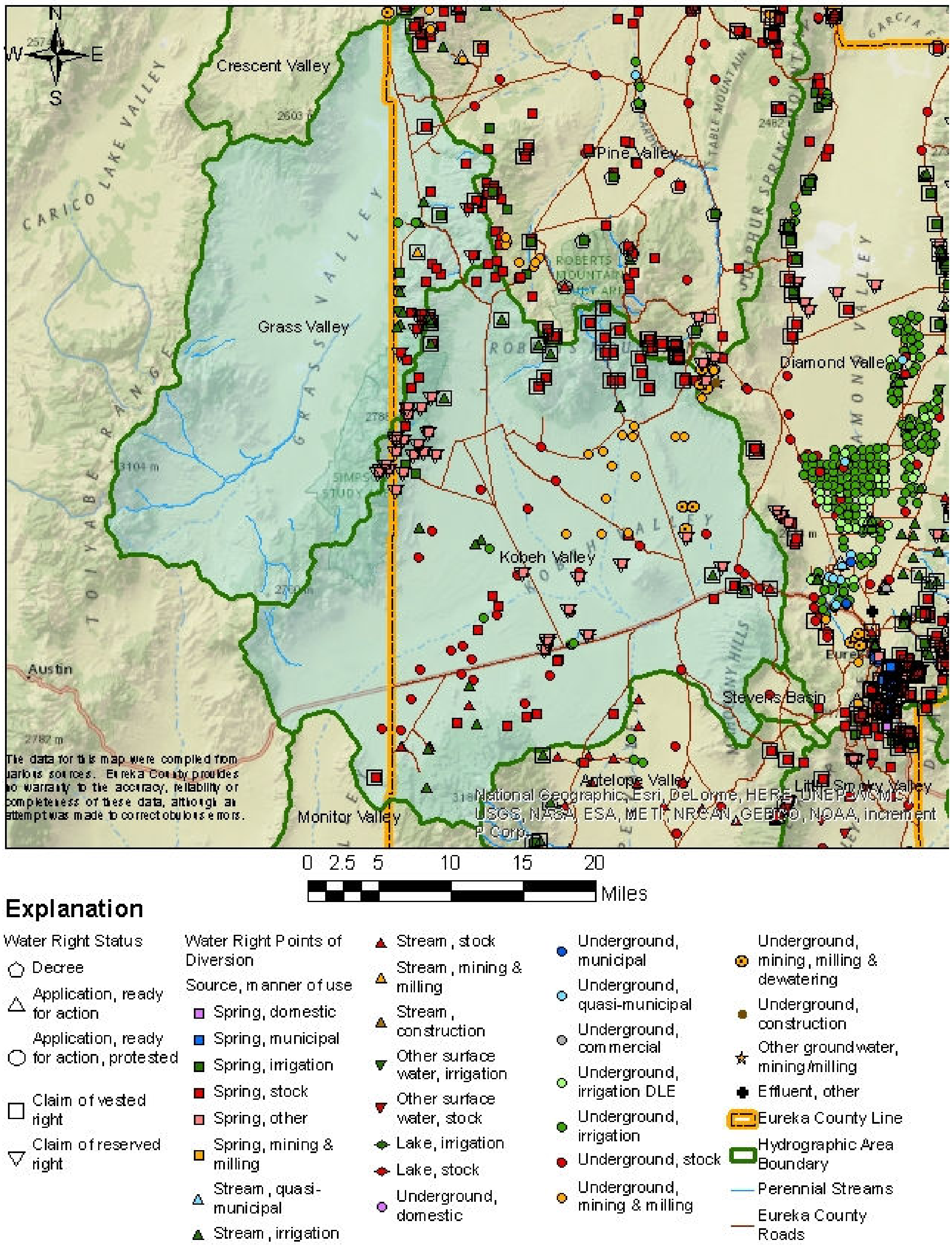


Figure 4-18. Points of Diversion for Water Rights in Eureka County Portion of the Grass Valley and Kobeh Valley Hydrographic Areas.

Groundwater Use

Domestic Water Use

Owing to the small number of residents in the basin, domestic use of groundwater in the basin is very small, likely less than 10 af/yr.

Mine Water use

Current use of groundwater for mining purposes in Grass Valley occurs at Barrick's Cortez Hills mining project. The wells are located in Lander County, a short distance west of the Eureka County line.

Irrigation Water Use

Irrigation water rights in the Eureka portion of the basin account for approximately 17 percent of the total underground irrigation rights in the basin. Irrigation in the Eureka County portion of the basin is concentrated at and near the Nevada Agricultural Experiment Station's Gund Research Ranch in the northeast quadrant of Grass Valley. The largest concentrated use of groundwater for irrigation occurs in the southern portion of the basin in Lander County where 3,742 af/yr of water rights have been appropriated.

Stock Water Use

There are currently water rights totaling approximately 130 af/yr for stock watering purposes. The NSE does not closely track the amount of water used for stock watering purposes. For purposes of the master plan, it is assumed that all 130 af/yr are consumed.

Geothermal Use

Ormat Technologies operates the McGinness Hills geothermal power plant in southern Grass Valley in Lander County. A 30 MW plant, which began operation in June 2012, is air-cooled and re-injects the heat-spent effluent into the aquifer such that use of the geothermal water resource is non-consumptive. However, Ormat has applied for 7,500 af/yr of groundwater rights for cooling purposes which would increase the plant output. Use of groundwater for this purpose would constitute a consumptive use and, if approved would result in over appropriation of the basin. These applications are currently ready for action, but have been protested by the Bureau of Land Management.

Water Level Trends

Water-level data are available from the Nevada Division of Water Resources for a few wells (http://webgis.water.nv.gov). Wells completed in alluvial deposits in the northern portion of the valley show declines of up to approximately 20 feet. The lack of long-term water level data created some uncertainty in the calibration the Grass Valley portion of a transient groundwater model developed by Barrick (Zhan, 2014).

4.4.10.2 Grass Valley HA Surface Water Use

Surface water provides sources of supply for domestic, irrigation and stock water and a few other uses within the basin. Table 4-14b shows the appropriated surface water rights for Grass Valley and the

PODs for the Eureka County portion of the basin are depicted in Figure 4-18. All of the permits for spring and stream sources have been issued certificates. The table does not include 18 claims of vested surface water rights that have not yet been adjudicated.

Of the total surface water rights from springs, 63 per cent of the rights for stock watering and about 10 per cent of the rights for irrigation are within Eureka County. Of the total water rights from streams, 71 percent of the irrigation rights and 100% of the stock water rights are in Eureka County.

Table 4-14b

Committed Surface Water Rights in the Grass Valley Hydrographic Area (HA 138)

Manner of Use	Committed Surface Water Rights (af/yr or af/season)
Springs	
Irrigation	2,008
Stock	188
Streams	
Irrigation	3,405
Stock	40
Note: Rounded to the nearest acre-foot.	

4.4.11 Kobeh Valley Hydrographic Area (HA 139)

The Kobeh Valley Hydrographic Area (HA 139) is located in southwestern Eureka County (Figures 4-4 and Figure 4-18) and is shared with Lander County to the west. The basin encompasses 868 square miles, of which 735 square miles (84%) are within Eureka County. A dominant feature of the valley is Roberts Mountain in the north.

Kobeh Valley is part of the Diamond Valley Flow System, which includes Monitor Valley (North and South Parts), Antelope Valley, Stevens Basin, and Diamond Valley. Data indicate that groundwater flows from Monitor and Antelope Valleys into Kobeh Valley where most groundwater is discharged by phreatophytes in the southern portion of the valley. The remainder is believed to flow eastward to Diamond Valley through alluvium and bedrock at Devils Gate and through bedrock north of Whistler Peak. Diamond Valley is the terminus of the flow system (Tumbusch and Plume, 2006).

Stoneberger Creek is a dry wash that links northern Monitor Valley with southwestern Kobeh Valley. Antelope Wash links northern Antelope Valley with southeastern Kobeh Valley. During wet years or following intense thunderstorms, there is a possibility of surface water flow from these adjacent basins into Kobeh Valley. Slough Creek is a dry wash in southeast Kobeh Valley that occasionally carries surface from Kobeh Valley to Diamond Valley through Devil's Gate.

4.4.11.1 Kobeh Valley HA Groundwater Use

Wells

The State well log database provides records for 113 wells in the basin of which 99 were drilled in the Eureka County portion of the basin (see Figure 4-16). Of the total number of wells, 11 have been plugged and formally abandoned, such that there approximately 100 active wells in the basin.

Of the total number of wells in the basin, nearly two thirds have been drilled by the mining industry. Most of these were reportedly drilled for monitoring purposes on behalf of General Moly's Mount Hope Project either by them or their predecessors, followed by a number of wells drilled to explore for groundwater supplies. These wells were also primarily drilled in relation to the Mount Hope Project and all were used to acquire data regarding groundwater conditions in the basin. No production wells have yet to be constructed for the Mount Hope Project as of the summer of 2014. Production wells and monitoring wells were drilled for and utilized by Atlas's Gold Bar Mine, but these have been inactive for more than a decade. A test well and an observation well were drilled near Roberts Creek by McEwen Mining for their project at the former Gold Bar property.

There are reports for 24 irrigation wells in the basin, of which half are located in the Eureka County portion of the basin. The others are located in the Lander County portion of the basin at the Bobcat Ranch and are currently owned by Kobeh Valley Ranches (KVR), the entity which reportedly exists solely to provide water to the Mount Hope Project. The wells at the Bobcat Ranch now owned by KVR are not presently active as virtually all the original water rights associated with them were transferred to the points of diversions for the proposed Mount Hope Project well field in eastern Kobeh Valley and all irrigation equipment was moved from the property. However, the NSE recently approved new appropriations by KVR for irrigation at the Bobcat Ranch and there is some chance that irrigation there may restart.

The well log database shows nine stock water wells, eight of which are located in the Eureka County portion of the basin. There are reports of seven domestic wells in the basin, six of which are located in Eureka County.

Well depths vary from less than 50 feet to more than 1,000 feet (see Figure 4-17). The shallower wells primarily represent monitoring wells drilled by the USGS in the phreatophyte area in the southern portion of the basin. The deeper wells are mostly associated with groundwater exploration and monitoring at the Mount Hope Project. Irrigation wells are all located on the valley floor, drawing groundwater from alluvial deposits and are typically less than 350 feet deep. Stock water wells have been drilled to depths of less than 300 feet. Depths of domestic wells reportedly vary from less than 50 feet to 350 feet.

Perennial Yield and Groundwater Rights

Kobeh Valley is a part of the Diamond Valley flow system which includes Monitor Valley (North and South Portions), Kobeh Valley, Antelope Valley, Stevens Basin, and Diamond Valley. Data suggest that groundwater flows into Kobeh Valley from Monitor and Antelope Valleys, thence to Diamond Valley, the terminus of the flow system. The Nevada State Engineer estimates the perennial yield of the basin at

16,000 acre-feet per year, of which 1,000 af/yr is reserved to account for inter-basin flow eastward into Diamond Valley through localized more permeable portions of the bedrock in the mountains, such that the NSE recognizes the perennial yield of Kobeh Valley to be effectively 15,000 af/yr. This quantity equates to the amount of groundwater discharged from phreatophytes in the southern portion of the basin.

Groundwater resource exploitation to date is mostly confined to the alluvial aquifer where water has historically been exploited for irrigation, stock water and mining. More recently there has been a concerted effort to explore for groundwater to develop a source of supply to the Mount Hope Project. While the primary source of water to the mine is expected to be derived from the alluvial deposits, approximately 10 per cent is planned to be derived from carbonate rocks south of Roberts Mountain. Groundwater will be also derived from the pit area located at the divide between Kobeh Valley and Diamond Valley to the east. Carbonate rocks crop out in the mountains and underlie alluvium at depth throughout the valley, although at shallower depths near Roberts Mountain. Exploration efforts in the carbonates suggest that they are subdivided into structural blocks at this locale with limited amounts of water in storage, although wells might be pumped at large rates, albeit for a short period of time.

Committed groundwater rights in the basin total 19,476.10 af/yr. These are summarized in Table 4-15a and the PODs for water rights in the Eureka County portion of the basin are depicted in Figure 4-18. Assuming a perennial yield of 15,000 af/yr, the basin is over-appropriated by 4,476.10 af/yr. However, the senior staff of the NSE considers a large proportion of the mining water rights to be temporary such that these rights will revert back to the source once the mining projects have concluded and, therefore, are available for appropriation by others.

Table 4-15a

Committed Groundwater Rights in the Kobeh Valley Hydrographic Area (HA 139)

Manner of Use	Committed Groundwater Rights (af/yr)
Irrigation	7,381.40
Mining and Milling	11,800.00
Stock water	294.70
Total	19,476.10

Source: http://water.nv.gov, accessed 12/04/13

Groundwater Use

Domestic Water Use

Owing to the small number of residents in the basin served by individual domestic wells, domestic use of groundwater in the basin is believed to be minor, possibly in the range of 10 to 20 af/yr.

Mine Water use

Previous use of groundwater in the basin for mining purposes was at the Gold Bar mine operated by Atlas Precious Metals, Inc., but that mining operation ceased in 1994. Most of the water rights in the basin for mining purposes (11,300 af/yr) are held by KVR exclusively for use at the Mount Hope Project as of early 2014. If the project moves forward all of this water would be exported from the basin to the mill located in Diamond Valley where it would be used in the milling circuit. A slurry of waste tailings would be returned to Kobeh Valley. However, development of the mine is currently on hold, such that there is virtually no groundwater currently used for mining purposes, except, perhaps a small amount related to exploratory drilling. In addition to KVR, McEwen Mining holds water rights totaling 500 af/yr for mining and milling purposes.

Irrigation Water Use

Prior to the acquisition of the irrigation rights in Kobeh Valley by Kobeh Valley Ranches for transfer to the Mount Hope Project, the NSE estimated 5,770 af/yr were pumped for irrigation purposes (reference: NSE, 2006: 2006 Crop Inventory and Groundwater Pumpage Inventory from Irrigation – Kobeh Valley, Basin 139). Since that time, irrigation has been reduced by more than 90 percent. The 2012 crop inventory prepared by the office of the Nevada State Engineer showed all irrigation in Kobeh Valley occurred in the Eureka County portion of the basin and that a total of 357 acre-feet of groundwater was applied to the land for irrigation purposes (NSE, 2012). This water originated from uncontrolled flowing artesian wells in the southern portion of the valley north of Highway 50. Water rights for irrigation totaling 1,120 af/yr were approved by the NSE in summer 2014. The wells for these permits are older, flowing artesian wells that had been flowing uncontrolled contrary to state law since water rights were transferred from them to KVR in 2010.

Stock Water Use

There are currently groundwater rights in Kobeh Valley totaling approximately 295 af/yr for stock watering purpose, equating to approximately two percent of the water resources in the basin. The NSE does not closely track the amount of water used for stock watering purposes. For purposes of the master plan, it is assumed that all 295 af/yr are consumed either by livestock or the burgeoning population of horses outside of horse management areas.

<u>Water Level Data Trends</u>

Water level data from wells indicate that water levels in most of Kobeh Valley are relatively stable, showing no long-term declines, with some exceptions. These exceptions relate to exploration wells drilled to derive groundwater from the carbonate rocks. An illustrative example is Well “206T”, constructed and test pumped for the Mount Hope Project. Following a 32-day aquifer stress (pumping tests) water levels in did not recover to pre-testing elevations. Instead, levels have been declining at approximately 1.5 feet per year since early 2012, more than eight feet. Several potential causes have been suggested, including variations in recharge resulting from climate variability and drawdown due to pumping in Diamond Valley. If the latter is occurring, the changes in level would support a hydraulic connection between Kobeh Valley through the bedrock north of Whistler Peak and inter-basin groundwater flow from Kobeh to Diamond Valley. Another exception is a localized cone of depression of more than 20 feet in the vicinity of the Bobcat Ranch in the southwestern portion of the basin caused by previous agricultural pumping in this area. After water rights were transferred from the ranch and irrigation ceased, water levels there began to rise, but irrigation resumed in the summer of 2015 and water levels in the alluvial aquifer in this part of the basin are expected to decline.

Near Mt Hope, water levels in some monitoring wells have shown an increase in elevation (Eureka Moly, 2015). The cause for this rise is unclear, but might be result from increased localized groundwater recharge arising from clearing juniper and pinion near the waste rock dumps for the proposed molybdenum mine.

4.4.11.2 Kobeh Valley HA Surface Water Use

Surface water flows from springs and streams in Kobeh Valley have been appropriated as sources of supply for irrigation and stock water within the basin. Permitted or certificated surface-water rights exist or claims of vested surface-water rights have been filed on the following:

- Streams originating on the south and west slopes of the Roberts Mountains - Roberts Creek, Rutabaga Creek, East Cottonwood Creek, Meadow Canyon Creek and Jackass Creek.
- Streams originating on the east slope of the Simpson Park Range - Ferguson Creek, Hickison Creek and an unnamed stream between Snow Water Canyon and West Cottonwood Creek arising from the flow of Fagan Spring.
- Streams originating on the northwest flank of Summit Mountain at the north end of the Monitor Range – Willow Creek, Kelly Creek, and Reynolds Creeks.

Table 4-15b summarizes the appropriated surface water rights for Kobeh Valley and the PODs for surface water rights in the Eureka County portion of the basin are plotted on Figure 4-18. All of the permits for spring and stream sources have been issued certificates. Not included in Table 4.15b are claims of vested water rights for stock water from spring and stream sources that have not yet been adjudicated and reserved rights claimed by the BLM totaling more than 5,500 af/yr (Interflow Hydrology, 2011). Of the total surface water rights from springs, 97 per cent of the rights for stock watering and about 95 per cent of the rights for irrigation are within Eureka County. Of the total water rights from streams, 95 percent of the irrigation rights and 100% of the stock water rights are in Eureka County.

Table 4-15b

Committed Surface Water Rights in the Kobeh Valley Hydrographic Area (HA 139)

Manner of Use	Committed Surface Water Rights (af/yr or af/season)
Springs	
Irrigation	529
Stock	280
Streams	
Irrigation	1,878
Stock	21
Notes: 1. Rounded to the nearest acre-foot 2. Source: HA139 Basin Abstract	

4.4.12 Monitor Valley (Northern Part) Hydrographic Area (HA 140A)

The Monitor Valley (Northern Part) Hydrographic Area (HA 140A) is located in the very southwestern corner of Eureka County (Figures 4-4 and 4-19) and is shared with Lander County to the west and Nye County to the south. The basin encompasses 529 square miles, of which 96 square miles (18%) are within Eureka County.

Monitor Valley is part of the Diamond Valley Flow System, which includes Kobeh Valley, Antelope Valley, Stevens Basin, and Diamond Valley. Data indicate that groundwater flows from Monitor and Antelope Valleys northward into Kobeh Valley where most groundwater is discharged by phreatophytes in the southern portion of the valley. The remainder is believed to flow eastward to Diamond Valley through alluvium and bedrock at Devils Gate and through bedrock north of Whistler Peak.

Wells

The well log data base available from the NSE shows drillers' reports for 12 wells. Of these, none are reported to have been drilled in the Eureka County portion of the basin. (Figure 4-19). In the other portions of the basin, most wells (7) were reportedly drilled for stock watering purposes, four were drilled as sources of domestic supply, and one was drilled for irrigation purposes.

Depths of water wells in the basin reportedly range from 74 feet to 400 feet, with an average of 175 feet (Figure 4-20).

Perennial Yield and Water Rights

The estimated perennial yield of the basin is 8,000 af/yr. This includes 2,000 af/yr of groundwater inflow from southern Monitor Valley. An estimated 6,000 af/yr of the total estimated perennial yield of the basin is believed to exit the basin as underflow to Kobeh Valley. Groundwater rights totaling 280.78 af/yr are summarized in Table 4-16a. Figure 4-21 shows no PODs for permitted or certificated water rights in the Eureka County portion of the basin; only PODs for claims of vested rights that have yet to be determined. Comparing the estimated perennial yield of 8,000 af/yr with the committed groundwater rights in the basin shows groundwater use is substantially less than the estimated perennial yield. It may not be possible to appropriate all of this estimated perennial yield because 75% exits the basin as underflow to Kobeh Valley, which is nearly fully appropriated at this time. Capturing the perennial yield in Monitor Valley would intercept recharge to Kobeh Valley that provides a basis of the perennial yield.

Table 4-16a

Committed Groundwater Rights in the Monitor Valley (North Part) Hydrographic Area (HA 140A)

Manner of Use	Committed Water Rights (af/yr)
Irrigation	175.12
Stock water	105.66
Total	280.78
Source: NDWR Hydrographic Area Summary	

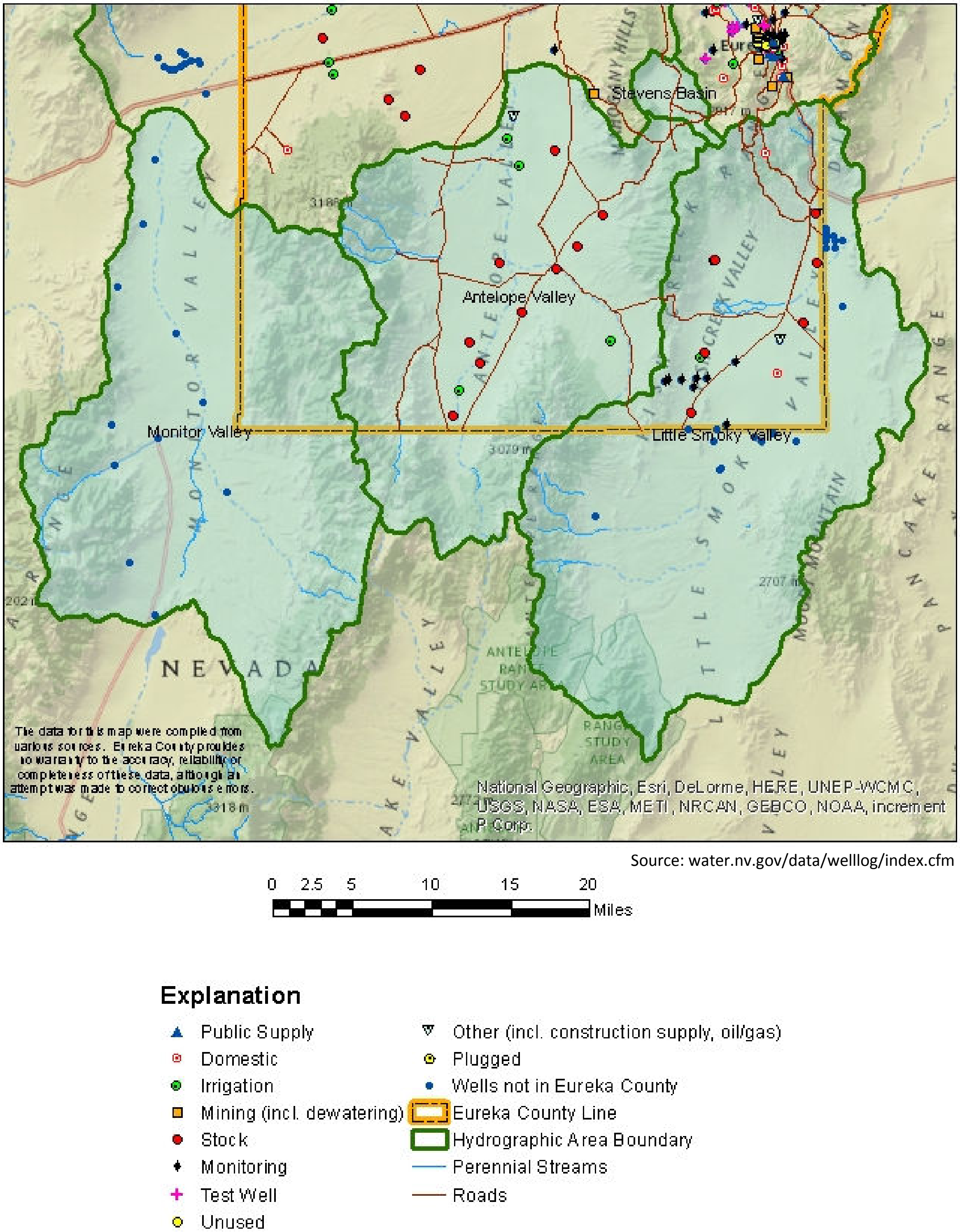


Figure 4-19. Wells in the Monitor Valley (North Part), Antelope Valley, Stevens Basin and Little Smoky Valley Hydrographic Areas.

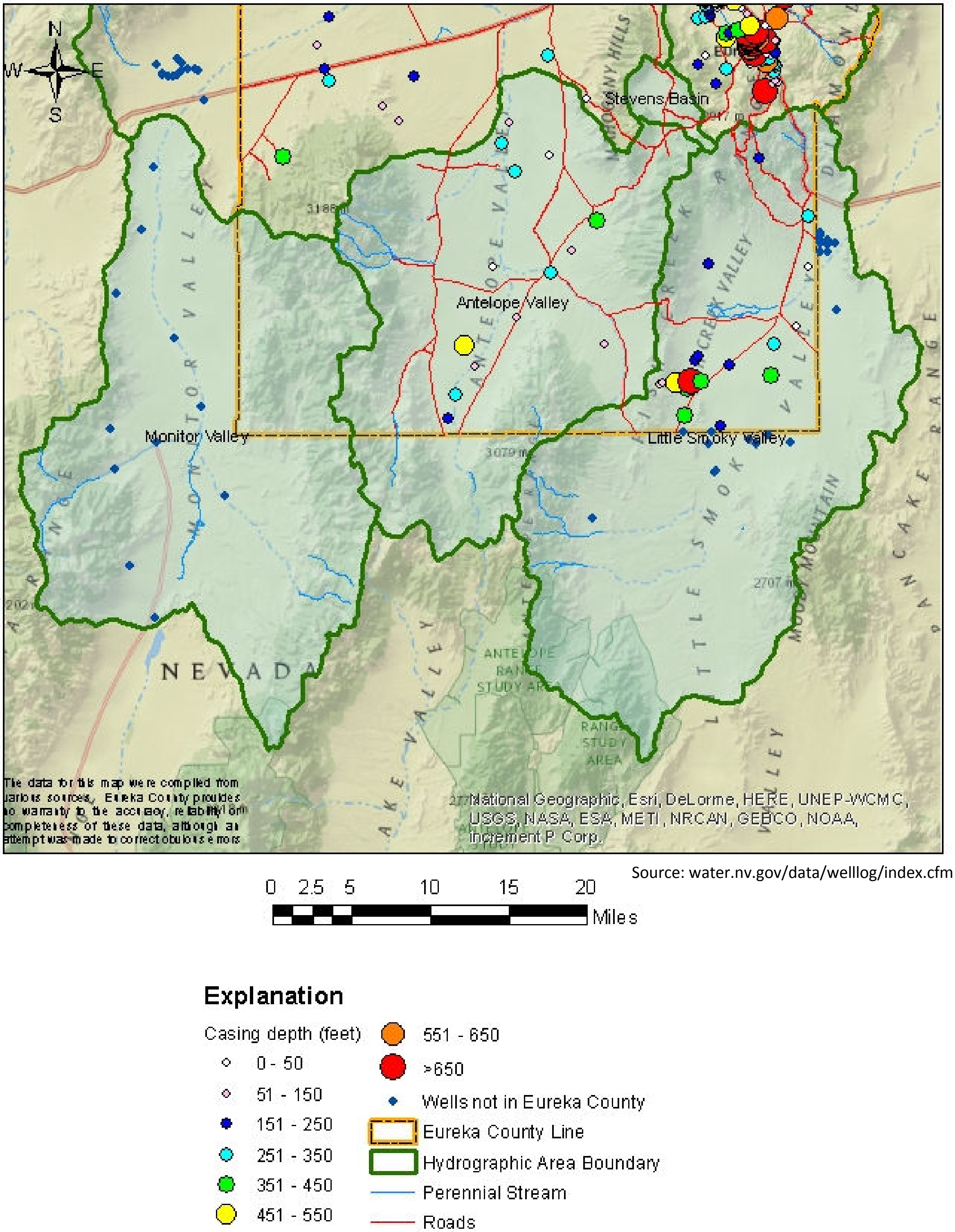


Figure 4-20. Depths of Wells in the Monitor Valley (North Part), Antelope Valley, Stevens Basin and Little Smoky Valley Hydrographic Areas.

4.4.12.1 Monitor Valley (Northern Part) HA Groundwater Use

Groundwater Use

Given that groundwater has been appropriated in an amount equal to about only 3.5 percent of the estimated perennial yield of the basin, the groundwater resources of the valley are largely untapped, although there are no records of the current groundwater usage. For the purposes of the Master Plan, it is assumed that all of the permits are exercised to the fullest such that approximately 281 af/yr are consumed. There are no groundwater rights on file for the Eureka County portion of the basin.

Irrigation Use

Because the NSE does not monitor groundwater usage in the basin, for purposes of the Master Plan, it is assumed that approximately 175 af/yr of water rights are consumed in Monitor Valley for irrigation purposes, but that none of this use occurs in the Eureka portion of the basin.

Stock Water Use

The NSE does not monitor water used to water livestock. For purposes of the Master Plan it will be assumed that all 106 af/yr of groundwater for which there are stock water permits is consumed.

Water Level Trends

The limited water level data for Northern Monitor Valley show that water levels remain stable (http://webgis.water.nv.gov). The fact that groundwater elevations are generally stable is consistent with the small amount of groundwater that has been put to use.

4.4.12.2 Monitor Valley (Northern Part) HA Surface Water Use

Surface water from springs and streams in the Northern Part of Monitor Valley has been appropriated as sources of supply for irrigation and stock water within the basin. Surface water rights are summarized in Table 4-16b and PODs are shown in Figure 4-21. The Northern Part of Monitor Valley is somewhat unique in that the amount of water for which claims of vested water rights have been filed exceeds the total of appropriated groundwater and surface water rights. These claims have yet to be adjudicated.

A total of 16 claims of vested water rights have been filed on streams in Northern Monitor Valley and 47 claims of vested water rights have been filed on springs. These claims have yet to be adjudicated, but could potentially total several thousand acre-feet per year of surface water for irrigation and stock water. Of these, only four claims of vested water rights to springs have been filed in Eureka County totaling approximately 50 af/yr (see Figure 4-21).

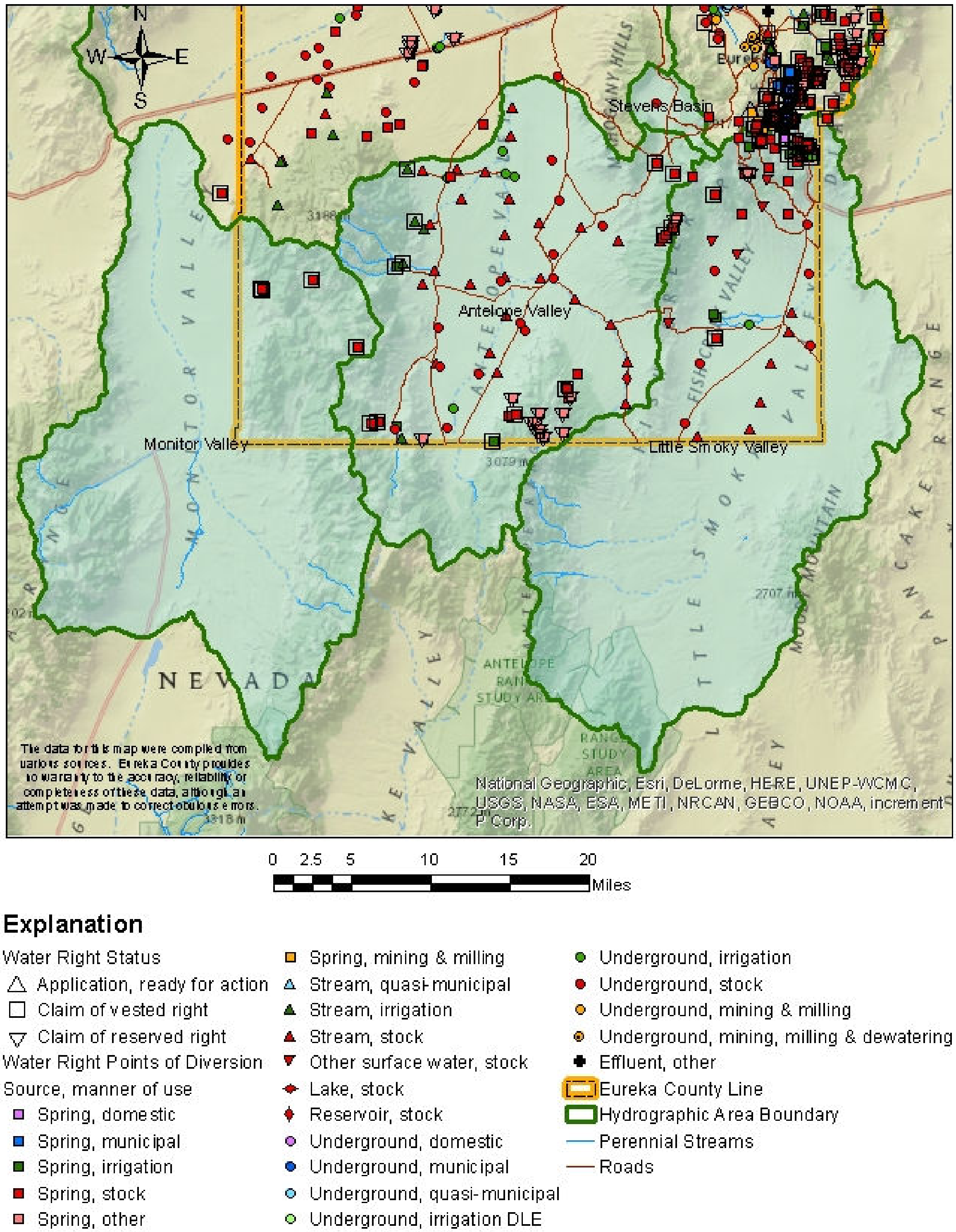


Figure 4-21. Points of Diversion for Water Rights in the Monitor Valley (North Part), Antelope Valley, Stevens Basin and Little Smoky Valley Hydrographic Areas.

Table 4-16b

Committed Surface Water Rights in the Monitor Valley (Northern Part) Hydrographic Area (HA 140A)

Manner of Use	**Committed Surface Water Rights** (af/yr or af/season)
Springs	
Irrigation	11
Stock	8
Streams	
Irrigation	46
Stock	7
Reservoir	
Stock	4
Notes: 1. Rounded to the nearest acre-foot 2. Source: HA139 Basin Abstract	

4.4.13 Antelope Valley Hydrographic Area (HA 151)

The Antelope Valley Hydrographic Area (HA 061) is located in south central Eureka County, south of Highway 50 (Figure 4-4 and 4-21). The basin is situated east of Monitor Valley, south of Kobeh Valley and southwest of the Town of Eureka. It encompasses 444 square miles, of which 383 square miles (86%) are within Eureka County, with the remainder in Nye County to the south.

Antelope Valley is part of the Diamond Valley Flow System, which includes Monitor Valley (North and South Parts), Kobeh Valley, Stevens Basin, and Diamond Valley. Groundwater flow in the basin is from the mountains toward the basin axis, then to the north where it approaches the land surface in the area of Kitchen Meadow and is discharged by phreatophytes. It is unclear why the water table approaches the land surface near Kitchen Meadow. Easterly-trending faults which might act to impede groundwater flow have been postulated as one possible cause, but there is no surface expression of such faults in this area. Alternatively, a decrease in the permeability of the alluvial deposits could effectively dam up the groundwater flow. Regardless of the cause, the amount of groundwater that bypasses the phreatophyte discharge area and flows from Antelope Valley to Kobeh Valley is believed to be small. There is also an indication of inter-basin flow to the east through the Fish Spring Range toward the Fish Spring Valley where it is thought to contribute to the discharge of Fish Creek Springs.

The principal perennial stream in the basin is Allison Creek which originates in the Monitor Range to the west of the valley. Antelope Wash links northern Antelope Valley with southern Kobeh Valley. Most years, there is no flow to the north, but during wet years or following intense thunderstorms, there is a possibility of surface water flow into Kobeh Valley and thence via Slough Creek from Kobeh Valley to Diamond Valley through Devil’s Gate.

4.4.13.1 Antelope Valley HA Groundwater Use

Wells

The State well log database provides records for 15 water wells in the basin, all of which have been drilled in the Eureka County portion (see Figure 4-19). There is currently no groundwater resource development via wells reported for the Nye County portion of the basin. Of the total number of wells reported in the basin, nearly two thirds were reportedly drilled for stock water, four for irrigation and only one drilled for domestic purposes.

Well depths vary from less than 50 feet to 520 feet; with an average depth of 193 feet (see Figure 4-20). These wells apparently derive groundwater solely from the basin-fill deposits.

Perennial Yield and Groundwater Rights

Antelope Valley is a part of the Diamond Valley flow system which includes Monitor Valley (North and South Portions), Kobeh Valley, Stevens Basin, and Diamond Valley. Data suggest groundwater flows into Kobeh Valley from Monitor and Antelope Valleys, thence to Diamond Valley, the terminus of the flow system. The Nevada State Engineer estimates the perennial yield of the basin at 4,000 acre-feet per year. This quantity is approximately equal to the amount of groundwater discharged from phreatophytes in the southern portion of the basin.

Committed groundwater rights in the basin total 3,063.18 af/yr. These are summarized in Table 4-17a and PODs for the Eureka County portion of the basin are shown in Figure 4-21. Assuming a perennial yield of 4,000 af/yr, there are approximately 900 af/yr of groundwater that might be appropriated before the perennial yield becomes fully appropriated.

Table 4-17a

Committed Groundwater Rights in the Antelope Valley Hydrographic Area (HA 151)

Manner of Use	**Committed Groundwater Rights** (af/yr)
Irrigation	2,905.64
Stock water	157.54
Total	3,063.18
Source: http://water.nv.gov, accessed 12/04/13	

Groundwater Use

The largest permitted use of groundwater in the basin is for irrigation, followed by stock water. There currently are no groundwater rights to other uses in the basin.

Irrigation Use

The largest use of groundwater for irrigation in the basin, approximately two-thirds of the total irrigation rights, are located in the southern one-third of the basin in southernmost Eureka County and northernmost Nye County. The NSE does not closely monitor groundwater use in the basin, such that the amount of groundwater actually put to use for irrigation is unknown. Assuming all of the permitted water rights are put to use, perhaps as much as 2,900 af/yr are currently used.

Stock Water Use

The NSE does not closely monitor stock water use. For purposes of the Master Plan it will be assumed that all 106 af/yr of groundwater for which there are stock water permits is consumed.

Water Level Trends

The limited water level data for Antelope Valley show that water levels have changed little. For the most part, water levels have changed less than 10 feet.

4.4.13.2 Antelope Valley HA Surface Water Use

Table 4-17b lists the committed surface water rights in the basin and PODs for the Eureka County portion of the basin are plotted in Figure 4-21. Surface water rights have been appropriated from Allison Creek, Cedar Creek, Copenhagen Creek, Meadow Canyon Creek, Antelope Valley Wash, Fenstermaker Wash, Sagehen Creek, and Fish Creek Well Canyon Creek. Of the total stock water rights from spring sources, approximately 84 per cent are in Eureka County and of the total stock water rights from streams, more than 95 percent are in Eureka County. Of the total land for which stream flow has been appropriated for irrigation, approximately 80 per cent is located in Eureka County, with the remainder Nye County.

Table 4-17b does not include 31 claims of reserved water rights to springs by the BLM, totaling about 543 af/yr. Approximately 80 per cent of these claims are located in Eureka County. It also does not include claims of vested water rights that have not yet been adjudicated. These include four claims of vested water rights from springs for irrigation purposes, of which 78 per cent of the claimed irrigated land is located just south of the Eureka County line in Nye County. Likewise, Table 4-17b does not include 17 undetermined claims of vested rights from springs. These are divided roughly equally between Eureka and Nye Counties.

Table 4-17b

Committed Surface Water Rights in the Antelope Valley Hydrographic Area (HA 151)

Manner of Use	Committed Surface Water Rights (af/yr or af/season)
Springs	
Irrigation	182
Stock	516
Streams	
Irrigation	78
Stock	192
Reservoir	
Stock	4

Notes: 1. Rounded to the nearest acre-foot
2. Source: HA151 Basin Abstract

4.4.14 Stevens Basin Hydrographic Area (HA 152)

The Stevens Basin Hydrographic Area (HA 152) is located in southeastern Eureka County, south of the Town of Eureka (Figures 4-4 and 4-21). Of the 16 hydrographic areas in the County's Water Resources planning area, it is the only basin located entirely in Eureka County. It is also the smallest of the hydrographic areas at only 17 square miles. The basin is closed such that surface water drains to the small playa at the center of the basin and there is no means for surface water to exit the basin. Groundwater that originates as precipitation falling within the basin must exit as inter-basin flow because there is no groundwater discharge area in the basin. The depth of water beneath the valley floor is too deep for phreatophytes and no springs discharge groundwater to the surface.

Wells

The State well log database provides no records of any Driller's Reports filed for any wells in Stevens Basin. However, one well has been constructed in the basin on the valley floor near the playa and limited information is available from the application for a water right associated with this well (Application Number 6972). Its depth is reported to be 566 feet and the depth to groundwater in the well is reported to be 460 feet below the land surface.

Perennial Yield and Groundwater Rights

Stevens Basin is a part of the Diamond Valley flow system which includes Monitor Valley (North and South Portions), Kobeh Valley, Antelope Valley, and Diamond Valley. Because the depth to groundwater is more than 400 feet below the valley floor and there are no groundwater discharge areas in the basin, all groundwater originating in the basin by default must flow out of the basin. It has been hypothesized that groundwater flows either to Antelope or Diamond Valley, but data are inadequate to make a reasoned determination as to the fate of the groundwater recharge. The Nevada State Engineer currently estimates the perennial yield of the basin at 100 acre-feet per year, although the initial estimate by the USGS was 200 af/yr. The rationale for downgrading the perennial yield is unclear.

4.4.14.1 Stevens Basin HA Groundwater Use

Committed groundwater rights in the basin total 19.27 af/yr. These are summarized in Table 4-18a and the POD for the sole water right in the basin is shown in Figure 4-21. Assuming a perennial yield of 100 af/yr, there are approximately 80 af/yr of groundwater that might be appropriated before the perennial yield has been fully appropriated. Eureka County recently applied for 75 af/yr of water for municipal use, but the application has not progressed far enough to be included in Figure 4-21.

Table 4-18a

Committed Groundwater Rights in the Stevens Basin Hydrographic Area (HA 152)

Manner of Use	Committed Groundwater Rights (af/yr)
Municipal	73
Stock water	27
Total	100
Source: http://water.nv.gov, accessed 12/04/13	

Groundwater Use

Groundwater use in Stevens Basin is currently limited to stock water use. It is unknown whether all of the stock water permitted is actually being put to use. However, for purposes of the County's Water Resource Master Plan, it is assumed all of this water is currently in use. Eureka County has explored for a municipal supply in the basin, but, to date, none of the water appropriated by them has been put to use.

Water Level Trends

Only one water level measurement exists for the one well in the basin. Consequently, there are no data with which to determine whether or not there is any trend to groundwater levels in the basin. Given the very small proportion of the water resources in the basin that have been exploited, it is unlikely that levels have changed significantly, except in response to variability of the climate.

4.4.14.2 Stevens Basin HA Surface Water Use

The National Hydrography Database does not identify any seeps, springs or perennial streams in the basin. Not surprisingly, the records of the Nevada State Engineer show that no surface water rights have been appropriated in the basin and there are no claims of vested surface water rights (see Figure 4-21).

4.4.15 Little Smoky Valley (North Part) Hydrographic Area (HA 155A)

The Little Smoky Valley (North Part) Hydrographic Area (HA 155A) is located in southeastern corner of Eureka County (Figure 4-4 and 4-21) and is shared by White Pine and Nye Counties. The basin, situated southeast of the town of Eureka, encompasses 591 square miles, of which 383 square miles are within Eureka County. The basin is semi-closed. That is, surface water drainage is from the mountains toward the axis of the valley, then northward into Newark Valley via an ephemeral stream channel. Groundwater is also believed to flow from the North Part of Little Smoky Valley through the basin-fill deposits to Newark Valley.

4.4.15.1 Little Smoky Valley (North Part) HA Groundwater Use

Wells

The State well log database provides records for 47 water wells in the basin, of which 25 are identified as having been constructed in the Eureka County portion of the basin (see Figure 4-19). Seven wells have been plugged and formally abandoned or did not encounter water, such that only 40 wells may be in use at the present. Twelve wells have been drilled for monitoring purposes and these are mostly related to the Gibellini Vanadium Mining Project located in Eureka County a short distance north of the Eureka-White Pine County Line. Twelve wells reportedly provide sources of domestic supply for individual residences and twelve more reportedly were drilled for irrigation. The records also indicate nine wells drilled for stock watering purposes. One well apparently was drilled as a source of water supply for an exploratory oil well drilling operation.

The deepest water well in the basin is completed to a depth of 748 feet. Average well depth is 223 feet (see Figure 4-20).

Perennial Yield and Groundwater Rights

Recharge to the northern part of Little Smoky Valley arising from infiltration of precipitation falling within the basin is estimated at 4,000 acre-feet per year (Rush and Everett, 1966). An estimated 2,000 acre-feet of recharge is ascribed to subsurface inflow from Antelope Valley, bringing the total estimate of recharge to the basin to 6,000 af/yr.

Historical discharge from the basin includes an estimated 1,900 acre-feet per year from phreatophytes, 3,300 af/yr of spring discharge consumed by irrigated crops and meadow grasses, and 1,000 af/yr of underflow toward the north to Newark Valley (*Id.*). Given that 1,000 af/yr of the total discharge represents outflow to Newark Valley, the NSE estimates the perennial yield to be 5,000 af/yr.

Committed groundwater rights in the basin total 5,055.65 af/yr. These are summarized in Table 4-19a and the PODs for water rights in the Eureka County portion of the basin are illustrated in Figure 4-21. Comparison of the total committed rights to the estimated perennial yield shows the basin to be fully appropriated. However, as discussed below, depending how spring discharge is incorporated into the basin water budget, it might be viewed that the basin is over appropriated by perhaps 20 percent.

Table 4-19a

Committed Groundwater Rights in the Little Smokey Valley Hydrographic Area (HA 155A)

Manner of Use	Committed Groundwater Rights (af/yr)
Irrigation (including DLE)	4,937.02
Stock water	117.97
Total	5,055.65
Source: http://water.nv.gov, accessed 12/04/13	

Groundwater Use

The largest permitted use of groundwater in the basin is irrigation, followed by stock water. There currently are no groundwater rights for other uses in the basin.

Irrigation Use

Only a small amount of groundwater (50.96 af/yr) is presently permitted for irrigation in the Eureka County portion of the basin. There is also a small amount of groundwater (127.92 af/yr) permitted for irrigation use in the Nye County portion of the basin. The largest use of groundwater for irrigation in the basin is located in White Pine County immediately east of the Eureka County line, where approximately 1,700 acres of land are irrigated. At a net irrigation requirement of 2.8 acre-feet per acre for alfalfa, it is estimated that irrigation consumes approximately 4,800 acre-feet of groundwater pumped from wells in the basin, which is less than the perennial yield. However, Fish Springs in the Eureka County portion of the basin discharges approximately 4,000 af/yr of groundwater, although this groundwater discharge is administered by the NSE as surface water. Of this spring discharge, approximately 3,300 af/yr is estimated to be consumed (Rush and Everett, 1966), bringing the total amount of groundwater consumed in the basin as a result of irrigation to approximately 7,000 af/yr, which is more than the 5,000 af/yr the NSE assumes for the perennial yield, although some of this discharge might originate as inter-basin flow. The irrigation wells located northeast of Fish Springs are situated such that they might capture the groundwater outflow to Newark Valley. Therefore, irrigation in the basin may be consuming somewhat more groundwater than the estimated perennial yield.

Stock Water Use

Approximately 118 af/yr of groundwater has been appropriated for stock watering purposes. The NSE does not closely monitor groundwater used to water livestock and for purposes of the Water Resources Master Plan it is assumed that in an average year, all of the water rights for this purpose are consumed.

Water Level Trends

Long term water level data are available from four wells located in White Pine County just east of the Eureka County Line. Water levels in these wells show some variability, but a very small downward trend, less than a few tenths of a foot per year on average, is apparent. Given the small changes in water level, irrigation pumping from the irrigation wells in the northern end of the basin has had an insignificant effect on water levels in the basin to date.

4.4.15.2 Little Smoky Valley (North Part) HA Surface Water Use

Table 4-19b lists the committed surface water rights in the basin and the PODs for the rights in the Eureka County portion of the basin are shown in Figure 4-21. Surface water rights have been appropriated from Fish Creek in the Eureka County portion of the basin and Pine Spring, Willow Creek, Snowball Creek and Indian Creek in the Nye County portion of the basin. Uses include municipal, mining, irrigation, stock water and other, including wildlife. Surface water sources include snowmelt and storm runoff that is impounded in reservoirs to provide seasonal water supplies to livestock.

Table 4-19b is a little misleading because a large proportion of the surface water rights in the basin are associated with groundwater discharging as Fish Creek Springs, which flows approximately 4,000 af/yr. The rights appropriate virtually all water from the spring source and from the stream downstream of the source (a total of nearly 7,100 stream and spring rights), such that water rights appear to exceed the actual flow of the spring complex.

Table 4-19b

Committed Surface Water Rights in the Little Smoky Valley (Northern Part)

Hydrographic Area (HA 155A)

Manner of Use	Committed Surface Water Rights (af/yr or af/season)
Springs	
Municipal	80
Mining and Milling	82
Irrigation	5,800
Stock	226
Streams	
Irrigation	1,750
Stock	7
Other Surface Water / Reservoir	
Stock	54
Notes: 1. Rounded to the nearest acre-foot 2. Source: HA155A Basin Abstract	

Table 4-19b does not include 23 claims of reserved water rights on springs by the BLM which total more than 400 af/yr. Also not included are 33 claims of vested rights from streams and springs for irrigation and stock watering that have not been adjudicated by the NSE.

4.4.16 Diamond Valley Hydrographic Area (HA 153)

The Diamond Valley Hydrographic Area (HA 061) is located in southeastern Eureka County (Figures 4-4 and 4-22). Diamond Valley encompasses 752 square miles, of which 700 miles (93 percent) are within Eureka County. The remaining 52 square miles, an area known as Garcia Flat, are within the southwestern-most portion of Elko County

Diamond Valley is a closed basin. That is, none of the groundwater recharge originating as infiltration of precipitation falling within the basin, surface water originating in the basin and inter-basin groundwater flow into the basin from adjacent basins flows out of the basin. As stated in previous sections, Diamond Valley is the terminus of the Diamond Valley Flow System, which includes Monitor Valley (North and South Parts), Kobeh Valley, Antelope Valley and Stevens Basin. Available data suggest inter-basin groundwater flow into Diamond Valley through bedrock from Kobeh Valley and Garden Valley (a portion of the Pine Valley HA) as well as a small amount of groundwater flow from Kobeh Valley through alluvial deposits at Devils Gate in the southwest corner of the basin. In wet years Slough Creek conveys water from Kobeh Valley into the basin providing additional groundwater recharge. But, as is the case with groundwater, none of this surface water flows out of the basin. Prior to development, virtually all the groundwater entering the basin was discharged in the northern half of the basin by phreatophytes that surrounded the extensive playa located there, the springs located on the margins of the playa, and bare soil evaporation within the playa itself. Since the onset of large-scale groundwater resource utilization in the basin that began in the 1960s, the natural flow of groundwater to the playa has been altered and the majority of groundwater discharge is by irrigation wells. The discharge of groundwater by springs around the margin of the playa has been significantly reduced and there is evidence that the discharge from phreatophytes has also declined.

Perennial streams are present in the mountains, but there is no perennial stream flow below the range front. The principal perennial streams include Eureka Creek, Simpson (Italian) Creek, Torre Creek, Hildebrand Creek, Cottonwood Creek, Minoletti Creek, Pedrioli Creek, and Green Canyon, all of which are situated in the Diamond Range which borders the valley on the east.

4.4.16.1 Diamond Valley HA Groundwater Rights and Use

Wells

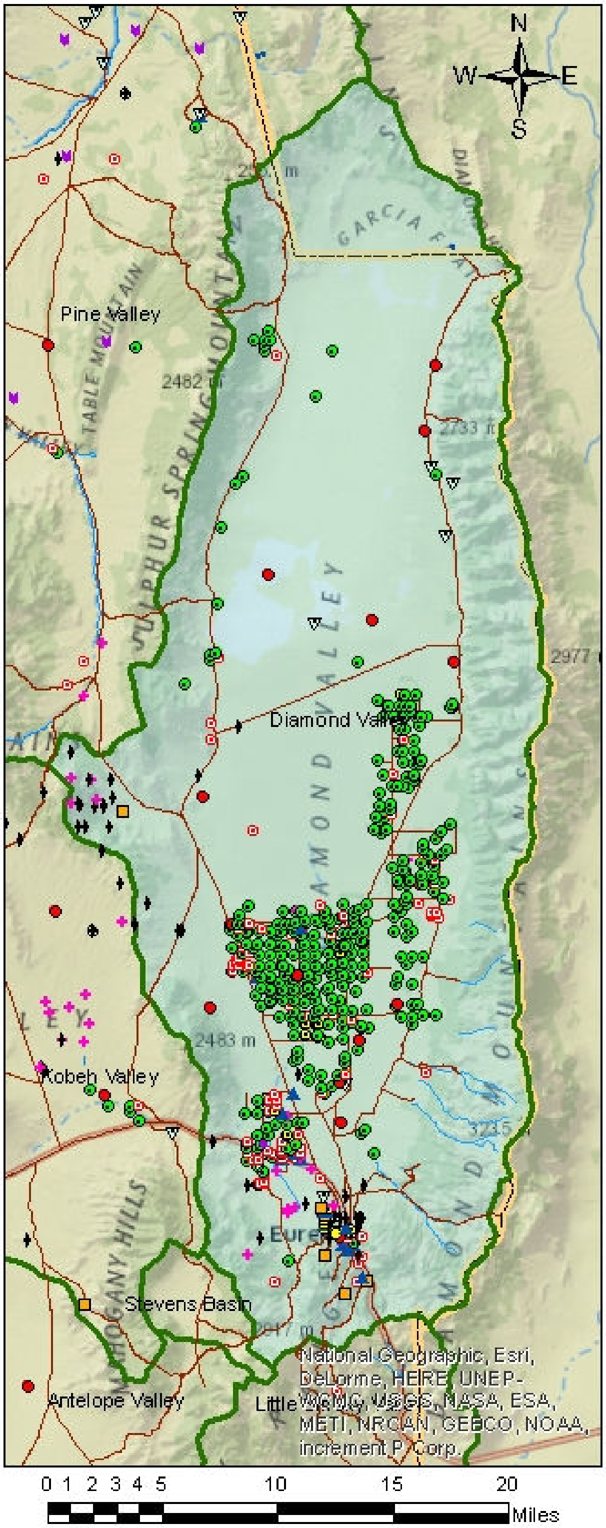
The State well log database provides records for approximately 740 wells in the basin (see Figure 4-22). Of these, 53 have reportedly been plugged and abandoned, 94 records represent replacement wells, 19 represent wells that have been deepened, and 74 were drilled as monitoring wells such that there may be approximately 500 water-supply wells in the basin. The well log database shows 437 wells drilled for irrigation purposes, 117 for domestic supply, 70 for monitoring, 21 for stock water. It also shows 24 for test or exploration purposes, 14 for other purposes, and five were unused. Records show 12 wells drilled as sources of public water supply, but this number includes exploration wells, wells that have been plugged and wells currently used for non-potable supply.

Well depths vary from 50 feet or less to more than 1,700 feet (Figure 4-23). The shallowest wells were mostly used to monitor groundwater near leaking underground storage tank (LUST) sites in the Town of Eureka. The deeper wells primarily were drilled in the mountain blocks as sources of mining water supply, mine dewatering, or monitoring) primarily for the Ruby Hill mine northwest of the Town of Eureka or for monitoring wells at the Mount Hope Project northwest of the Town Many wells drilled for the mining industry are over 1,000 feet deep with the deepest wells more than 3,000 feet deep.

In the early stages of groundwater resource utilization, irrigation supplies could be developed from wells with depths of about 150 to 250 feet. As time passed and as water levels in the aquifer have declined, well depths have generally increased and it is not uncommon for irrigation wells to be drilled to depths greater than 400 feet.

Perennial Yield and Groundwater Rights

Recharge to Diamond Valley arising from infiltration of precipitation within the basin was originally estimated at 22,000 acre-feet per year (Eakin, 1962). A small amount of underflow from Kobeh Valley through the alluvium was also acknowledged. The recharge estimate was later increased to 30,000 af/yr by incorporating an estimate of inter-basin flow from the Garden Valley area of Pine Valley (Harrill, 1968) to achieve a better balance between recharge and discharge.



The data for this map were compiled from various sources. Eureka County provides no warranty to the accuracy, reliability or completeness of these data, although an attempt was made to correct obvious errors.

Source: water.nv.gov/data/welllog/index.cfm

Figure 4-22. Wells in the Diamond Valley Hydrographic Area.

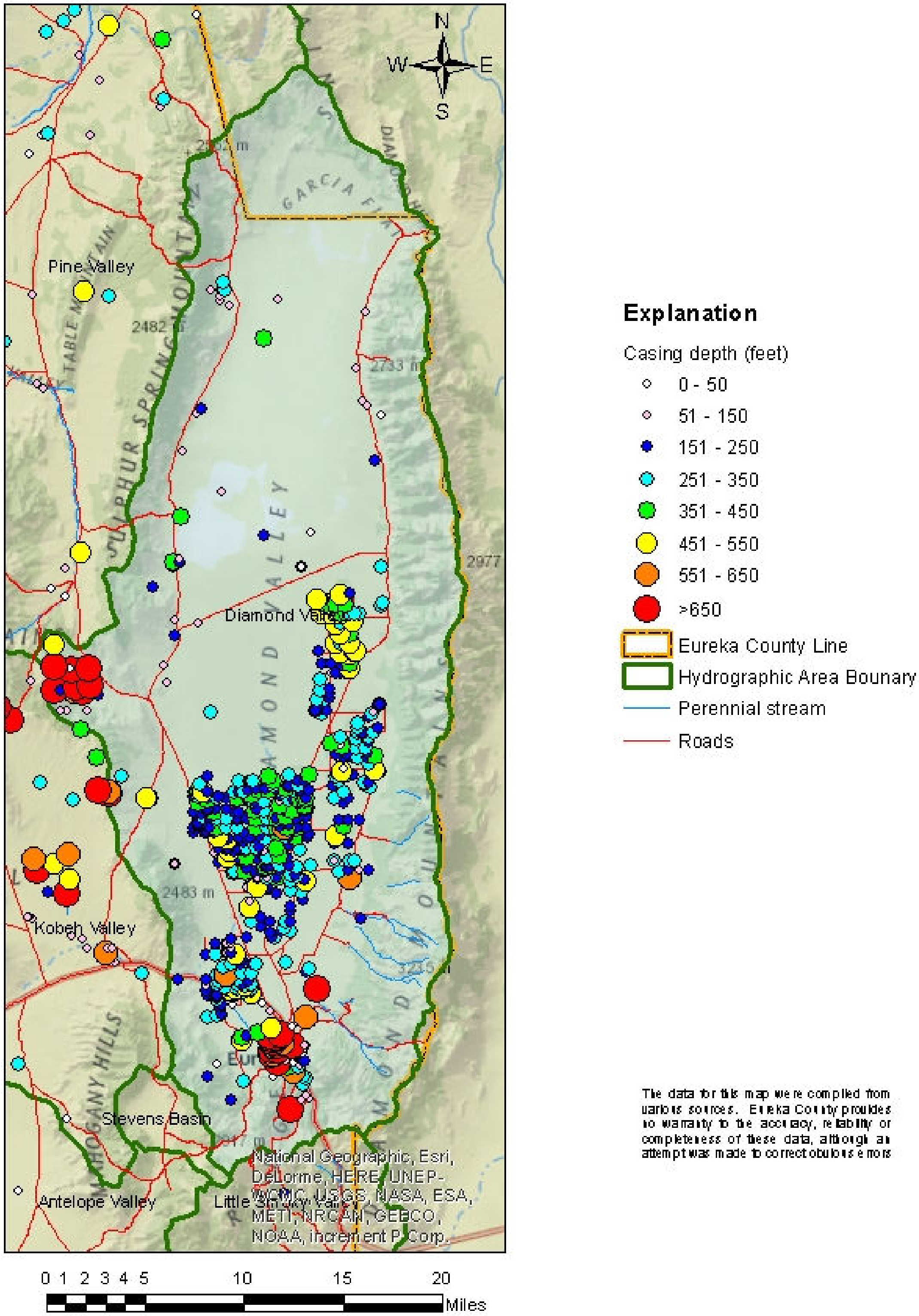


Figure 4-23. Depths of Wells in the Diamond Valley Hydrographic Area.

Recent analysis of the Diamond Valley aquifer undertaken in support of the Mount Hope Project suggests perhaps as much as 1,000 af/yr inter-basin flow from Kobeh Valley through the bedrock in the mountains north of Whistler Peak. The NSE currently assumes groundwater recharge to the basin from all sources is 30,000af/yr. The United States Geological Survey is nearing completion of a study of the Diamond Valley Flow System. The results of this study may have an effect on the perennial yield estimate used by the NSE.

Estimates of natural discharge from the basin prior to development included approximately 5,000 af/yr of evaporation from bare soil at the playa and 25,000 af/yr evapotranspiration (ET) from phreatophytes, mostly from the northern portion of the valley. The phreatophyte ET was supported in part by spring discharge and partly by a shallow water table such that these components of groundwater discharge are implicit in the phreatophyte discharge estimate.

Committed groundwater rights in the basin presently total 130,748.33 af/yr. These are summarized in Table 4-20a and the PODs in the basin are shown in Figure 4-24. Due to the density of PODs in southern Diamond Valley near the Town of Eureka, that area is expanded in Figure 4-25. Comparison of the total committed rights to the estimated perennial yield shows the basin to be over appropriated by a factor about 3.5 (approximately 4.5 times the estimated perennial yield). A significant amount of these water rights are currently not being exercised, such that approximately 75,000 acre-feet per year are probably are being consumed at present. The vast majority (96%) of the water rights are for irrigation purposes. Because water rights are not required for individual domestic wells, Table 4-20a does not incorporate groundwater pumped from approximately 120 domestic wells reportedly constructed in the basin.

Table 4-20a

Committed Groundwater Rights in the Diamond Valley Hydrographic Area (HA 153)

Manner of Use	Committed Groundwater Rights (af/yr)
Commercial	109.24
Domestic	33.60
Irrigation (including DLE)	124,676.40
Mining and Milling	2,909.24
Municipal	1,678.91
Quasi-municipal	483.34
Stockwater	857.60
Total	130,748.33
Source: http://water.nv.gov, accessed 12/04/13	

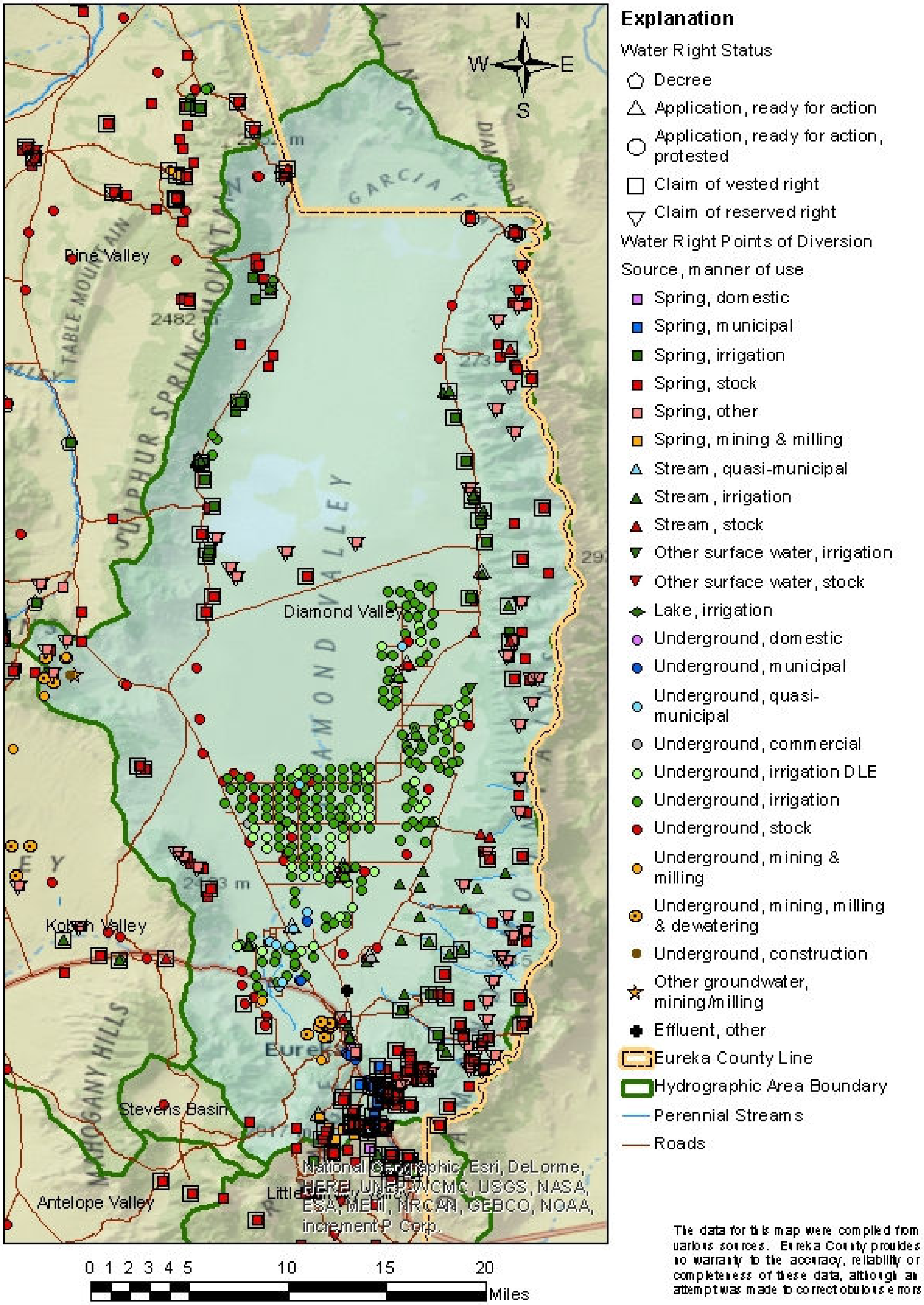


Figure 4-24. Points of Diversion for Water Rights in the Diamond Valley Hydrographic Area.

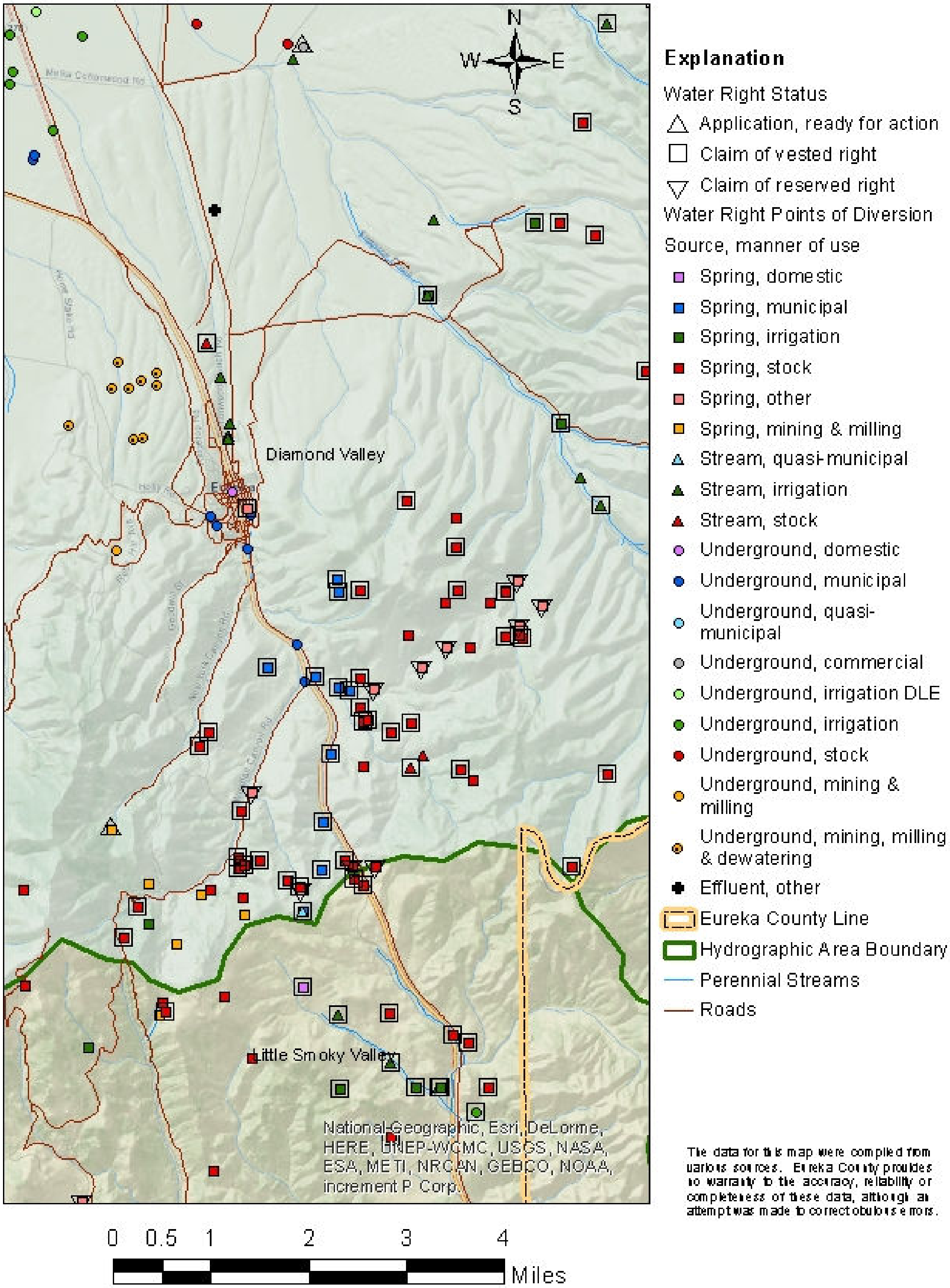


Figure 4-25. Points of Diversion for Water Rights near the Town of Eureka in the Diamond Valley Hydrographic Area.

Groundwater Use

Groundwater in the basin is used to provide public water supply, domestic supply to residences not supplied by public water systems, irrigation, mining and milling supplies, mine dewatering, stock watering, and commercial use. The overwhelming majority of groundwater pumped in Diamond Valley is used for irrigation.

Public Water System Use

There are currently three public water systems in Diamond Valley. These include the two community water systems operated by the Eureka County Public Works Department and the water system at the Ruby Hill Mine operated by Barrick. The Department operates the Eureka Town Water System and Devils Gate General Improvement District (GID) in Diamond Valley. Both of these entities utilize wells in southern Diamond Valley. The Town of Eureka also derives water from developed springs, after a nearly 25-year hiatus that started in the late 1980s. These spring sources were re-activated after significant improvements in 2012 and 2013 and re-integrated into the Town's supply in 2014.

Town of Eureka System

Until 1989, the water supply to the Town of Eureka was derived from 10 springs in the mountains south of the Town. Use of the spring sources was discontinued at that time due to source reliability issues and problems maintaining the aging spring diversions and transmission line to the Town. By 2013, the 10 spring sources were completely reconstructed and a new transmission pipe has been installed to convey the water to a chlorination facility, thence to the Town. In March 2014, the springs were re-integrated into the Town's water supply. Although these spring sources are regulated by the NSE and BSDW as surface water, they in fact capture groundwater discharge in the mountains. The springs, which in aggregate are permitted to divert up to approximately 80 af/yr or approximately 45% of the current average demand of the Town, are an invaluable source of supply derived from bedrock sources thought to be insulated from the water level declines observed in the alluvial aquifer and which may affect future viability of the Town's and the GID's wells (see Chapter 6). Another benefit of the spring sources is the water flows to the Town under gravity. In comparison, water from the Town's water supply wells must be piped more than four miles and lifted a total of approximately 800 feet to Town's storage tanks at significant cost.

As stated previously, the Town installed wells in the late 1980s to address issues with the spring source. It pumps groundwater from two wells northwest of the intersection of US Highway 50 and State Route 278 at a location approximately three miles northwest of Eureka. Diamond Valley Well No. 1 is equipped to pump 900 gpm. Diamond Valley Well No. 2, located approximately 100 feet from Well No. 1, is equipped to pump 750 gpm, and provides redundancy to the system. The average daily demand for the Town of Eureka is 160,000 gpd and the maximum daily demand is 480,000 gpd. In comparison, the capacity of Well No. 1 is 1,296,000 gpd. In 2009, the system served 276 customers and the annual use at that time was approximately 179 acre-feet.

Declining water levels in the alluvial aquifer exploited by the Town's wells represent a threat to the Town's water supply. Water level trends are discussed in more detail in a subsequent section (See Water Level Trends, following Figure 4.28).

<u>Devil's Gate GID System</u>

The Devil's Gate GID operated by Eureka County Public Works Department is located approximately 4.5 miles northwest of the Town of Eureka. It includes two districts – District 1 and District 2. District 1 straddles US Highway 50 west of the intersection with State Highway 278. District 2 is located about one mile north of District 1. There are currently 17 users in District 1 and 41 users in District 2. The water supply is provided by two wells which are rated to supply a total of approximately 120 gpm; approximately 70 gpm from the "Frontier" Well and approximately 50 gpm from the "Gourley" well. With the largest well out of service, the system can accommodate up to 125 users although the GID holds sufficient existing water rights allow for approximately 118 users, assuming two af/yr per residence. The GID owns a third well that is rated to produce 240 gpm, but elevated levels of arsenic in the groundwater pumped from it make it unsuitable for use without treating the water to remove arsenic. It currently provides a source of construction water supply.

In 2009, approximately 6.4 acre-feet were consumed in District 1 and approximately 17.6 acre-feet were pumped from District 2, for a total of 24 acre-feet.

Declining water levels in the alluvial aquifer of Diamond Valley represent a threat to the GID's water supply. From 2008 to 2013, water levels declined 21 feet in the Frontier Well or at a rate of approximately 4.2 feet/year. In the Gourley Well, water levels have declined 1.6 ft/year over the same time period. Water level trends are discussed in more detail in a subsequent section.

<u>Other Groundwater Usage by Eureka County</u>

The County also operates a well at the Eureka County Airport and several small-yield wells within the Town that are used to irrigate turf at parks. The recreational uses of the water fall under the general heading of municipal use, but these are independent of the Town and Devil's Gate GID public supplies. The water supply at the airport is not regulated as a public supply because it serves too few individuals for the threshold of regulation to apply.

<u>Barrick Ruby Hill Mine Potable Water Supply</u>

The Ruby Hill Mine water operates a non-transient, non-community supply to serve the needs of its employees. The supply is provided by a dedicated potable-water-supply well at the mine site. Annual use varies with the level of mining activity, but during 2013, approximately four acre-feet were consumed. The system has provided water to 125 employees, butMining operations have ceased for the foreseeable future.

Domestic Water Use

The State well log database lists driller's reports for 117 domestic wells serving single-family residences in Diamond Valley. There are also an undetermined number of irrigation wells that may provide domestic water supply. In Nevada, each domestic well owner is allowed to pump two (2.0) af/yr, but, domestic well consumption is at best loosely regulated and the wells are unmetered. For purposes of the Water Resources Master Plan, it is assumed that each domestic well user pumps all the groundwater allowed, and that total use by individual domestic well users is less than 250 af/yr or less than 0.1 per cent of the groundwater currently pumped.

Irrigation Water Use

Very little agricultural land in Diamond Valley was irrigated using groundwater prior to 1960 (Figure 4-26). After 1960, irrigated acreage and estimated irrigation water pumpage increased in a nearly linear fashion until 1984, followed by a decrease of about 24 percent through 1992. Irrigated acreage then remained relatively constant for about eight years. Since 2002/2004, irrigated acreage has resumed a roughly linear trend along with estimated irrigation groundwater pumping, albeit at a much slower pace prior to 1984.

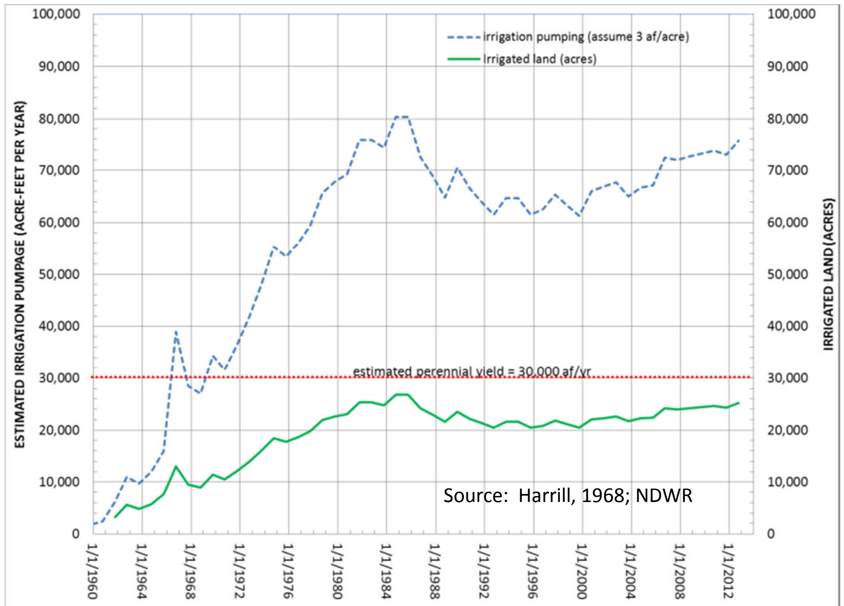


Figure 4-26. Irrigated Acreage and Estimated Irrigation Pumpage for Diamond Valley.

With few exceptions, most irrigation occurs in the southern half of the basin, with limited irrigation west of the playa in the northern half of the basin. Nearly all irrigation in the basin is accomplished through the use of center-pivot sprinklers. At present, there are approximately 180 pivots in use, plus a handful of wheel lines (Figure 4-27). Flood irrigation is still practiced, but on a very limited basis. For the most part, the corners of the fields utilizing center pivots are not irrigated. However, a few farmers do irrigate their corners either with wheel lines or by using end guns on their pivots.

The NSE ordered irrigation wells in Diamond Valley to be equipped with totalizing meters in 1982, but meters are not widely accepted by the farmers and only limited meter data are available. The amount of groundwater pumped each year for irrigation in Diamond Valley, or many other basins in Nevada for that matter, is typically not measured. Instead, it is *estimated* on the basis of the observed acreage of land on which water is applied. These estimates are tabulated in annual Crop Inventories prepared by the NSE's staff of a small number of the more than 200 hydrographic areas of the state. The average annual duty (the amount which the NSE permits applicants to pump) for irrigation water rights in Diamond Valley is approximately four feet of water per acre, which implies irrigators were permitted to pump as much as approximately 101,000 acre-feet in 2012. However, because the net irrigation requirement for alfalfa, the principal crop grown in Diamond Valley, is 2.5 feet of water per year per acre, irrigators are likely applying 3.0 feet of water per year per acre or less. Limited meter data confirm

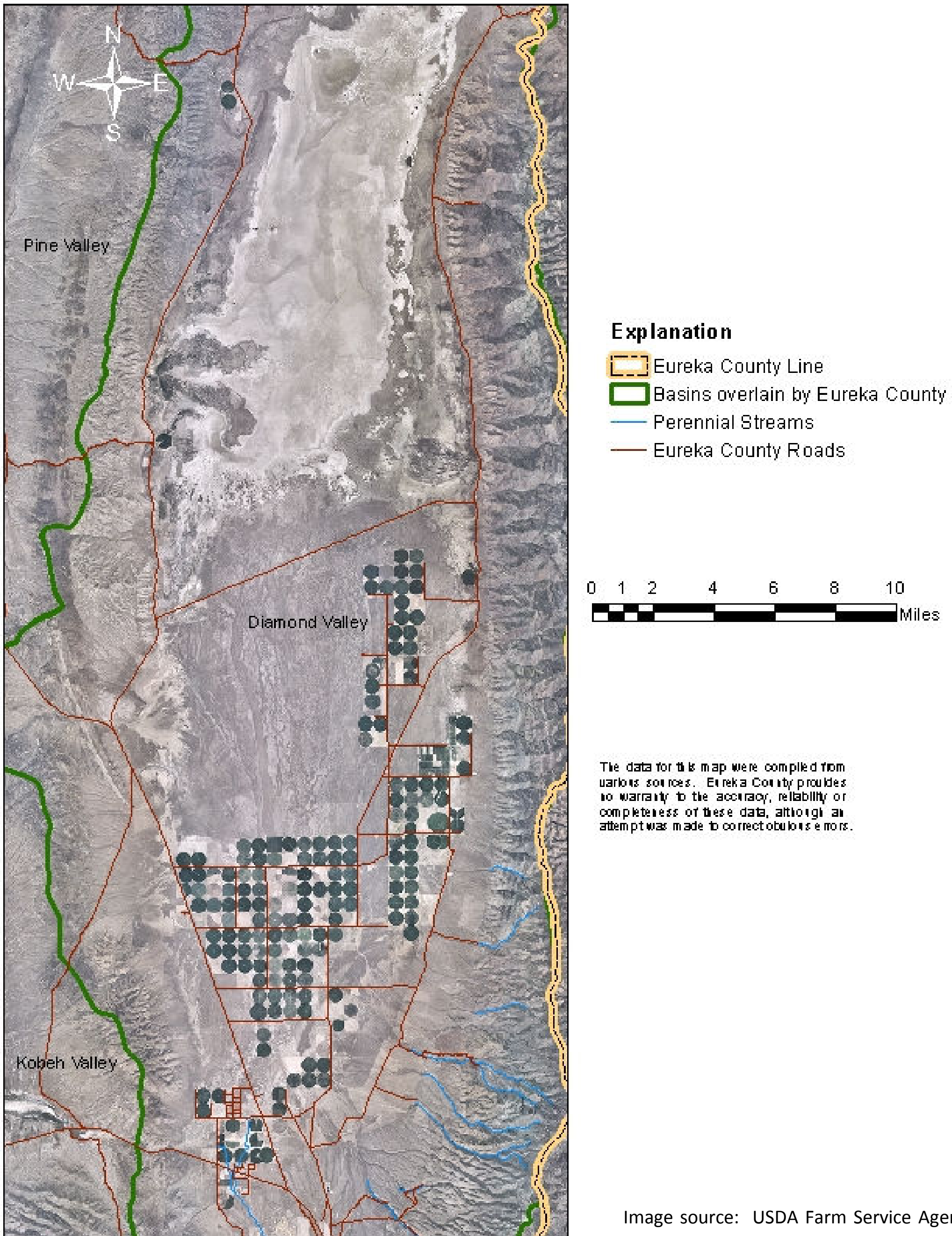


Image source: USDA Farm Service Agency National Agricultural Imagery Program, 2010

Figure 4-27. Aerial Image of Irrigated Land in Diamond Valley.

the amount of water pumped is closer to 3.0 feet than 4.0 feet. Therefore, for purposes of discussion in the Master Plan, irrigation pumpage in Diamond Valley is assumed to be 3.0 af/acre/year, or a total of approximately 76,000 acre-feet per year in 2012. Of this amount, an undetermined small portion almost certainly infiltrates the soil to become secondary recharge that can serve to inhibit salt build-up in the soil.

Regardless of the specific amount of water pumped, the available data suggest that irrigation water usage by itself is more than double the estimated perennial yield of the basin and is unsustainable. This over-pumping of the basin is causing a decline in water levels in the range of about one to three feet per year. A discussion of this trend is provided in a subsequent section.

Mine Water Use

At present, water use by the mining industry in Diamond Valley is limited to Barrick's Ruby Hill Mine located on the outskirts of the Town of Eureka. The principal source of supply is derived from wells deriving groundwater from wells completed in bedrock and which serve to dewater the pit. The mine's water rights allow for pumping up to 1,000 acre-feet per year. The pumping rate varies, but has averaged between about 600 to 800 af/yr. Of this amount, approximately half is currently infiltrated into the alluvial aquifer via rapid infiltration basins (RIBs) located west of the mine after the water has been treated to reduce the concentration of arsenic. The remainder is consumed in the milling process and incidental uses such as dust suppression. Mine usage is currently less than one percent of the total amount of water rights permitted in the basin. Operations at Ruby Hill have been suspended for the foreseeable future, but mine dewatering and some limited water use will continue for the foreseeable future.

Other potential mining use includes the Mount Hope Project located approximately 28 miles northwest of Eureka. A portion of the proposed pit is situated in Eureka County and some of the groundwater proposed to be pumped to dewater the pit is expected to originate from the Diamond Valley HA. This water, potentially amounting to only a few hundred acre-feet per year, would be consumed by ancillary uses at the mine, assuming, of course the project ever becomes operational. Water not consumed within the Diamond Valley portion of the mine area would need to be infiltrated or otherwise returned to the Diamond Valley aquifer(s).

Stockwater Use

Ranchers in Diamond Valley hold rights to pump approximately 850 af/year to provide a source of water supply to livestock. The NSE does not closely monitor the use of water for this purpose, so the amount of water currently consumed for this purpose is unknown. However, stockwater rights amount to less than one percent of the total water rights in the basin, such that this use is miniscule compared to other uses. For purposes of the Master Plan, it is assumed that all 850 af/yr are consumed.

Commercial Use

Water rights for the commercial use of groundwater total approximately 109 af/yr, or less than one-tenth of a percent of the total water rights in the basin. Of this, three af/yr have been appropriated by the Church of Latter Day Saints for use at church facilities. The remainder is held by Eureka Moly to be used at a gravel pit in northwest Diamond Valley, should their Mount Hope Project go forward. At present, their temporary permit has expired and they have not filed for the permanent permit. If the temporary permit is not renewed or they do not complete the water right process, the water will revert back to the original permit which was for irrigation use in southern Diamond Valley.

Water Level Trends

Water level data for the alluvial aquifer in Diamond Valley date back to the start of large scale groundwater exploitation in the 1960s. The data are available from the Nevada Division of Water Resources and the United States Geological Survey and, for the most part, represent water levels taken in the spring of the year prior to the on-set of irrigation. The data document how water levels have declined since the 1960s and that a cone of depression has developed over most of southern Diamond Valley, with more than 100 feet of cumulative drawdown near the centroid of the area of irrigation wells (Figure 4-28). Currently, water levels are declining at a rate of about one to three feet per year.

Figure 4-29 illustrates several hydrographs representative of water levels in southern-most, central and northern-most parts of the basin-fill aquifer in the south half of Diamond Valley. Some prominent points regarding the hydrographs include:

- Depth to water in the aquifer was initially greater at the southern end of the valley, indicative of the slope of the land surface and the general direction of groundwater flow from south to north in the southern half of the basin.
- The pattern of water level decline is similar over a large area in the center of the south half of the valley (wells N20 E53 04DDB2, N21 E53 11CDDD, and N22 E54 33BBDD).
- Water levels at the north end of the irrigated land (represented by well N23 E54 30DDD2) have declined less compared to the central part of the basin in large part because of distance from the center of ag pumping. A similarly lesser rate of decline is observed at the south end of the basin beginning in 1997 (well N20 E53 32BDCC1). The lesser rate of decline is also due in large part to the distance from the center of agricultural pumping.
- The rate of water-level decline from the mid-1970s to early 1980s was followed by a lesser rate of decline through the mid-1990s as a result of a decrease in irrigated acreage from 1984 to 1992 (see Figure 4-29).

In addition to the annual water level measurements obtained by the NSE and the USGS, Eureka County funds a network of 12 monitoring wells equipped with water-level data recorders (data loggers). Of these, six are operated by the County Natural Resources Department and six are operated by the non-profit Diamond Valley Natural Resources Protection and Conservation Association (DNRPCA) and funded by Eureka County. Water levels from the County's monitoring wells have been logged since the spring of 2011 (Figure 4-30) and data have been collected from the DNRPCA monitoring wells since spring 2013 (Figure 4-31). Water level measurements are logged daily in each of the wells with the exception of the well located in Section 36, Township 24 North, Range 53 East (Figure 4-30). This well provides a source of stock water supply and measurements have been collected hourly to help show the effect of the pump cycling on and off. From Figure 4-30, it is evident that the operation of the well has not obscured the water level trend.

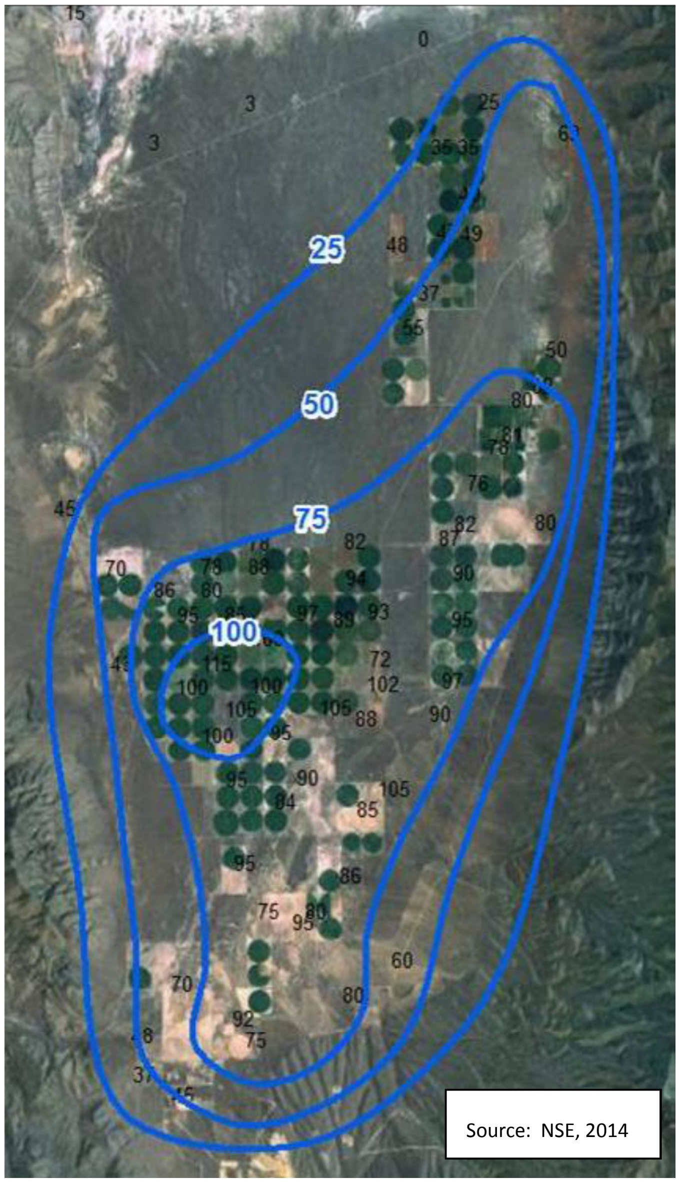


Figure 4-28. Map of Water Level Decline in Diamond Valley.

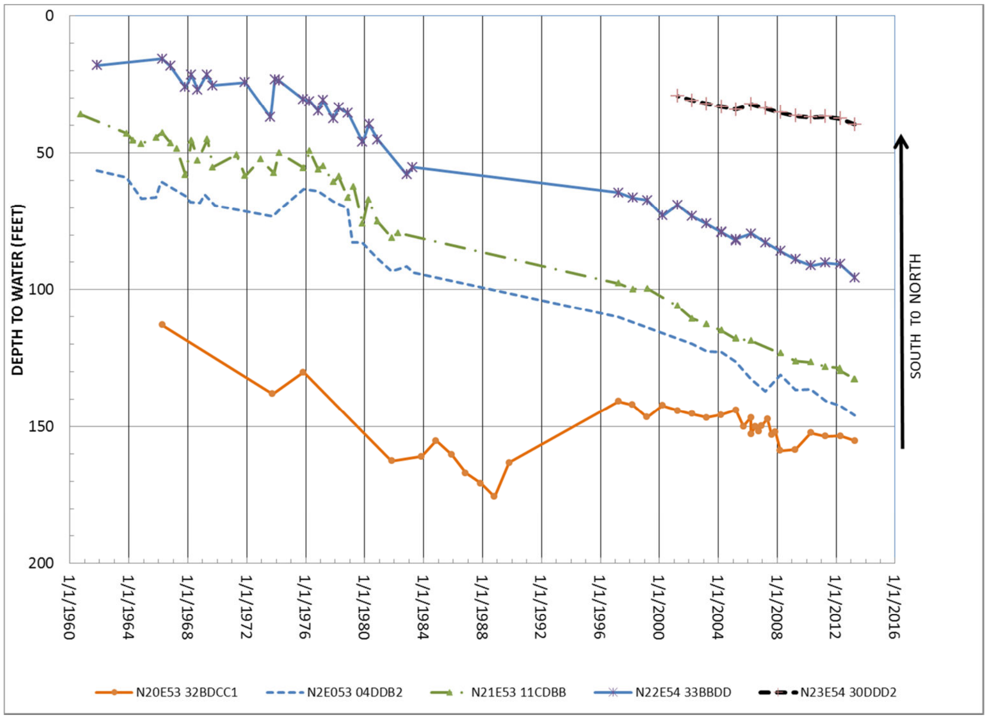


Figure 4-29. Hydrographs of Representative Wells in Diamond Valley.

The data from the County's and DNRPCA's monitoring wells help to define the annual variation in water levels in the aquifer resulting from irrigation pumping. From the data, it can be seen that water levels vary seasonally from between about five and 40 feet, depending on how close the monitoring well is to a pumped well or whether or not the monitoring well is completed to the same depth as a pumped well.

As discussed previously, the public water supply wells that supply the Town of Eureka and the Devil's Gate GID draw groundwater from the alluvial deposits in Diamond Valley.

Mining groundwater in Diamond Valley for more than 50 years and the resultant continual decline in water level within the alluvial aquifer prompted the NSE to designate the Diamond Valley HA as a Critical Management Area (CMA) (NRS 534.110 (7)). Once designated, the water rights holders have 10 years to develop and implement a Groundwater Management Plan (GMP) with which to bring groundwater consumption into balance with recharge to, in effect, balance the basin water budget. The alternative to implementing a GMP is for the NSE to balance the basin budget by curtailing water rights on the basis of priority. In the case of Diamond Valley, the NSE would need to reduce groundwater pumping by 50 to 60 percent to effectively balance the basin water budget.

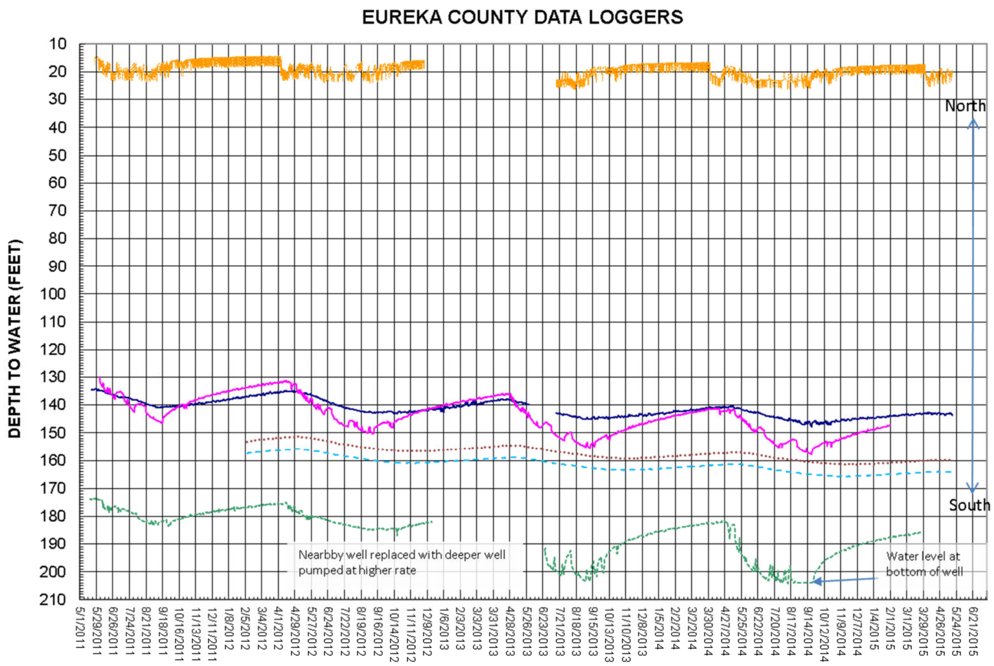


Figure 4-30. Eureka County Monitoring Network Hydrographs.

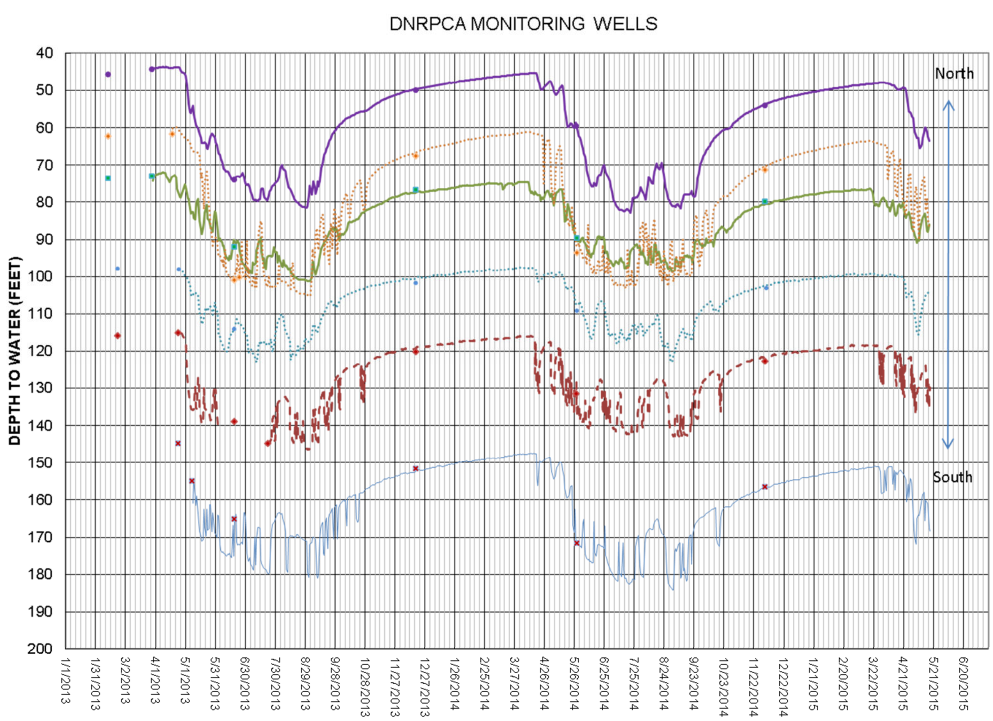


Figure 4-31. Eureka County / DNRPCA Monitoring Network Hydrographs.

4.4.16.2 Diamond Valley HA Surface Water Rights and Use

Water rights have been appropriated from several streams and numerous springs in Diamond Valley. All the perennial streams are located in the Diamond Range east of the valley and the streams are perennial only in the mountain block above the range front. The streams become intermittent or ephemeral on the alluvial fans below the range front. The principal streams include Eureka Creek, Simpson (Italian) Creek, Torre Creek, Hildebrand Creek, Cottonwood Creek, Minoletti Creek, Pedrioli Creek, and Green Canyon. Additionally, during wet years or after periods of intense rainfall, Slough Creek flows into Diamond Valley from Kobeh Valley through Devil's Gate. Average annual runoff from the Diamond Range has been estimated at 5,000 af/yr (Harrill, 1968). The estimated annual runoff from the rest of the valley margins is estimated at 800 af/yr (*Id*.)

Water rights associated with these surface water sources are provided in Table 4-20b and PODs are shown in Figure 4-23 and 4-24. Not included in Table 4-20b are:

- More than 60 claims to reserved water rights to springs by the BLM totaling approximately 0.34 cfs.
- More than 100 claims of vested water rights from springs that have been filed to date.

Table 4-20b

Committed Surface Water Rights in the Diamond Valley Hydrographic Area (HA 153)

Manner of Use	**Committed Surface Water Rights** (af/yr or af/season)
Springs	
Municipal	80
Mining & Milling	24
Irrigation	1,401
Stock	1,146
Streams	
Irrigation	4,947
Stock	31
Notes: 1. Rounded to the nearest acre-foot 2. Source: HA153 Basin Abstract	

Many of the springs on which claims have been filed are located in the mountains, but a number are located on the valley floor or issue from the alluvium near the range front. Big Shipley Hot Springs west of the playa and Diamond Springs (a.k.a. Thompson Springs) east of the playa, both of which are located below the range front, historically flowed at significant rates, perhaps as much as 6,000 to 7,000 af/yr. Groundwater exploitation in the basin has caused the discharge from many springs to decline or cease to flow altogether. The discharge from Big Shipley Hot Springs declined to about 1,500 af/yr and Thompson Spring has ceased to flow.

Springs are treated by the NSE as surface water sources despite the fact they represent groundwater discharge and the spring discharge has historically not figured into the amount of groundwater considered to be available for appropriation in the basin. To offset the loss of spring water sources, the NSE has recently granted "mitigation water rights" to offset the loss of spring flow resulting from groundwater exploitation in the basin (NSE Ruling #6290). The effect of the ruling is to increase the amount of groundwater presently pumped from the basin. On February 10, 2016, the Nevada Seventh Judicial District Court overturned Ruling #6290 and ordered the NSE to '. . . establish Sadler Ranch's mitigation right . . . based on the amount of water Sadler Ranch appropriated to beneficial use prior to 1905."

On October 8, 1982 the NSE initiated adjudication of all claims of rights to surface water and groundwater in Diamond Valley (NSE Order #800), but this effort failed to progress and the adjudication process languished. After a 30-yeqar hiatus the NSE resuscitated the process on August 21, 2015 (NSE Order #1263). Subsequently, on October 16, 2015, the NSE issued Order # 1266 requiring all claimants to file Proofs of Appropriation on or before May 31, 2106.

The adjudication of pre-statutory rights is a necessary precursor to any GMP prepared for the basin in response to its designation as a GMP. Unless as all water rights in the basin have been determined, it will be difficult to assess the degree to which groundwater usage must be reduced to balance the basin water budget.

5.0 WATER QUALITY

Objective: Identify the issues that might affect water supplies within the County and help residents recognize how these issues might affect them. These concerns may be related either to water quantity or **water quality**.

5.1 SURFACE WATER QUALITY

5.1.1 Surface Water Quality Standards

A discussion of surface water quality standards is available from the Nevada Division of Environmental Protection website (http://ndep.nv.gov/docs). It is reprised below.

> *"Section 303 of the Clean Water Act and 40 CFR 131 give states responsibility for setting, reviewing and revising beneficial uses and water quality standards. State of Nevada authorities are contained in Nevada Revised Statutes 445A.425, 520 and 565 and water quality standards for waters of Nevada are found in the Nevada Administrative Code (NAC numbers 445A.118 through 2234). Water quality standards are set for a waterbody segment at a level designed to ensure protection of the designated beneficial use(s) set for the waterbody. Standards are generally based on United State Environmental Protection Agency (EPA) criteria, such as, physical, chemical and biological characteristics, to protect the designated beneficial use(s). Workshops are held to obtain comments on proposed beneficial uses and/or water quality standards from federal, state and local agencies and the general public. Proposed standards are presented at a public hearing to the Nevada State Environmental Commission (SEC) for review and adoption. Standards adopted by the SEC are then subject to approval by the EPA before incorporating into the NAC.*
>
> *Nevada's water quality standards, as contained in the Nevada Administrative Code (NAC) 445A.11704 –445A.2234, define the water quality goals for a waterbody, or a portion of a waterbody, by designating beneficial uses of the water and setting criteria necessary to protect the beneficial uses. Beneficial uses include, but are not limited to, irrigation, recreation, aquatic life, and drinking water supply. In many cases, two or more reaches exist for a river or stream system, with each reach possibly having different beneficial uses and numeric criteria. Reaches are established at specific control points pursuant to NAC 445A.1239 (often referred to as the "Tributary Rule"[1]). On a*

[1] NAC 445A.1239 states that on a given waterbody, the standards apply to that control point and the remainder of the waterbody upstream, all surface waters upstream (in Nevada) or to the next control point upstream, if any. In Rapanos v. United States, the U.S. Supreme Court gave a split ruling. Independently, Justice Kennedy expanded on the tributary rule, holding that a wetland or non-navigable waterbody falls within the Clean Water Act's domain if it bears a "significant nexus" to a traditional navigable waterway. Such a nexus exists where the wetland or

given waterbody, the standards apply to that control point and the remainder of the waterbody upstream, all surface waters upstream (in Nevada) or to the next control point upstream, if any. If there are no control points downstream from a particular control point, the standards for that control point apply for the remainder of the waterbody downstream, all surface waters downstream (in Nevada) or to the next waterbody downstream named in the NAC.

Nevada's water quality standards contain both narrative and numeric criteria. The narrative standards contained in NAC 445A.121 apply to all surface waters of the state and require waters to be "free from" various pollutants in sufficient levels so as to not be unsightly, interfere with any beneficial uses, create a public nuisance, be toxic to human, animal, plant, or aquatic life, or have any adverse effects. There are two types of numeric standards in the regulations, waterbody specific conventional pollutants and toxic materials. Waterbody specific numeric standards have been developed for many of the waters in Nevada (NAC 445A.1252 – 445A.2234). The standards for these waters include criteria designed to protect the beneficial uses (referred to as beneficial use standards) and, in certain cases, antidegradation requirements. The Tributary Rule provides protection for those surface waters that are not specifically defined in these regulations. Numeric criteria for toxic materials are contained in NAC 445A.1236 and apply to all waters specified in NAC 445A.1233 – 445A.2234. Numeric criteria in NAC 445A.1236 are specified for four beneficial uses, municipal or domestic supply, aquatic life, irrigation, and watering of livestock. Most of the standards are based on ambient water quality criteria published by EPA; however, numeric criteria for the protection of municipal and domestic water supply are generally based on maximum contaminant levels (MCLs) which have been adopted by the Nevada Division of Public and Behavioral Health."

Waterbody-specific water quality standards developed for streams in Eureka County are provided in the following Tables 5-1a through 5-1m. Footnotes and explanations for the entire table are found following Table 5-1l.

waterbody, either by itself or in combination with other similar sites, significantly affects the physical, biological, and chemical integrity of the downstream navigable waterway.

Table 5-1a

STANDARDS OF WATER QUALITY

Humboldt River from Palisade to Osino

PARAMETER	REQUIREMENTS TO MAINTAIN EXISTING HIGHER QUALITY	WATER QUALITY STANDARDS FOR BENEFICIAL USES	Beneficial Use [a]										
			Livestock	Irrigation	Aquatic	Contact	Noncontact	Municipal	Industrial	Wildlife	Aesthetic	Enhance	Marsh
Beneficial Uses			X	X	X	X	X	X	X	X			
Aquatic Life Species of Concern			Warm-water fishery										
Temperature - °C ΔT^b - °C	ΔT = 0	ΔT ≤ 2			*	X							
pH - SU	A-Avg. 7.0 - 8.5 S.V. 7.0 - 8.6	S.V. 6.5 - 9.0 ΔpH ± 0.5	X	X	X	*		X	X	*			
Dissolved Oxygen - mg/l		S.V. ≥ 5.0	X		*	X	X	X		X			
Total Phosphorus (as P) - mg/l		Apr-Nov Seasonal Avg. ≤ 0.1			*	X	X	X					
Nitrogen species (as N) - mg/l	Total Nitrogen A-Avg. ≤ 1.4 S.V. Apr-Nov ≤ 2.4	Nitrate S.V. ≤ 10 Nitrite S.V. ≤ 1.0	X	X	X			*		X			
Total Ammonia (as N) - mg/l		[c]			*								
Suspended Solids - mg/l		Annual Median ≤ 80[d]			*								
Turbidity - NTU		S.V. ≤ 50			*			X					
Color - PCU	[e]	No Adverse Effects						*					
Total Dissolved Solids - mg/l	A-Avg. ≤ 350 S.V. ≤ 400	A-Avg. ≤ 500	X	X				*					
Chloride - mg/l	A-Avg. ≤ 21 S.V. ≤ 30	S.V. ≤ 250	X	X				*		X			
Sulfate - mg/l		S.V. ≤ 250						*					
Sodium - SAR		A-Avg. ≤ 8		*				X					
E. coli - No./100 ml		A.G.M. ≤ 126 S.V. ≤ 410				*	X						
Fecal Coliform -No./100 ml	A.G.M. ≤ 20 S.V. ≤ 150	S.V. ≤ 1,000	X	*			X	X		X			

Table 5-1b
STANDARDS OF WATER QUALITY
Humboldt River from Palisade Gage to Battle Mountain Gage

PARAMETER	REQUIREMENTS TO MAINTAIN EXISTING HIGHER QUALITY	WATER QUALITY STANDARDS FOR BENEFICIAL USES	Beneficial Use [a]										
			Livestock	Irrigation	Aquatic	Contact	Noncontact	Municipal	Industrial	Wildlife	Aesthetic	Enhance	Marsh
Beneficial Uses			X	X	X	X	X	X	X	X			
Aquatic Life Species of Concern			Warm-water fishery										
Temperature - °C ΔT[b] - °C	ΔT = 0	ΔT ≤ 2			*	X							
pH - SU	A-Avg. 7.0 - 8.4 S.V. 7.0 - 8.6	S.V. 6.5 - 9.0 ΔpH ± 0.5	X	X	X	*		X	X	*			
Dissolved Oxygen - mg/l		S.V. ≥ 5.0	X		*	X	X	X		X			
Total Phosphorus (as P) - mg/l		Apr-Nov Seasonal Avg. ≤ 0.1			*	X	X	X					
Nitrogen species (as N) - mg/l	Total Nitrogen A-Avg. ≤ 1.9 S.V. Apr-Nov ≤ 4.0	Nitrate S.V. ≤ 10 Nitrite S.V. ≤ 1.0	X	X	X			*		X			
Total Ammonia (as N) - mg/l		c			*								
Suspended Solids - mg/l		Annual Median ≤ 80[d]			*								
Turbidity - NTU		S.V. ≤ 50			*			X					
Color - PCU	e	No Adverse Effects						*					
Total Dissolved Solids - mg/l	A-Avg. ≤ 425 S.V. ≤ 520	A-Avg. ≤ 500	X	X				*					
Chloride - mg/l	A-Avg. ≤ 50 S.V. ≤ 70	S.V. ≤ 250	X	X				*		X			
Sulfate - mg/l		S.V. ≤ 250						*					
Sodium - SAR		A-Avg. ≤ 8		*				X					
E. coli - No./100 ml		A.G.M. ≤ 126 S.V. ≤ 410				*	X						
Fecal Coliform -No./100 ml	A.G.M. ≤ 50 S.V. ≤ 200	S.V. ≤ 1,000	X	*			X	X		X			

Table 5-1c

STANDARDS OF WATER QUALITY

Maggie Creek from where it is formed by the Maggie Creek Tributaries to its confluence with Jack Creek

PARAMETER	REQUIREMENTS TO MAINTAIN EXISTING HIGHER QUALITY	WATER QUALITY STANDARDS FOR BENEFICIAL USES	Beneficial Use [a]										
			Livestock	Irrigation	Aquatic	Contact	Noncontact	Municipal	Industrial	Wildlife	Aesthetic	Enhance	Marsh
Beneficial Uses			X	X	X	X	X	X	X	X			
Aquatic Life Species of Concern			Trout										
Temperature - °C DT[b] - °C		S.V. ≤ 20 DT = 0			*	X							
pH - SU		S.V. 6.5 - 9.0	X	X	*	*		X	X	*			
Dissolved Oxygen - mg/l		S.V. ≥ 6.0	X		*	X	X	X		X			
Total Phosphorus (as P) - mg/l		S.V. ≤ 0.10			*	*	X	X					
Total Ammonia (as N) - mg/l		[c]			*			X					
Total Dissolved Solids - mg/l		S.V. ≤ 500 or the 95th percentile (whichever is less).	X	X				*					
E. coli - No./100 ml		A.G.M. ≤ 126 S.V. ≤ 410				*	X						
Fecal Coliform -No./100 ml		S.V. ≤ 1,000	X	*			X	X		X			

Table 5-1d

STANDARDS OF WATER QUALITY

Maggie Creek from its confluence with Soap Creek to its confluence with the Humboldt River

PARAMETER	REQUIREMENTS TO MAINTAIN EXISTING HIGHER QUALITY	WATER QUALITY STANDARDS FOR BENEFICIAL USES	Beneficial Use [a]										
			Livestock	Irrigation	Aquatic	Contact	Noncontact	Municipal	Industrial	Wildlife	Aesthetic	Enhance	Marsh
Beneficial Uses			X	X	X	X	X	X	X	X			
Aquatic Life Species of Concern													
Temperature - °C ΔT[b] - °C		S.V. ≤ 34 ΔT ≤ 3			*	X							
pH - SU		S.V. 6.5 - 9.0	X	X	*	*		X	X	*			
Dissolved Oxygen - mg/l		S.V. ≥ 5.0	X		*	X	X	X		X			
Total Phosphorus (as P) - mg/l		S.V. ≤ 0.33			*	*	X	X					
Total Ammonia (as N) - mg/l		c			*			X					
Total Dissolved Solids - mg/l		S.V. ≤ 500 or the 95th percentile (whichever is less).	X	X				*					
E. coli - No./100 ml		A.G.M. ≤ 126 S.V. ≤ 410				*	X						
Fecal Coliform -No./100 ml		S.V. ≤ 1,000	X	*			X	X		X			

Table 5-1e

STANDARDS OF WATER QUALITY

Maggie Creek from its confluence with Jack Creek to its confluence with Soap Creek

PARAMETER	REQUIREMENTS TO MAINTAIN EXISTING HIGHER QUALITY	WATER QUALITY STANDARDS FOR BENEFICIAL USES	Beneficial Use [a]										
			Livestock	Irrigation	Aquatic	Contact	Noncontact	Municipal	Industrial	Wildlife	Aesthetic	Enhance	Marsh
Beneficial Uses			X	X	X	X	X	X	X	X			
Aquatic Life Species of Concern			Trout.										
Temperature - °C ΔT^b - °C		S.V. ≤ 20 ΔT ≤ 3			*	X							
pH - SU		S.V. 6.5 - 9.0	X	X	*	*		X	X	*			
Dissolved Oxygen - mg/l		S.V. ≥ 6.0	X		*	X	X	X		X			
Total Phosphorus (as P) - mg/l		S.V. ≤ 0.33			*	*	X	X					
Total Ammonia (as N) - mg/l		[c]			*			X					
Total Dissolved Solids - mg/l		S.V. ≤ 500 or the 95th percentile (whichever is less).	X	X				*					
E. coli - No./100 ml		A.G.M. ≤ 126 S.V. ≤ 410				*	X						
Fecal Coliform -No./100 ml		S.V. ≤ 1,000	X	*			X	X		X			

Table 5-1f

STANDARDS OF WATER QUALITY

J.D. Ponds

PARAMETER	REQUIREMENTS TO MAINTAIN EXISTING HIGHER QUALITY	WATER QUALITY STANDARDS FOR BENEFICIAL USES	Beneficial Use [a]										
			Livestock	Irrigation	Aquatic	Contact	Noncontact	Municipal	Industrial	Wildlife	Aesthetic	Enhance	Marsh
Beneficial Uses			X	X	X	X	X	X	X	X			
Aquatic Life Species of Concern													
Temperature - °C ΔT[b] - °C		S.V. ≤ 34 ΔT ≤ 3			*	X							
pH - SU		S.V. 6.5 - 9.0	X	X	*	*		X	X	*			
Dissolved Oxygen - mg/l		S.V. ≥ 5.0	X		*	X	X	X		X			
Total Phosphorus (as P) - mg/l		S.V. ≤ 0.33			*	*	X	X					
Total Ammonia (as N) - mg/l		c			*			X					
Total Dissolved Solids - mg/l		S.V. ≤ 500 or the 95th percentile (whichever is less).	X	X				*					
E. coli - No./100 ml		A.G.M. ≤ 126 S.V. ≤ 410				*	X						
Fecal Coliform -No./100 ml		S.V. ≤ 1,000	X	*			X	X		X			

Table 5-1g

STANDARDS OF WATER QUALITY

Denay Creek from its origin to Tonkin Reservoir

PARAMETER	REQUIREMENTS TO MAINTAIN EXISTING HIGHER QUALITY	WATER QUALITY STANDARDS FOR BENEFICIAL USES	Beneficial Use [a]										
			Livestock	Irrigation	Aquatic	Contact	Noncontact	Municipal	Industrial	Wildlife	Aesthetic	Enhance	Marsh
Beneficial Uses			X	X	X	X	X	X		X			
Aquatic Life Species of Concern													
Temperature - °C ΔT[b] - °C		S.V. ≤ 20 ΔT = 0			*	X							
pH - SU		S.V. 6.5 - 9.0	X	X	*	*		X		*			
Dissolved Oxygen - mg/l		S.V. ≥ 6.0	X		*	X	X	X		X			
Total Phosphorus (as P) - mg/l		S.V. ≤ 0.10			*	*	X	X					
Total Ammonia (as N) - mg/l		[c]			*			X					
Total Dissolved Solids - mg/l		S.V. ≤ 500 or the 95th percentile (whichever is less).	X	X				*					
E. coli - No./100 ml		A.G.M. ≤ 126 S.V. ≤ 410				*	X						
Fecal Coliform -No./100 ml		S.V. ≤ 1,000	X	*			X	X		X			

Table 5-1h

STANDARDS OF WATER QUALITY

Tonkin Reservoir

PARAMETER	REQUIREMENTS TO MAINTAIN EXISTING HIGHER QUALITY	WATER QUALITY STANDARDS FOR BENEFICIAL USES	Beneficial Use [a]										
			Livestock	Irrigation	Aquatic	Contact	Noncontact	Municipal	Industrial	Wildlife	Aesthetic	Enhance	Marsh
Beneficial Uses			X	X	X	X	X	X		X			
Aquatic Life Species of Concern													
Temperature - °C ΔT[b] - °C		S.V. ≤ 20 ΔT = 0			*	X							
pH - SU		S.V. 6.5 - 9.0	X	X	*	*		X		*			
Dissolved Oxygen - mg/l		S.V. ≥ 6.0	X		*	X	X	X		X			
Total Phosphorus (as P) - mg/l		S.V. ≤ 0.025			*	*	X	X					
Total Ammonia (as N) - mg/l		[c]			*			X					
Total Dissolved Solids - mg/l		S.V. ≤ 500 or the 95th percentile (whichever is less).	X	X				*					
E. coli - No./100 ml		A.G.M. ≤ 126 S.V. ≤ 410				*	X						
Fecal Coliform - No./100 ml		S.V. ≤ 1,000	X	*			X	X		X			

Table 5-1i

STANDARDS OF WATER QUALITY

Denay Creek below Tonkin Reservoir

PARAMETER	REQUIREMENTS TO MAINTAIN EXISTING HIGHER QUALITY	WATER QUALITY STANDARDS FOR BENEFICIAL USES	Beneficial Use [a]										
			Livestock	Irrigation	Aquatic	Contact	Noncontact	Municipal	Industrial	Wildlife	Aesthetic	Enhance	Marsh
Beneficial Uses			X	X	X	X	X	X	X	X			
Aquatic Life Species of Concern													
Temperature - °C ΔT[b] - °C		S.V. ≤ 24 ΔT = 0			*	X							
pH - SU		S.V. 6.5 - 9.0	X	X	*	*		X	X	*			
Dissolved Oxygen - mg/l		S.V. ≥ 5.0	X		*	X	X	X		X			
Total Phosphorus (as P) - mg/l		S.V. ≤ 0.10			*	*	X	X					
Total Ammonia (as N) - mg/l		[c]			*			X					
Total Dissolved Solids - mg/l		S.V. ≤ 500 or the 95th percentile (whichever is less).	X	X				*					
E. coli - No./100 ml		A.G.M. ≤ 126 S.V. ≤ 410				*	X						
Fecal Coliform -No./100 ml		S.V. ≤ 1,000	X	*			X	X		X			

Table 5-1j

STANDARDS OF WATER QUALITY

Rock Creek below Squaw Valley Ranch

PARAMETER	REQUIREMENTS TO MAINTAIN EXISTING HIGHER QUALITY	WATER QUALITY STANDARDS FOR BENEFICIAL USES	Beneficial Use [a]										
			Livestock	Irrigation	Aquatic	Contact	Noncontact	Municipal	Industrial	Wildlife	Aesthetic	Enhance	Marsh
Beneficial Uses			X	X	X	X	X	X	X	X			
Aquatic Life Species of Concern													
Temperature °C ΔT[b] - °C		S.V. ≤ 34 ΔT ≤ 3			*	X							
pH - SU		S.V. 6.5 - 9.0	X	X	*	*		X	X	*			
Dissolved Oxygen - mg/l		S.V. ≥ 5.0	X		*	X	X	X		X			
Total Phosphorus (as P) - mg/l		S.V. ≤ 0.33			*	*	X	X					
Total Ammonia (as N) - mg/l		[c]			*			X					
Total Dissolved Solids - mg/l		S.V. ≤ 500 or the 95th percentile (whichever is less).	X	X				*					
E. coli - No./100 ml		A.G.M. ≤ 126 S.V. ≤ 410				*	X						
Fecal Coliform -No./100 ml		S.V. ≤ 1,000	X	*			X	X		X			

Table 5-1k

STANDARDS OF WATER QUALITY

Roberts Creek from its origin to Roberts Creek Reservoir

PARAMETER	REQUIREMENTS TO MAINTAIN EXISTING HIGHER QUALITY	WATER QUALITY STANDARDS FOR BENEFICIAL USES	Beneficial Use [a]										
			Livestock	Irrigation	Aquatic	Contact	Noncontact	Municipal	Industrial	Wildlife	Aesthetic	Enhance	Marsh
Beneficial Uses			X	X	X	X	X	X		X			
Aquatic Life Species of Concern													
Temperature - °C ΔT[b] - °C		S.V. ≤ 20 ΔT = 0			*	X							
pH - SU		S.V. 6.5 - 9.0	X	X	*	*		X		*			
Dissolved Oxygen - mg/l		S.V. ≥ 6.0	X		*	X	X	X		X			
Total Phosphorus (as P) - mg/l		S.V. ≤ 0.10			*	*	X	X					
Total Ammonia (as N) - mg/l		c			*			X					
Total Dissolved Solids - mg/l		S.V. ≤ 500 or the 95th percentile (whichever is less).	X	X				*					
E. coli - No./100 ml		A.G.M. ≤ 126 S.V. ≤ 410				*	X						
Fecal Coliform - No./100 ml		S.V. ≤ 1,000	X	*			X	X		X			

Table 5-1l

STANDARDS OF WATER QUALITY

Roberts Creek below Roberts Creek Reservoir

PARAMETER	REQUIREMENTS TO MAINTAIN EXISTING HIGHER QUALITY	WATER QUALITY STANDARDS FOR BENEFICIAL USES	Beneficial Use [a]										
			Livestock	Irrigation	Aquatic	Contact	Noncontact	Municipal	Industrial	Wildlife	Aesthetic	Enhance	Marsh
Beneficial Uses			X	X	X	X	X	X	X	X			
Aquatic Life Species of Concern													
Temperature - °C ΔT[b] - °C		S.V. ≤ 24 ΔT = 0			*	X							
pH - SU		S.V. 6.5 - 9.0	X	X	*	*		X	X	*			
Dissolved Oxygen - mg/l		S.V. ≥ 5.0	X		*	X	X	X		X			
Total Phosphorus (as P) - mg/l		S.V. ≤ 0.10			*	*	X	X					
Total Ammonia (as N) - mg/l		[c]			*			X					
Total Dissolved Solids - mg/l		S.V. ≤ 500 or the 95th percentile (whichever is less).	X	X				*					
E. coli - No./100 ml		A.G.M. ≤ 126 S.V. ≤ 410				*	X						
Fecal Coliform - No./100 ml		S.V. ≤ 1,000	X	*			X	X		X			

Table 5-1m

STANDARDS OF WATER QUALITY

Fish Springs Pond

PARAMETER	REQUIREMENTS TO MAINTAIN EXISTING HIGHER QUALITY	WATER QUALITY STANDARDS FOR BENEFICIAL USES	Beneficial Use [a]										
			Livestock	Irrigation	Aquatic	Contact	Noncontact	Municipal	Industrial	Wildlife	Aesthetic	Enhance	Marsh
Beneficial Uses			X	X	X	X	X	X	X	X			
Aquatic Life Species of Concern			Trout.										
Temperature - °C ΔT[b] - °C		S.V. ≤ 20 ΔT = 0			*	X							
pH - SU		S.V. 6.5 - 9.0	X	X	*	*		X	X	*			
Dissolved Oxygen - mg/l		S.V. ≥ 6.0	X		*	X	X	X		X			
Total Phosphorus (as P) - mg/l		S.V. ≤ 0.10			*	*	X	X					
Total Ammonia (as N) - mg/l		[c]			*			X					
Total Dissolved Solids - mg/l		S.V. ≤ 500 or the 95th percentile (whichever is less).	X	X				*					
E. coli - No./100 ml		A.G.M. ≤ 126 S.V. ≤ 576				*	X						
Fecal Coliform - No./100 ml		S.V. ≤ 1,000	X	*			X	X		X			

Explanation and Footnotes for Tables 5-1a through 5-1l

a. Beneficial use terminology is found in NAC 445A.122 and 445A.1252.
b. Maximum allowable increase in temperature above water temperature at the boundary of an approved mixing zone, but the increase must not cause a violation of the single value standard.
c. The ambient water quality criteria for ammonia are provided in NAC 445A.118.

* = The most restrictive beneficial use.
X = Beneficial use.
S.V. = Single Value
A.G.M = Annual geometric mean.
A-Avg. = Annual Average.

5.1.2 303(d) List of Impaired Waters

“The term "303(d) list" is short for the list of impaired and threatened waters (stream/river segments, lakes) that the Clean Water Act requires all states to submit for EPA approval every two years on even-numbered years. The states identify all waters where required pollution controls are not sufficient to attain or maintain applicable water quality standards, and establish priorities for development of TMDLs[2] based on the severity of the pollution and the sensitivity of the uses to be made of the waters, among other factors (40C.F.R. §130.7(b)(4)). States then provide a long-term plan for completing TMDLs within 8 to 13 years from first listing.”

“EPA policy allows states to remove waterbodies from the list after they have developed a TMDL or after other changes to correct water quality problems have been made. Occasionally, a waterbody can be taken off the list as a result of a change in water quality standards or removal of designated uses; however, designated uses cannot be deemed unattainable and removed until a thorough analysis clearly shows that they cannot be attained.”

A 303(d) listing for a waterbody is based on available data and/or information indicating that at least one designated use is not being supported. Accordingly, this would indicate a need to develop a TMDL. Impaired or threatened waters identified within Eureka County are listed in Table 5-2 and shown in Figure 5-1. To date, within Eureka County, TMDLs have been adopted for two reaches of the Humboldt River: 1) the reach between Battle Mountain and Palisade and 2) the reach from Palisade upstream to Osino. The USEPA approved TMDLS for these waterbodies are listed in Table 5-3.

In many cases, the TMDL analysis is the trigger for determining the source(s) of pollutants. EPA cannot enforce implementation of a TMDL once the analysis is complete. Although, if the TMDL requires more stringent permit limits for point sources these must be implemented in the appropriate NPDES permits at the time of their renewal. If the TMDL identifies nonpoint sources of pollutants as a major cause of impairment, states can apply for EPA funded grants, called “Section 319” grants.

[2] TMDL – "A TMDL (Total Maximum Daily Loading) is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that load among the various sources of that pollutant. Pollutant sources are characterized as either point sources that receive a wasteload allocation (WLA), or nonpoint sources that receive a load allocation (LA)."(http://toxics.usgs.gov/definitions).

Table 5-2

303(d) List of Waters in Eureka County

Water Name	Description	Parameter	Impaired Use(s)	New Listing (as of 2014)
Humboldt River	Palisade to Battle Mountain	Iron	AQL	Yes
		Manganese	IRR	
		Turbidity	AQL	
Maggie Creek	From where it is formed by tributaries [downstream] to its confluence with Jack Creek	Phosphorous (total)	AQL, RWC	
Maggie Creek	From its confluence with Jack Creek to its confluence with Soap Creek	Temperature	AQL	
Pine Creek	From its confluence with Dry Creek to the Humboldt River	Phosphorus (Total)	AQL	
		Total Dissolved Solids	MDS	
Rock Creek	Below Squaw Valley Ranch	Iron	AQL	Yes
Trout Creek	From its origin to Pine Creek	Escherichia coli	RWC	
		Iron	AQL	
		pH	PWL,RWC	

Source: NDEP, 2014. *Nevada 2012 Water Quality Integrated Report Assessment Period - October 1, 2006 through September 30, 2011.*

AQL – aquatic life

IRR – irrigation

RWC – recreation involving contact with water

MDS – municipal or domestic supply

PWL - propagation of Wildlife

Table 5-3

EPA Approved TMDL List for Waterbodies in Eureka County

Water Name	Description	TMDL Parameter	Remarks
Humboldt River	From Osino to Palisade	Phosphorous	Standard met in 2006; *not* met in 2008-10 and 2012
		Total Suspended Solids (TSS)	Standard met in 2006, 2008-10 and 2012
Humboldt River	From Palisade to Battle Mountain	Phosphorous	Standard met in 2006, 2008-10 and 2012
		Total Suspended Solids (TSS)	Standard *not* met in 2006, 2008-10 and 2012

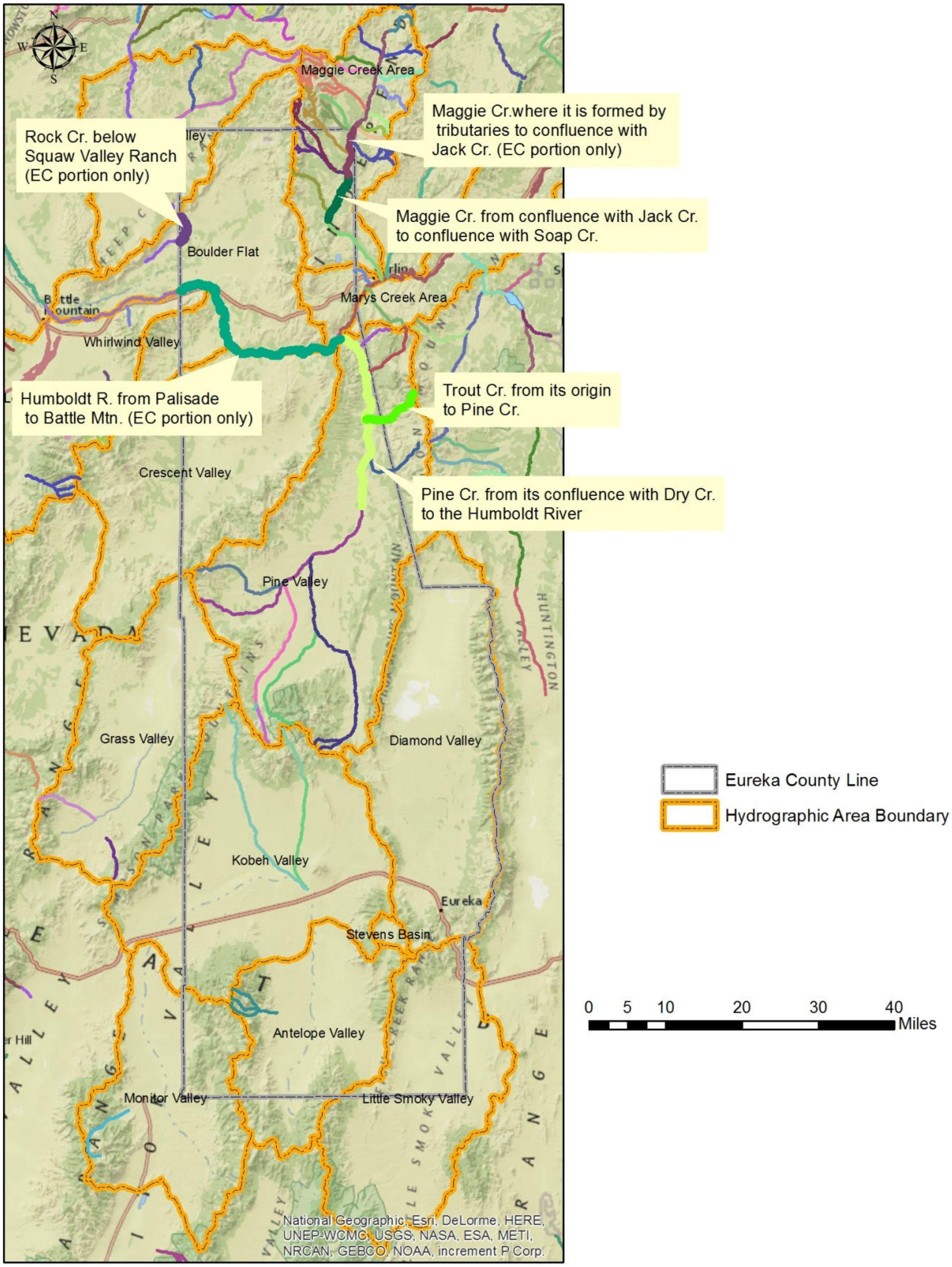


Figure 5-1. Streams Assessed in the 2012 Interim Report and Streams in Eureka County on the 303(d) List.

5.1.3 Nonpoint Sources

A synopsis of nonpoint pollution is found in the *Nevada 2012 Water Quality Integrated Report Assessment Period - October 1, 2006 through September 30, 2011* (NDEP, 2014). This summary is reprised below.

> *"Nonpoint source (NPS) pollution is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands and even underground sources of drinking water. These pollutants include:*
>
> - *Excess fertilizers, herbicides and insecticides from agricultural lands and residential areas;*
> - *Oil, grease and toxic chemicals from urban runoff and energy production;*
> - *Sediment from improperly managed construction sites, crop and forest lands and eroding stream banks;*
> - *Salt from irrigation practices;*
> - *Acid drainage from abandoned mines;*
> - *Bacteria and nutrients from livestock, pet wastes and faulty septic systems;*
> - *Atmospheric deposition; and*
> - *Hydromodification[3].*
>
> *NPS is the leading cause of water quality problems in Nevada and controlling NPS pollution remains a challenge. Sources are difficult to locate and the effects of NPS pollutants on specific waters vary and may not always be fully assessed. However, we do know that these pollutants can have harmful effects on drinking water supplies, recreation, fisheries, and wildlife.*
>
> *The Nevada NPS Pollution Management Program works with local entities to fund and implement nonpoint source pollution management projects. These projects reduce the amount of NPS pollutants that enter Nevada's waterways. Projects are varied and include channel stabilization, erosion control projects, grazing management, urban runoff management, and low impact development installations. Additionally, citizen involvement in water quality protection activities is essential for controlling NPS*

[3] Hydromodification can be any activity that increases the velocity and volume (flow rate), and often the timing, of runoff. Such activities include:

- Construction and maintenance of channels, levees, dams, and other water conveyance structures and/or impoundments for purposes of flood control, water storage, water conveyance, and navigation;
- Dredging and/or filling or other alterations to natural land contours for the purposes of new development (including transportation and other infrastructure) or navigation;
- Development of impervious surfaces (asphalt, concrete, most buildings, etc.); and
- Deforestation or removal of vegetation. (http://www.swrcb.ca.gov/water_issues/programs/nps/encyclopedia)

pollution. The Nevada NPS Pollution Management Program educates citizens on water quality issues related to NPS pollution. The NPS program has had success with outreach programs to a number of stakeholder groups in Washoe, Douglas, and Clark counties, and is currently making concerted effort to reach out to ranching and conservation stakeholders in other areas of the state (Elko, Humboldt, and White Pine counties)."

5.2 GROUNDWATER QUALITY

Concentrations of major ions (calcium, magnesium, sodium, potassium, bicarbonate, sulfate, and chloride) and total dissolved solids (TDS) in groundwater are primarily derived from dissolution of minerals in rocks and soil in contact with the water. In general, concentrations of solutes (substances dissolved in water) increase with the amount of time water has been in contact with rock and soil and, therefore, increases along the path the water flows from recharge areas to discharge areas. Therefore, concentration is typically less in recharge areas and increases along the flow path toward discharge areas. Evapotranspiration will increase concentrations of most major ions, but chemical reactions can remove selected solutes by mineral precipitation and ion exchange. Groundwater quality is frequently degraded near ore deposits where reducing conditions are often created by the presence of sulfides in the ore resulting in increased concentrations of arsenic, iron, manganese, sulfate and TDS.

Major-ion composition and TDS affect the aesthetic properties of water, such as taste, color, and odor. Although no adverse health effects associated with these aesthetic properties, they may reduce consumer satisfaction with the water or may have economic impacts. Technical properties, such as sodium adsorption ratio, may adversely affect the suitability of water for crop irrigation.

5.2.1 Drinking Water Standards

The U.S. Environmental Protection Agency (EPA) has established National Primary Drinking Water Regulations (NPDWR) that set mandatory water quality standards for drinking water contaminants. These are enforceable standards called "maximum contaminant levels" (MCLs), which are established to protect the public against consumption of drinking water contaminants that present a risk to human health. An MCL is the maximum allowable amount of a contaminant in drinking water which is delivered to the consumer.

> A primary drinking water standard sets a maximum contaminant level (MCL) for contaminants in water that present a risk to human health.

> A secondary drinking water standard sets a secondary maximum contaminant level (SMCL) for contaminants in water that address aesthetic considerations, such as taste, color and odor.

In addition, EPA has established National Secondary Drinking Water Regulations (NSDWRs) that set non-mandatory water quality standards for 15 contaminants. EPA does not enforce these "secondary maximum contaminant levels" (SMCLs). They are established only as guidelines to assist public water systems in managing their drinking water for aesthetic considerations, such as taste, color and odor. These contaminants are not considered to present a risk to human health at the SMCL. Some states, such as Nevada, have adopted the SMCLs as enforceable standards.

The primary and secondary standards for inorganic contaminants in Nevada are listed in Table 5-4. In addition to those listed below, there are standards for a host of organic chemicals (mostly pesticides and herbicides), but these are not listed in the table.

Table 5-4

Drinking Water Standards for Inorganic Contaminants

Contaminant	Maximum Contaminant Level (milligrams per Liter, mg/L, unless specified otherwise)	
	Primary MCL	Secondary MCL
Total Dissolved Solids, TDS		500 [a]/ 1000 [b]
pH (pH units)		6.5 to 8.5
Color (color units)		15
Odor (threshold odor units)		3.0
Foaming Agents		0.5
Aluminum		0.2
Antimony	0.006	
Arsenic	0.010	
Asbestos (fibers > 10 micrometers, million fibers per liter, MF/L)	7	
Barium	2	
Beryllium	0.004	
Cadmium	0.005	
Chloride		400
Chromium	0.1	
Copper	1.3 [c]	1.0
Cyanide (free cyanide)	0.2	
Fluoride	4.0	2.0
Iron		0.3 [a] / 0.6 [b]
Lead	0.015 [c]	
Magnesium		150
Manganese		0.05 [a] / 0.10 [b]
Mercury	0.002	
Nitrate (as nitrogen)	10	
Nitrite (as nitrogen)	1	
Selenium	0.05	
Silver		0.1
Sulfate		250 [a] / 500 [b]
Thallium	0.002	
Uranium (micrograms per liter, µg/L)	30	
Zinc	5.0	

Notes:
a. Recommended
b. Maximum
c. There is a required process to lower the concentration of the contaminant if present above the threshold

5.2.2 Variability of Water Quality in Eureka County

Water quality data for Eureka County are available from numerous sources. These include but are not limited to: the records of the Eureka County Public Works Department; semi-annual monitoring reports for Boulder Valley prepared by Barrick Gold Corporation and Maggie Creek prepared by Newmont Mining; annual monitoring reports for Crescent Valley prepared by Barrick; Reconnaissance Series Reports prepared for the Nevada Department of Conservation and Natural Resources, the National Water Information System (NWIS) of the United States Geological Survey; NEPA documents prepared for mining projects such as the Mount Hope Project, the Pipeline and Cortez Hills projects; and the records of the Nevada State Laboratory. To provide a sense of the variability of water quality throughout the County the concentration of total dissolved solids and arsenic are depicted in Figures 5.2 and 5.3. It must be realized that a large part of the County contains little data and it should not presumed that water quality is suitable for all purposes until a well is drilled and the chemical quality verified through chemical analysis.

5.2.2.1 Concentration of Total Dissolved Solids

From Figure 5.2 it is apparent TDS is highly variable in the aquifers throughout the county, ranging from less than 250 mg/L, which generally indicates very good water quality, to more than 2,000 mg/L. For the most part TDS is less than the recommended SMCL of 500 mg/L and well below the maximum SMCL of 1,000 mg/L. There are some notable exceptions, however.

Elevated TDS is found south and northeast of the playa in northern Diamond Valley. This high TDS groundwater is primarily derived from shallow monitoring wells along the margin of the playa near the groundwater discharge area and reflects the effect of evaporation and transpiration which concentrates dissolved solids. As discussed in previous sections, the presence of high TDS water at the playa is notable because large-scale pumping in Diamond Valley has created an extensive cone of depression in southern Diamond Valley. The result is a reversal of the natural hydraulic gradient such that the high TDS water, normally found beneath the playa can now flow in an opposite direction. The long-term consequence is migration of high TDS water toward the nearest irrigation wells, albeit at a very slow rate. Somewhat elevated TDS is also found in southern Diamond Valley along a north-south trend that roughly follows one of the floodways from Devil's Gate to the playa, but the reason for this is not evident.

Elevated TDS also occurs in groundwater derived from the mountain block west of Diamond Valley from the vicinity of Mount Hope (where Pine Valley, Diamond Valley and Kobeh Valley come together) south toward Whistler Mountain. Higher TDS is also encountered along the southern flank of Roberts Mountain. TDS levels in these areas appear to be related to mineralized areas that have been mined in the past or are the targets of future mining projects.

Elevated TDS is also found southwest of Beowawe near the boundary of Whirlwind and Crescent valleys. It is representative of the deep geothermal resource found in this area that has been exploited to generate electricity. The chemical quality of shallower, non-thermal resources in this area is not well documented nor is the degree to which the deep geothermal source is hydraulically connected to the shallow aquifers.

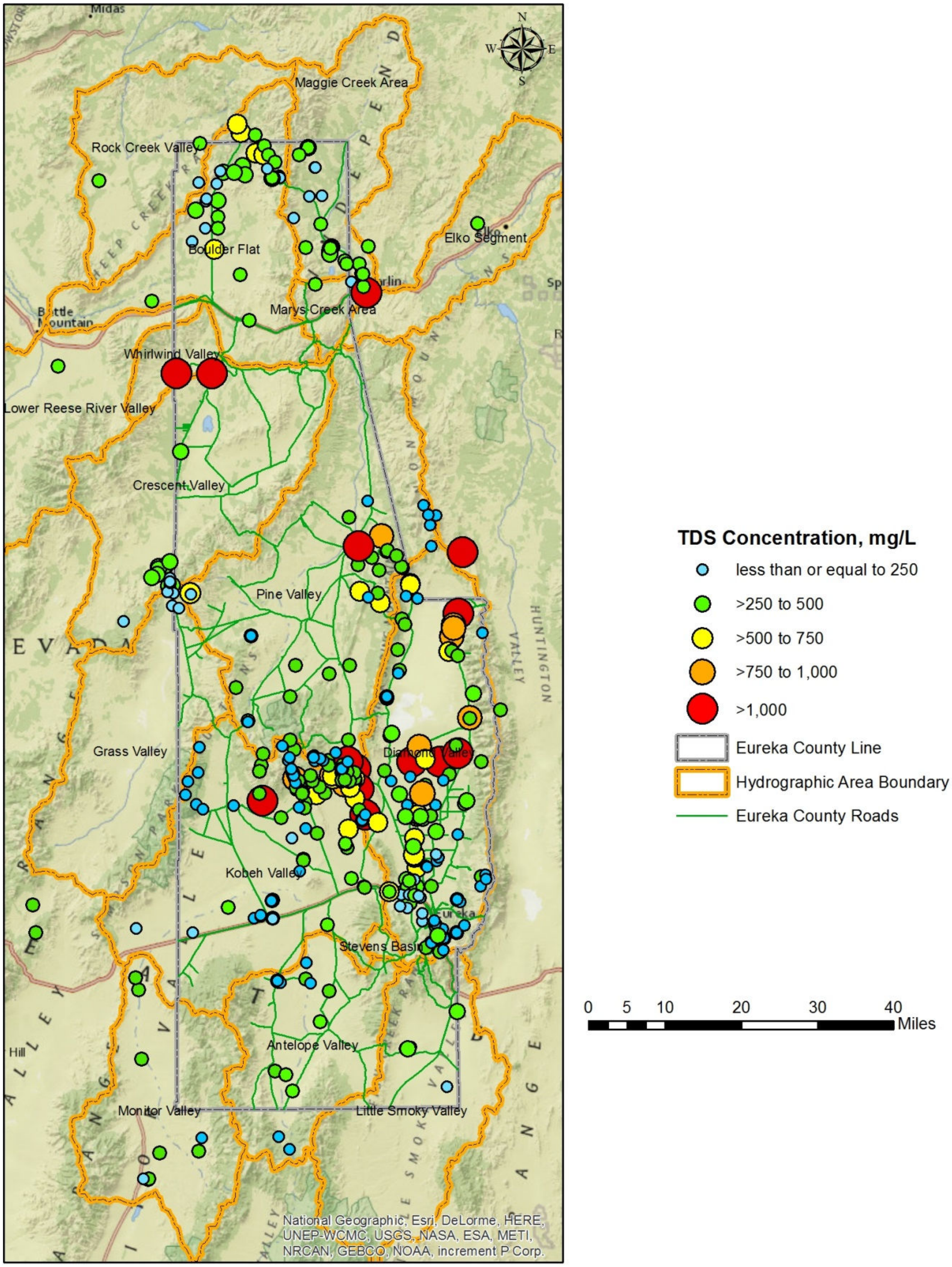


Figure 5-2. Concentration of Total Dissolved Solids, TDS, in Eureka County.

Elevated TDS in central Pine Valley is found in the area of the Blackburn oilfield. It is characteristic of water derived from relatively deep oil wells in the field.

TDS is not always elevated in the vicinity of mineral deposits. This circumstance is demonstrated by the chemical quality of the groundwater in northernmost Eureka County near Barrick's and Newmont's mining operations. For the most part, TDS near these mines is less than recommend SMCL of 500 mg/L whether derived from alluvial or bedrock aquifers, with a few sites showing concentrations of between 500 and 750 mg/L, but well below the SMCL of 1,000 mg/L. A similar situation exists for the area where Crescent Valley, Pine Valley, and Grass Valley come together in the vicinity of Barrick's mines and exploration projects.

5.2.2.2 Concentration of Dissolved Arsenic

Figure 5-2 shows variability of the concentration of arsenic in aquifers in Eureka County. Comparison of Figure 5-2 and 5-3 shows that data for arsenic in groundwater are less widely distributed than for TDS such that there are limited data or no readily available data in some basins. Note that a lack of data does not preclude water from exceeding the MCL for arsenic, merely that no data are available.

Elevated arsenic concentrations are reported for a few wells in southern Diamond Valley. These include wells at Barrick's Ruby Hill Mine which derive groundwater from bedrock and a County-owned well located north of Highway 50 and west of State Route 278 that derives water from alluvial deposits. For the remainder of Diamond Valley, data suggest relatively low concentrations of arsenic may be the norm.

In Kobeh Valley, elevated concentrations of arsenic are found along the southern flank of Roberts Mountain near the former Atlas Gold Bar Mine and one exploratory well drilled on the valley floor near the proposed Mt. Hope Project well field. There does not appear to be a strong correlation between elevated TDS (Figure 5.2) and arsenic in this area.

Elevated arsenic concentrations are shown for some wells completed in or near mineral deposits located where Pine Valley, Grass Valley, and Crescent Valley come together near Barrick's Cortez Hills project and their exploration program in southwest Pine Valley at Horse Canyon east of Mt. Tenabo.

Arsenic concentrations above the MCL are also found in groundwater supplies for the Town of Crescent Valley. The water supply to the town is treated to remove arsenic.

Relatively high concentrations of arsenic are shown west of Beowawe near the border of Crescent Valley and Whirlwind Valley. As with TDS in this area, the elevated arsenic levels are related to a high temperature geothermal resource found at relatively large depths and not reported for the relatively shallow alluvial aquifer.

Elevated arsenic is also found in central Pine Valley at the Blackburn oilfield. As is the case with TDS, it is associated with water produced from deep oil wells.

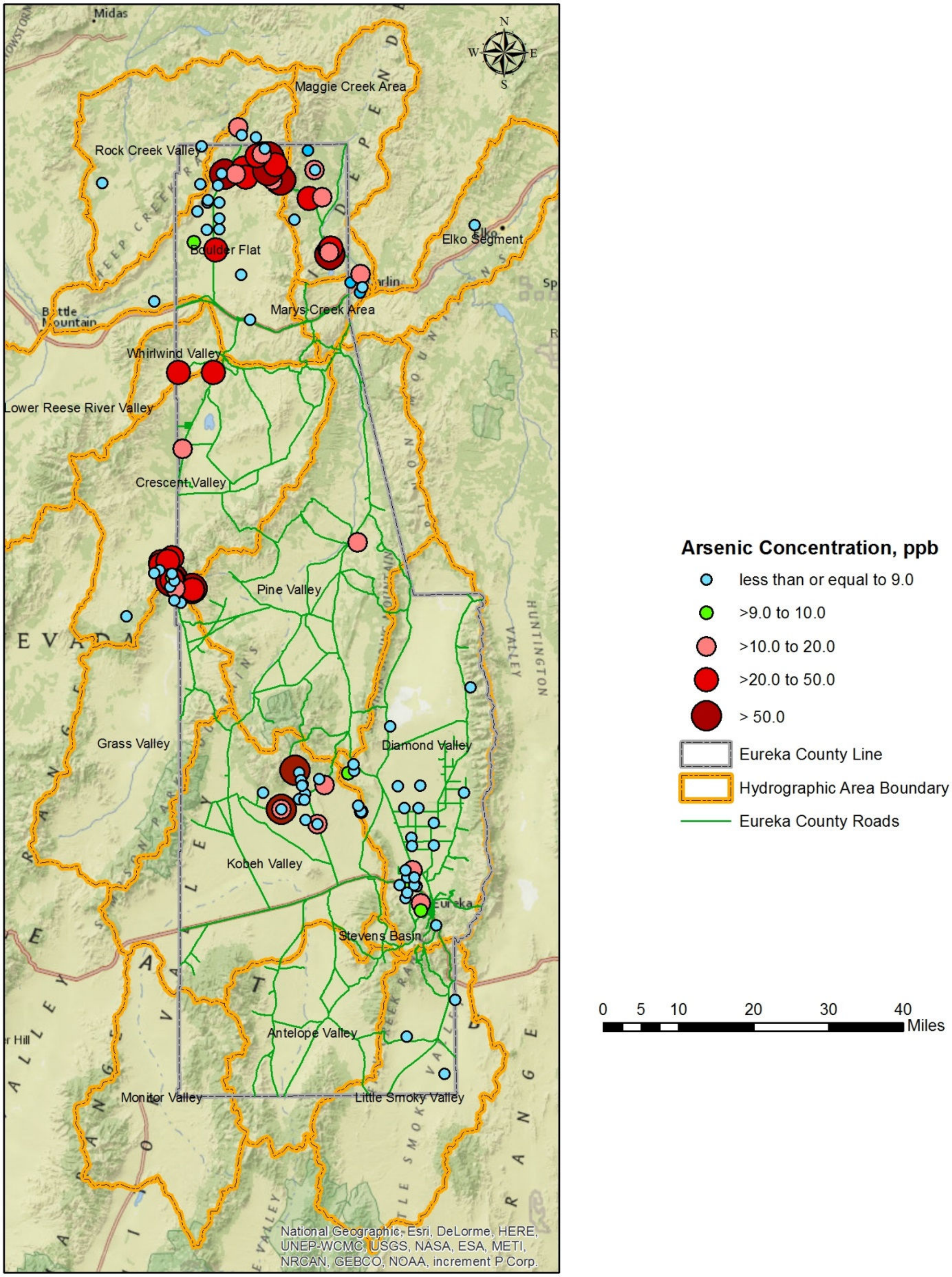


Figure 5-3. Concentration of Arsenic in Eureka County.

Elevated concentrations of arsenic are found in extreme northern Eureka County near Barrick's and Newmont's gold mining operations, although the concentration is variable. Barrick discharges water to the TS reservoir for irrigation use and much of the water infiltrates through a fissure in the volcanic rocks at this site, and the water is treated to remove arsenic. Although some water pumped by Newmont exceeds the MCL, the aggregate chemistry of the water they pump to dewater their operations and discharge to Maggie Creek is less than the MCL and does not require treatment.

5.2.2.3 Other Constituents of Concern

Nitrate

In areas of Nevada where there is a relatively high density of residences served by individual septic systems, the quality of the groundwater can become degraded with nitrate. The potential for degradation is enhanced where wells are not constructed with proper sanitary seals. In this situation, the annular space surrounding the well casing can serve as a vertical conduit for shallow water to migrate downward into the deeper horizons tapped by a well. However, Eureka County is sparsely populated and elevated nitrate from septic systems does not appear to constitute a problem even in the more populated areas of the County near the community of Crescent Valley and southern Diamond Valley. However, one of the original wells at the Devil's Gate GID acquired by the County from the land developer did experience elevated concentrations of nitrate, but it was not constructed with an appropriate sanitary seal. Its construction was modified and the issue abated. Although there is a significant livestock industry in the county, livestock are not concentrated in feedlots which can cause an increase in nitrate derived from animal wastes. Although elevated concentrations of nitrate can occur in some volcanic rock terrain, there is no evidence of such an occurrence in Eureka County.

Metals

There are a number of metals for which primary and secondary MCLs exist. However, exceedances of MCLs for these dissolved constituents are relatively rare except near some ore bodies.

Radionuclides

There are also MCLs for radioactive constituents in the drinking water supply. These include uranium metal and alpha and beta radiation. Radioactivity in water is not a recognized problem in the County, even for the Town of Eureka spring supply which derives water from igneous rocks, a common source of radioactivity in water.

5.2.3 Chemical Quality of Water for Public Water Systems Operated by Eureka County

Eureka County operates three public water systems – the Eureka Town system, Devils Gate GID system and the Town of Crescent Valley system. All three are classified as community systems regulated by the State of Nevada. The Eureka Town system is supplied by wells which tap the alluvial aquifer in southern Diamond Valley and spring sources in the mountains above the town which derive water from bedrock. The Devils Gate GID is supplied by alluvial wells in southern Diamond Valley. The water supply for the Town of Crescent Valley is derived from wells that tap alluvial deposits near central Crescent Valley. The chemical quality of the source water is provided in Table 5-3.

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Table 5-5

Chemical Quality of Groundwater for Public Water Systems Operated by Eureka County

Public Water Supply Source / Contaminant (milligrams per liter, mg/L, unless specified otherwise)	Eureka Town Diamond Valley Well 1	Eureka Town Diamond Valley Well 2	Eureka Town Springs (composite)	Devil's Gate GID District 1 Well 1	Devil's Gate GID District 2 Well 1	Crescent Valley[3] Well 1	Crescent Valley Well 2	MCL or SMCL
Total Dissolved Solids, TDS	156	164	300	216	318	330	400	500 [a]/ 1000 [b]
pH (pH units)	7.80	7.82	7.95	7.88	7.99	7.74	7.67	6.5 to 8.5
Color (color units)	<5	<5	5	<5	ND[2]	5 to 10	5 to 10	15
Odor (Threshold Odor Units)	<1	<1	0	<1	ND	ND	ND	3.0
Foaming Agents	<0.1	<0.1	<0.05	<0.1	ND	<0.050	0.051	0.5
Aluminum	<0.1	<0.1	<0.05	<0.1	<0.1	<0.045	<0.045	0.2
Antimony			<0.001	<0.001		<0.0025	<0.0025	0.006
Arsenic	0.008	0.009	0.003	0.008	0.007	0.012 (0.001 - 0.005)	0.011 (0.001 – 0.005)	0.010
Barium			0.096	0.1	0.05	0.037	0.042	2
Beryllium			<0.001	<0.0005	<0.001	<0.0010	<0.0010	0.004
Cadmium			<0.001	<0.0005	<0.001	<0.0010	<0.0010	0.005
Chloride	8	8	19	3	28	54	72	400
Chromium			0.002	<0.05	0.002	<0.0050	<0.0050	0.1
Copper	0.01	<0.01	0.002	<0.01	0.03	<0.050	<0.050	1.3 [c] / 1.0
Cyanide (as free cyanide)			<0.05		<0.01	<0.010	<0.010	0.2
Fluoride	0.3	0.3	0.2	<0.1	0.1	0.21	<0.020	4.0 / 2.0
Iron	<0.03	<0.03	<0.05	0.25	0.3	0.034	0.16	0.3 [a] / 0.6 [b]
Lead			0.002	0.001	<0.001	<0.0025		0.015 [c]
Magnesium	17	17	15	18	18	11	13	150
Manganese	<0.01	<0.01	0.001	<0.01	<0.01	<0.0050	<0.0050	0.05 [a] / 0.10 [b]
Mercury			<0.00001	<0.0005	<0.0002	<0.00010	<0.00010	0.002
Nickel			0.003	<0.02	<0.001	<0.010	<0.010	
Nitrate (as nitrogen)	0.6	0.6	0.77		1.1	<1.0	1.3	10
Nitrite (as nitrogen)			<0.05	<0.10	<0.01	<0.025	<0.50	1
Selenium			0.011	<0.005	0.003	<0.0050	<0.0050	0.05
Silver	<0.01	<0.01	<0.001	<0.01	0.02	<0.0050	<0.0050	0.1
Sodium	10	11		11	20	46	54	
Sulfate	26	24	32	28	38		110	250 [a] / 500 [b]

Thallium			<0.0005	<0.0004	<0.0005	<0.0010	<0.0010	0.002
Uranium (micrograms per liter, µg/L)	1.7	1.9			3			30
Zinc	0.02	<0.01	0.01	0.05	<0.01	<0.010	0.013	5.0

Notes:
Red denotes primary drinking water standard / blue denotes secondary standard
ND is not detected, < denotes less than a minimum reportable value
Crescent Valley's water is treated to remove arsenic and parentheses indicate treated water delivered to the distribution system
a. Secondary standard, recommended concentration
b. Secondary standard, maximum concentration
c. There is a required process to lower the concentration of the contaminant if present above the threshold
d. Analyses results listed may be from more than one laboratory report if an incomplete analyses was performed

Overall chemical quality of these community supplies is good. However, the concentration of arsenic in water from the two groundwater sources (wells) for the Town of Crescent Valley exceeds the MCL of 0.010 mg/L (0.011 and 0.012, respectively for the two sources). Arsenic treatment reduces the concentration of arsenic in the water delivered to the community to between 0.001 and 0.005 mg/L, well below the MCL. Comparison between the raw water and the treated water shows that the treatment process has little effect on the overall character of the water. Elevated arsenic is sporadic in water derived from wells in southern Diamond Valley. One well drilled for the Devil's Gate GID yields water with a concentration of arsenic greater than the MCL and is presently used only as a source of construction water.

6.0 WATER RESOURCES AVAILABLE FOR GROWTH

Objective: Estimate how much water may be available for future growth and provide insight as to where these supplies might be developed.

6.1 CURRENT USE VS. AVAILABLE RESOURCE

Chapter 2 addressed the process by which water rights are acquired in Nevada. Of particular significance was the recognition of the obligation on behalf of the Nevada State Engineer to deny applications for new appropriations or applications to change existing rights if 1) there is no unappropriated water at the source and 2) the applications will conflict with existing rights[1]. Eureka County's Land Use Master Plan and the Eureka County Code clearly demonstrate the County's support for prior appropriation. They also mandate that water resources be managed in order to ensure the resource can be beneficially used in perpetuity. Chapter 3 described the geologic conditions influencing the occurrence and availability of groundwater in Eureka County and the hydrographic areas in its Water Resource Master Plan Planning Area shared with adjoining counties. Chapter 4 provided estimates of the perennial yield of water resources in each basin within the county's planning area and discussed how these estimates of perennial yield should serve to guide sustainable water resource utilization. It also provided clear and convincing information documenting the fact that many of the basins in Eureka County's Water Resource Master Plan planning area are fully-appropriated to over-appropriated such that the provisions of NRS 533.370 (2) can reasonably be expected to guide the actions of the NSE. In this chapter (Chapter 6), committed water rights are compared to estimates of current water use and perennial yield in order to illustrate where water may be available for new appropriations or where there may need to be some adjustments of water use to allow a reasonable expectation that water resources will be available in perpetuity.

Chapter 6 also provides estimates of future water demands within the County brought about by growth.

[1]NRS 533.370 (2) states "Except as otherwise provided in subsection 10, where there is no unappropriated water in the proposed source of supply, or where its proposed use or change conflicts with existing rights or with protectable interests in existing domestic wells as set forth in NRS 533.024, or threatens to prove detrimental to the public interest, the State Engineer ***shall*** [emphasis added] reject the application and refuse to issue the requested permit. If a previous application for a similar use of water within the same basin has been rejected on those grounds, the new application may be denied without publication."

Table 6-1

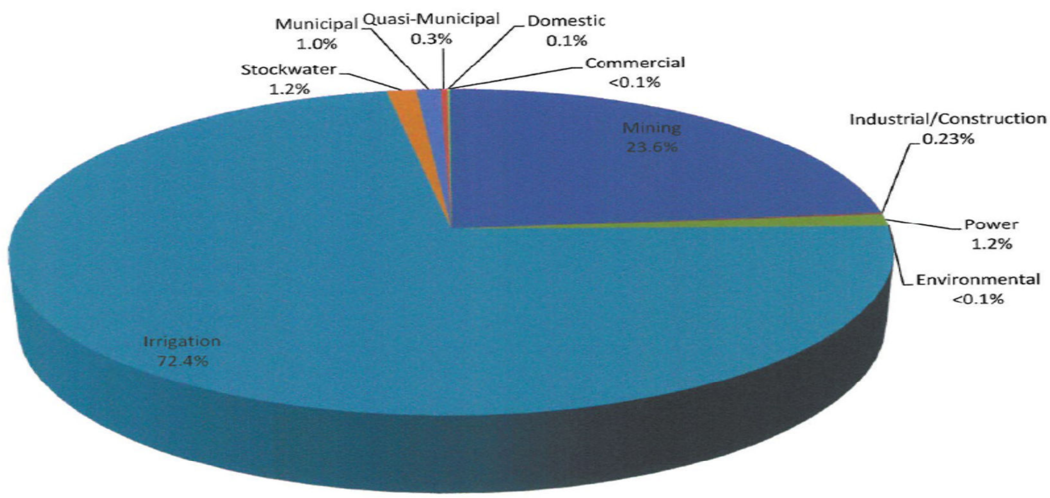
Comparison of Perennial Yield, Committed Underground Rights, and Estimated Consumptive Use for Hydrographic Areas in the Eureka County Water Resource Planning Area

Hydrographic Area Number	Hydrographic Area Name	Estimated Perennial Yield [a] (af/yr)	Committed Underground Rights (af/year)	Pending New Permits (af/yr)	Estimated Current Consumptive Use (af/yr)	Estimated Claims of Vested Rights (af/yr)	Remarks
Humboldt River Region							
49	Elko Segment	13,000	24,801	30	9,000		Committed water rights exceed estimated perennial yield. Therefore, there is no unappropriated groundwater in the basin. However, consumptive use is currently less than perennial yield.
52	Mary's Creek						
51	Maggie Creek	4,000	14,263	645	31,000		Committed water rights exceed estimated perennial yield. Therefore, there is no unappropriated groundwater in the basin. Consumptive use (primarily groundwater exported from the basin via the Humboldt River) exceeds perennial yield. Because most of this use is related to mining, this use is considered temporary.
53	Pine Valley	20,000	17,084	3,753	1,500		If pending applications are approved, committed water rights will equal or exceed perennial yield and there would be no unappropriated water in the basin. Consumptive use is currently well below the perennial yield of the basin.
54	Crescent Valley	16,000	67,333		13,000	1,900	Committed water rights exceed estimated perennial yield. Therefore, there is no unappropriated groundwater in the basin. Consumptive use is currently less than perennial yield because water pumped to dewater the mines is infiltrated back to the aquifer. Much of the pending applications relate to changes in points of diversion of existing rights and do not constitute additional usage.
59	Lower Reese River Valley	17,000	37,506	500	22,000	1,100	Committed water rights exceed estimated perennial yield. Therefore, there is no unappropriated groundwater in the basin. Consumptive use exceeds perennial yield.
60	Whirlwind Valley	3,000	4,404 (26,937)		4,000	7	Committed water rights exceed estimated perennial yield. If geothermal water rights are included, committed water rights greatly exceed perennial yield. Therefore, there is no unappropriated groundwater in the basin. Additionally, there are nearly 27,000 af/yr of water rights for geothermal uses. Most of these rights are for non-consumptive use.
61	Boulder Flat	30,000	73,117		29,000	minimal	Committed water rights exceed estimated perennial yield. Therefore, there is no unappropriated groundwater in the basin. However, consumptive use is currently about equal to perennial yield because much of the water pumped to dewater the mines is infiltrated back to the aquifer.
62	Rock Creek	2,800	2,260		2,300		Committed water rights are less than perennial yield. Therefore, there is a small quantity of unappropriated water in the basin.

Central Region							
138	Grass Valley	13,000	13,318	7,500	3,900		Committed water rights are approximately equal to perennial yield. Therefore, there is no unappropriated groundwater in the basin. If pending applications are approved, committed water rights would be significantly greater than perennial yield.
139	Kobeh Valley [b,d]	15,000	19,476		800	5,500	Committed water rights are currently less than perennial yield. If pending applications are approved, committed water rights would approximately equal perennial yield and there would be no unappropriated water in the basin. However, the NSE considers a large proportion of the water rights for mining and milling to be temporary, such that there is water available for appropriation.
140A	Monitor Valley (North) [b]	8,000	281		280	>1,000	Committed water rights are less than perennial yield. Of the perennial yield of 8,000 af/yr, 6,000 af/year are believed to be inflow to Kobeh Valley and are factored into its perennial yield.
151	Antelope Valley [b]	4,000	3,063		3,000	yes	Committed water rights are less than perennial yield. Therefore, there is unappropriated groundwater in the basin.
152	Stevens Basin [b, c]	100	19		19	0	Committed water rights are less than perennial yield. Therefore, there is unappropriated groundwater in the basin.
153	Diamond Valley [b]	30,000	134,153	6,500	80,000		Committed water rights greatly exceed estimated perennial yield. Therefore, there is no unappropriated groundwater in the basin. If pending applications for groundwater rights to mitigate the loss of spring flow are approved, the over-appropriation of the basin will be exacerbated. Consumptive use is currently about double the perennial yield. Efforts are underway to establish a Groundwater Management Area to help manage the resource.
155A	Little Smokey Valley (North)	5,000	5,056	2,000	7,000	yes	Current groundwater use includes the discharged from Fish Springs. Committed water rights exceeds estimated perennial yield. Consumptive use is slightly more than estimated perennial yield.
	Total	180,900	416,136		126,799		As a whole, Committed Underground Rights for the 16 HAs overlain by Eureka County are 2.3 times the available resource. Consumptive use, however, is approximately 70% of the available resource.

a) source: NSE Basin Summaries
b) Part of the Diamond Valley Flow System
c) Only basin entirely within Eureka County
d) Perennial yield adjusted by the NSE in 2012

The Nevada State Engineer estimated groundwater pumpage in Eureka County for the year 2013 to be approximately 181,000 acre-feet (Nevada Division of Water Resources, 2015). This quantity is virtually the same as the combined perennial yield for all 16 HAs in the Eureka County water resource planning area (see Table 6-1). Eureka County occupies only a portion of these 16 HAs, sharing them with Elko, White Pine, Nye and Lander Counties and in some instances the amount of water pumped from the Eureka County portion of a basin is very small. The largest use in the County by far is irrigation, followed by mining (Figure 6-1). All other uses combined (municipal, quasi-municipal, domestic, commercial, industrial/commercial, power, and environmental) comprise only four percent of the water estimated by the NSE as having been pumped within Eureka County in 2013.



TOTAL 2013 EUREKA COUNTY PUMPAGE: 181,000 ACRE-FEET

Figure 6-1. The Nevada State Engineer's estimate of groundwater pumping in Eureka County for the Year 2013 (source: NV Div. of Water Resources, 2015).

Uses such as municipal, quasi-municipal, mining, commercial, *etc*. are generally metered; therefore, estimates of annual usage for these uses should be reasonably accurate. The State Engineer's estimates for irrigation in Eureka County should be taken for what they are – estimates – because meter data are unavailable for a large proportion of irrigation wells. Irrigation usage is often based on Basin Summaries prepared by the NSE staff. These utilize the somewhat questionable assumption that the entire duty of a water right is pumped. For example, in Diamond Valley, the NSE estimated more than 100,000 acre-feet of groundwater was pumped for irrigation in 2013, assuming approximately 25,000 acres of irrigated land and an average duty of about 4 acre-feet per acre. A better estimate for Diamond Valley and other basins could have been obtained using 2013 National Agriculture Imagery Program (NAIP) digital imagery and the published net irrigation requirement for crops in the basin. The net irrigation requirement for alfalfa in Diamond Valley is 2.5 acre-feet per acre and the NSE assumes an irrigation efficiency of 0.85 for center-pivot irrigation, suggesting 2.9 af/acre is a better estimate of the water pumped per acre than the 4.0 af/acre assumed for the 2013 estimate. Few farmers waste electricity to pump more water than is necessary for a healthy crop, except perhaps when they might increase water use in order to prove beneficial use, and a basin-wide average is probably closer to 3.0 af/acre, although some irrigators report pumping as little as 2.1 af/acre using highly managed irrigation practices. Consequently, the amount of water pumped in Diamond Valley for irrigation is more likely closer to 75,000 af/year. In basins where NAIP imagery and Basin Inventories are both available, it seems more appropriate to rely on the aerial imagery combined with net irrigation requirements rather than assuming the entire duty of a right is pumped as is done for Basin Inventories.

In contrast to the NSE's estimate of water *pumped*, an independent assessment of *consumptive use* prepared for the Master Plan suggests that combined consumptive use in the planning area is closer to 127,000 af/yr. Table 6-1, above, compares estimates of perennial yield, committed underground rights, and planning-level estimates of current consumptive use. In combination, *committed water rights* in the 16 hydrographic areas comprising Eureka County's water resource master planning area are more than three times the combined estimated perennial yield. However, *estimated current consumptive use* in the planning area is about 70 percent of the perennial yield suggesting there are undeveloped water resources that have yet been put to beneficial use. However, remaining resources may not be located in areas favorable to development or where significant population growth is likely to occur.

In basins where committed water rights are less than the perennial yield, new groundwater appropriations can normally accommodate increased water use arising from additional demands on the resource by industry or population growth. The NSE characteristically grants water rights in excess of a basin's perennial yield if the use is "temporary" such as a mine with a defined lifespan, although temporary is not well defined in the statutes or in practice as many temporary rights have been in existence for several decades. In the basins where the total quantity of water rights exceeds the available resource, but actual consumptive use is less than the perennial yield, water consumption up to the amount of the perennial yield can be accommodated without "mining" the resource through the acquisition of water rights that are in good standing and by changing the point of diversion, place and manner of use as necessary. It must be recognized that exploiting the resource *will* result in lowering water levels in the aquifer and the capture of natural discharge. Where groundwater discharges as springs or as baseflow of a stream and has been appropriated, conflicts with senior appropriators are likely and must be considered in any resource exploitation program.

The situation where committed water rights and consumptive use both exceed the perennial yield essentially results in unsustainable groundwater mining. In this situation, it should be assumed that future development can be accommodated only through water conservation measures and transferring existing "wet" rights to the new use. Alternatively, as temporary permits expire at the conclusion of mining or other projects, water consumption will decrease, providing a potential to free up water for appropriation. However, at some point consumptive use must come into balance with perennial yield if sustainable use of the resource is to be assured.

Basins in Eureka County's planning area where *committed water rights* equal or exceed perennial yield include:

- Elko Segment HA – water rights exceed, but current consumptive use is less than perennial yield.

- Mary's Creek HA – water rights exceed, but consumptive use is less than perennial yield.
- Maggie Creek HA – water rights and current consumptive use exceed perennial yield.
- Crescent Valley HA – water rights exceed, but current consumptive use is estimated to be less than perennial yield.
- Lower Reese River Valley HA – water rights and current consumptive use exceeds perennial yield.
- Whirlwind Valley HA – water rights and current consumptive use exceeds perennial yield.
- Boulder Flat HA - current consumptive use is approximately equal to perennial yield.
- Grass Valley HA - committed underground rights approximately equal to perennial yield, current consumptive use is less than perennial yield; if pending applications are approved, committed underground rights will exceed perennial yield.
- Kobeh Valley HA – committed water rights exceed perennial yield by about 23%. Current consumptive use is well below perennial yield. Most water rights are for mining and the NSE considers mining to be a temporary use such that there may be more than 6,000 af/yr of groundwater that could be put to use for uses other than mining.
- Diamond Valley HA – water rights more than four times, consumptive use is approximately double the perennial yield.
- Little Smoky Valley (Northern Part) - committed underground rights are approximately equal to perennial yield; when the groundwater discharge from Fish Creek Springs is considered, current consumptive use exceeds perennial yield.

Basins in which there is unappropriated groundwater within the basin (committed water rights are less than perennial yield) include:

- Pine Valley HA - if pending applications are approved, the basin will become fully appropriated; current consumptive use is well below the perennial yield.
- Rock Creek HA - approximately 500 af/yr of unappropriated water in the basin
- Monitor Valley HA - committed water rights and consumptive use of groundwater are well below perennial yield; of the 8,000 af/yr perennial yield for the basin, 6,000 af/yr contributes to the perennial yield of Kobeh Valley as inter-basin flow.
- Antelope Valley HA - approximately 1,000 af/yr available for appropriation.
- Stevens Basin HA - less than 100 af/yr is available for appropriation.

Figure 6-2 shows the basins where committed water rights exceed perennial yield; therefore, there is no unappropriated groundwater in these basins. However, estimated consumptive use in some of these basins does not currently exceed perennial yield and Figure 6-2 shows where consumptive use in basins presently does not exceed perennial yield. Figure 6-2 also illustrates the basins where current consumptive use exceeds perennial yield. For the remaining basins in the planning area, committed water rights are less than perennial yield; therefore, water consumption is currently below perennial yield.

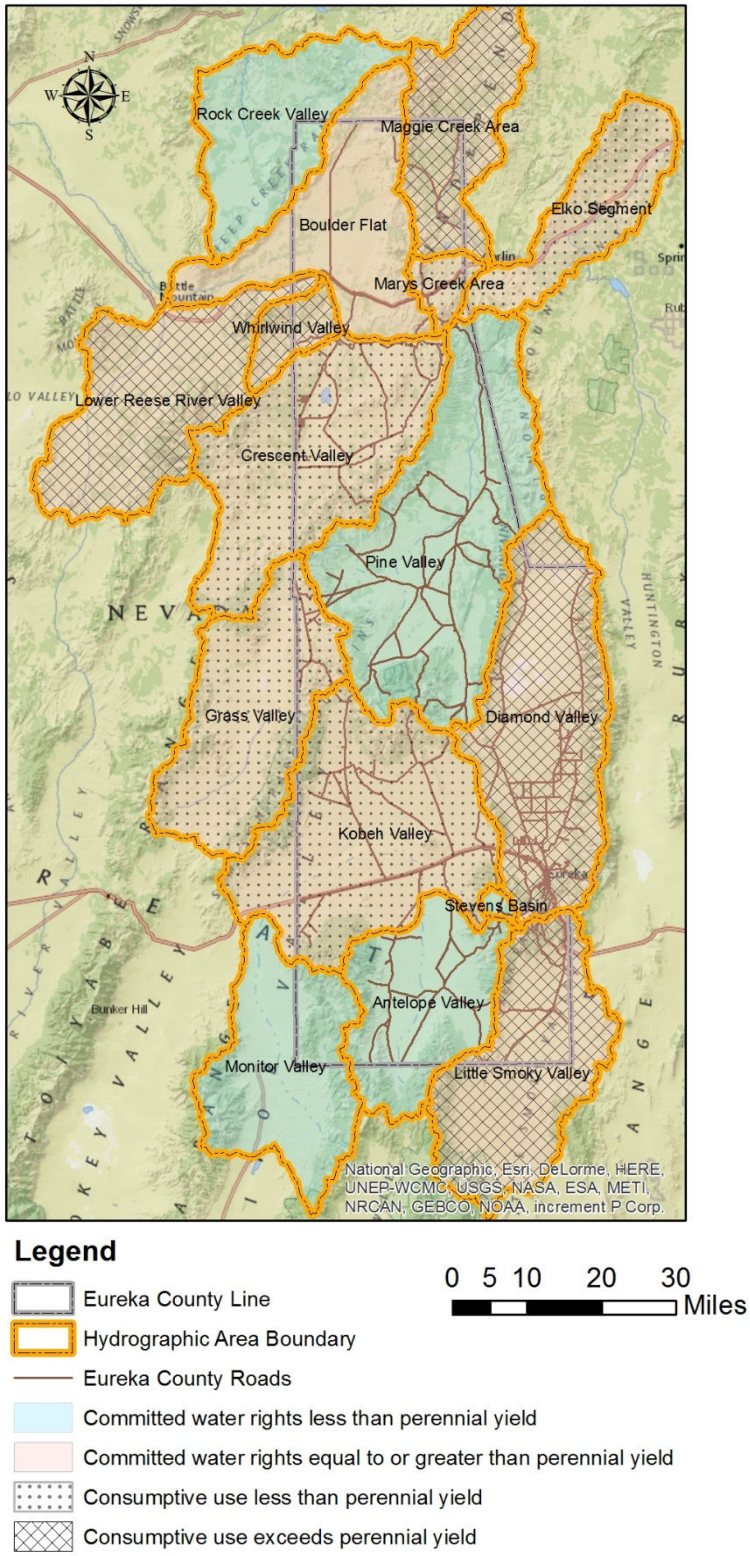


Figure 6-2. Comparison between Committed Water Rights, Consumptive Use, and Perennial Yield in Eureka County Hydrographic Areas.

The total amount of committed water rights for the basins comprising the Eureka County Water Resources Master Plan planning area is more than double the combined perennial yield. Current consumptive use over the same area is estimated at approximately 70% of the perennial yield, but there are basins where consumptive use presently exceeds the perennial yield (Figure 6-2). The water resources necessary to sustain future growth within the county must come from several sources. These are:

- The basins in Eureka County where committed water rights are less than perennial yield (Rock Creek Valley, Pine Valley, Monitor Valley, Antelope Valley, and Stevens Basin). However, the combined amount of unappropriated groundwater in these hydrographic areas is relatively small.
- Water conservation, primarily through improved irrigation efficiency or introduction of low-water use crops.
- Temporary mining water rights reverting back to the source at the conclusion of mining projects.

6.2 Future Public and Domestic Water Supply Demand

6.2.1 Population Trends

Population estimates for Eureka County, the Town of Eureka and Town of Crescent Valley are available from the Nevada State Demographer. Data from the previous 20 years are plotted in Figure 6-3.

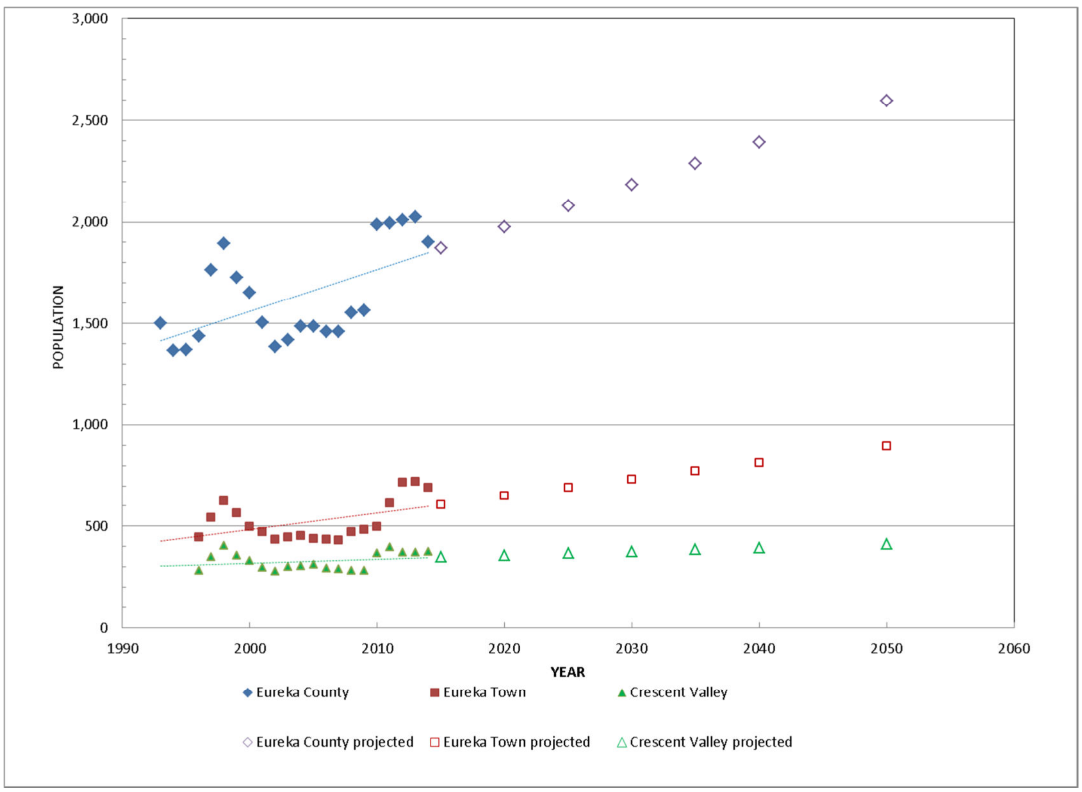


Figure 6-3 Population in Eureka County, 1993 through 2014

The data for the County as a whole and the communities of Eureka and Crescent Valley show a general upward trend punctuated by periods of rapid population rise and decrease. These variations are largely the result of the cyclical nature of the mining industry. In the absence of these booms, population trends have been relatively flat for the past 20 years.

As suggested by Figure 6-3, predicting population growth in Eureka County can be problematic because it is heavily influenced by the ups and downs of the mining industry where the opening or closing of a single mining project or a change in the price of gold can change the County's population by a substantial percentage. Figure 6-3 illustrates how the population in the County within the past 20 years has twice jumped by approximately 30 percent over the short time span of one to two years. The graph also shows that population can just as easily experience a rapid decline. Between these population spikes, however, the population has increased, albeit by a small number. The difficulty with predicting population is further illustrated by the 2010 Eureka County Land Use Master Plan which underestimated the 2014 county-wide population by 11 percent (predicted population of 1,694 versus actual population of 1,903).

There are several mining projects within Eureka County or close by in neighboring counties that are in the exploration and planning stage or which have recently come on line. These have the potential to increase direct mining-related water use in basins within Eureka County's planning area or through an increase in population resulting from the portion of the labor force choosing to reside in Eureka County. These include:

The Mount Hope Project (Pine, Kobeh and Diamond Valley)

McEwen Mining's Gold Bar Project (Kobeh Valley)

Waterton's Mineral Point Project (Diamond Valley)

Barrick's Gold Rush Project (Pine Valley)

Kinross's Bald Mountain Project Expansion (Newark Valley)

American Vanadium's Gibellini Mine (Little Smoky Valley, North Part)

Midway Gold's Pan Project (Newark Valley), operations cut back June 2015

Midway Gold's Gold Rock Project (Railroad Valley, North Part)

6.2.2 Future Municipal/Quasi-Municipal Demand

Eureka County operates three distinct community water systems – the Eureka Town Water System, the Devils Gate General Improvement District Water System and the Crescent Valley Town Water System. Although each system presently functions independently, in early 2016, the County began to evaluate the merits of combining them into a single County system. An emergency intertie links the Eureka Town Water System and the Devils Gate System, but no water is presently exchanged between them.

6.2.2.1 Eureka Town Water System

The Eureka Town Water System derives its water supply from two wells in southern Diamond Valley and 10 springs in the mountains south of the Town. The average day demand (ADD) in the Town is currently approximately 150,000 to 160,000 gallons per day (gpd) and the maximum day demand (MDD) is presently about 450,000 gpd. The spring sources alone meet approximately 40 percent of the present-day ADD for the Town and supply a larger proportion of the daily demand during the winter months.

The 2012 Water System Master Plan for the Town of Eureka and Devils Gate GID Water Systems (Lumos and Associates, 2012) categorized three areas of potential growth in the Town of Eureka.

- The Townsite – Vacant lots and available land within the Town of Eureka provide an opportunity to develop an estimated 85 additional residential lots within the Town of Eureka.
- The Eureka Canyon Subdivision – This subdivision included a plan for 232 residential and 40 commercial lots which has been since been modified to 132 single-family units, 110 multi-family units and 3 commercial parcels.
- The Prospect Subdivision – A potential buildout capacity of 113 lots.

The 2012 report concluded that demand arising from 100 percent buildout in the Town can be met by the combination of the existing wells and the springs. The Town's wells presently are equipped provide a maximum of approximately 1,296,000 gpd and the springs add approximately up to 70,000 gpd for a total capacity of about 1,366,000 gpd compared to the buildout MDD of 1,340,388 gpd.

Table 6-2

Current and Future Water Demand for the Eureka Town Water System

	Average Day Demand (gallons per day)	Maximum Day Demand (gallons per day)	Capacity (gallons per day)
Current Water Use	150,000	450,000	1,366,000 [a]
Estimated Water Use at 100% of System Buildout [b]	532,000	1,340,000	
Estimated Water Use in 2035 [c]	161,00	483,000	

a. Includes up to 70,000 gpd from springs.
b. Includes Townsite lot infill, Eureka Canyon Subdivision and Prospect Subdivision.
c. Assumes a linear increase in population based on linear regression of 1993 through 2014 population.

Source: Lumos & Associates, 2012

Because large fluctuations in population observed over the past 20 years renders predicting population in Eureka County somewhat speculative, a simple linear regression was applied to the Town's population from 1993 through 2014 and the trend was extended into the future to estimate population increase (Figure 6-3). Assuming further that future water use will be proportional to population, the ADD 20 years into the future (year 2035) was estimated to be approximately 161,000 gpd suggesting an MDD of approximately 483,000 gpd. This approximately 10 percent increase by 2035 is well below the present capacity of the Eureka Town Water System.

However, there are other factors in play that have a real potential to affect the Town Water System's ability to meet the demand projected 30 years into the future and full buildout demands. Water levels in Diamond Valley are declining at a rate of about one to three feet per year. Continued declines will ultimately affect output from the two existing Town water-supply wells to the point where they may be unable to meet the buildout demand unless something is done to stabilize the water levels in the basin. The most tenable strategy to stabilize groundwater levels is to bring water use in the basin back into balance with the perennial yield by reducing groundwater consumption. Achieving a balance between water use and perennial yield may require a 50 to 60 percent basin-wide reduction in the present-day groundwater use, based on current estimates of the perennial yield and pumping from the alluvial aquifer.

Additionally, the current protracted period of lower than average precipitation is affecting the cumulative discharge of the Town's spring sources. In 2014, the springs were yielding approximately 70,000 gpd. In early 2015 the spring discharge had decreased to about 50,000 gpd (Ron Damele, personal communication). However, the spring flows respond to recharge from precipitation and by June 2015, the spring flows had increased due to a series of rainfall events.

The Diamond Valley Hydrographic Area is a candidate for designation by the NSE as a Critical Management Area (CMA) due to the large groundwater overdraft discussed at length in other sections of this Master Plan. The designation carries with it a responsibility for the water users to develop a Groundwater Management Plan (GMP) with which to balance the basin water budget. If appropriators and water users in the basin cannot develop and implement a GMP within a 10-year period, the NSE has stated he may be left with no option other than to curtail pumping solely on the basis of priority and "only the most senior water right holders will be able to use their water right." "Even accounting for consumptive use, only 5/18/1960 dates or better would be in priority." (NSE, 2014). This means that water rights with a priority date junior (later in time) to May 18, 1960 or approximately 60 percent of water rights would be subject to curtailment.

While the Town currently holds groundwater rights in excess of the projected buildout demand (Lumos, 2012), all of its groundwater rights are junior to a priority date of May 18, 1960. Its most senior rights have a priority date of July 8, 1960 nearly two months after the NSE's suggested cutoff date and the place of use for these rights is currently limited to the Eureka County airport property, not the Town Water System. The groundwater rights at the airport property total only approximately 88 million gallons per year, which equates to approximately 55 percent of the current ADD of the Town. The most senior groundwater rights for the Town Water System have a priority date of May 23, 1962 which means they are even more junior that the rights associated with the airport property. The possibility for the Town Water System's water rights to be curtailed underscores the need for the Town's residents to take an active role in the development of a GMP. In the absence of a Groundwater Management Plan which addresses community water supplies, the Town may be compelled to purchase senior water rights just to satisfy current demand, much less any future demand.

The Town's spring sources are especially important in the event the NSE curtails groundwater pumping according to priority, but, on their own, the springs cannot meet the present-day ADD. For that reason, the Town is proposing to explore for groundwater in the Stevens Basin HA south of the community. If the exploration proves successful, that is, proves up a supply of 75 acre-feet per year, the combination of the springs and the Stevens Basin source would meet the current ADD, but probably not meet the current MDD. The County's efforts to help reduce the basin overdraft include a proposal to import 6,000 af/year to Diamond Valley from southeastern Kobeh Valley.

6.2.2.2 Devils Gate General Improvement District Water System

The Devils Gate General Improvement Water District (GID) Water System comprises two Districts northwest of the Town of Eureka. Both Districts derive their water supply from wells which exploit groundwater in the alluvial aquifer of southern Diamond Valley.

District 1 is served by the "Frontier" well with a capacity of 70 gpm, which equates to 100,800 gpd (Lumos, 2012). As of 2013 there were 17 water users in District 1 (Day Engineering, 2013). The ADD for

District 1 was determined to be 7,968 gpd, corresponding to a MDD of 23,904 gpd which is approximately one-fourth the capacity of the Frontier well (Lumos, 2012). The well clearly has sufficient capacity at present to accommodate growth within District 1, excepting the limitations discussed below.

District 2 is served by the "Gourley" well, equipped to pump 53 gpm, which equates to 76,320 gpd (Lumos, 2012). As of 2013, there were 41 water users in District 2 (Day Engineering, 2013). The District 2 ADD in 2010 was 23,788 gpd, corresponding to a MDD of 71,364 gpd, which is approximately 94 percent the capacity of the Gourley well (Lumos, 2012). The well has the capability to accommodate only a small amount of growth within District 2 for the time being.

Table 6-3

Current and Future Water Demand for the Devils Gate GID Water System

	Average Day Demand (gallons per day)	Maximum Day Demand (gallons per day)	Existing Capacity (gallons per day)
Current Water Use			
District 1	7,968	23,904	100,800
District 2	23,788	71,364	76,320
District 1 & 2 combined	31,756	95,268	177,120
Estimated Future Water Use			
District 1 & 2, combined buildout [a, b, c]	79,488	198,720	177,120 [d]
District 1 & 2, combined in 2035 [e]	35,600	106,800	

a. Assumes 138 water users at buildout versus 58 users in 2013; additional use based on lot infill only.
b. Existing water rights are sufficient to serve a total of 118 users.
c. Maximum number of water users that can be served with the existing sources is 125 (Day Engineering, 2013).
d. Declining water levels in the aquifer will affect the output of the existing sources and well production may be severely affected by the year 2020 if the current rate of decline is not arrested.
e. Assumes a 12% increase by the year 2035.

The 2012 Water System Master Plan for the Town of Eureka and Devils Gate GID Water identified areas where the GID might provide future service (Lumos, 2012). These include:

- District 1 Lot Infill – potentially 11 additional residential lots
- District 1 Future Annexation – potentially 28 additional residential lots
- District 2 Lot Infill – potentially 112 additional residential lots
- Ruby Hills Subdivision (North) – potentially 98 residential lots
- Ruby Hills Subdivision (South) – potentially 24 residential lots

The 2013 Devils Gate Water System Report update (Day Engineering, 2013) provided a different assessment of the buildout of the Districts 1 and 2 as well as the facilities necessary to serve properties currently outside of the footprint of the GID. The report update defined buildout as the infill of existing lots within the GID footprint and concluded buildout of the two Districts would amount to a total of 136 water users. The report further concluded that the combined existing supply of 120 gpm was inadequate to meet the buildout demand and represented a shortfall of approximately 20 gpm.

There are factors that will limit future water usage within the Devils Gate GID Water System just as there are for the Eureka Town Water System. First, existing water rights for the GID are sufficient for approximately 118 customers, based on current water usage, compared to 136 water users at buildout (Day Engineering, 2013). This projected buildout usage equates to approximately double the current usage, but the water rights are insufficient to supply buildout of the GID. Second, at the current rate of water level decline in the aquifer, the outputs of the GID's wells are likely to be severely impacted as soon as sometime between years 2017 and 2020, to the point they would cease to meet the even current ADD of the GID (*ibid*.).

To satisfy the demand associated with buildout as defined in the 2013 update, the Devils Gate GID must:

- Acquire additional water rights. These rights must have a priority date that will guarantee they will survive curtailment of groundwater pumping by the NSE in the event a Groundwater Management Plan that protects the GID's supply cannot be established.
- Develop new wells. The low success rate for wells in the vicinity of the Devils Gate GID illustrates it cannot be assured that new wells completed in this area will achieve the water quantity or water quality necessary to meet the GID's needs. Because of the predicted loss of capacity for the existing wells due to declining water levels in the aquifer, new wells will be needed just to meet current demands, not just the buildout demand.
- Acquire water from the Town Water System. However, the Town has water issues of its own, as was discussed in the previous pages.

To satisfy the demand associated with buildout that might arise through development of property outside the footprint of the GID seeking service or annexation into the GID, it must:

- Require dedication of groundwater rights to the District. Preference should be given to more-senior rights with a priority date that would prevent them from being subject to curtailment on the basis of priority this action is ever ordered by the NSE to address the basin overdraft. However, the District could adopt a policy where junior rights would be acceptable, but would somehow be discounted due to their lower priority.
- Require funds from developers to fully cover the cost to install new wells to meet the concomitant increase in demand and to pay for any facilities needed to treat water to remove arsenic from the supply, if treatment is necessary.

State of Nevada population data do not break out the population of the residents in the GID. The 2013 report (Day Engineering, 2013) characterized growth as relatively flat. For purpose of this Water Resources Master Plan, the GID is assumed to grow at the same percentage as the Town over the next 20 years (an estimated increase of 12 per cent). Table 6-3 provides estimates of the ADD and MDD for 20 years into the future (the year 2035), with the caveat that ongoing conditions in the aquifer might severely affect current sources of supply.

The Devils Gate GID Water System is faced with a water right situation similar to the Eureka Town Water System. That is, in the absence of a GMP for Diamond Valley that addresses the GID's long-term supply the NSE may be forced to curtail groundwater rights purely on the basis of priority, including the GID's groundwater rights. The situation appears to be more serious than for the Town Water System because the priority dates of the majority of the GID's groundwater rights are more junior than the Town's rights.

This state of affairs underscores the need for the current and future water users to take an active role in the development of a GMP for Diamond Valley.

6.2.2.3 Crescent Valley Town Water System

The Crescent Valley Town Water System obtains its water supply from two wells deriving groundwater from the alluvial aquifer in the Crescent Valley Hydrographic Area. Each well is capable of producing approximately 300 gpm, which equates to 432,000 gpd.

The maximum demand for 180 customers in Crescent Valley is based on a maximum day demand of 1.69 gpm per customer, or a MDD of 438,000 gpd (Day Engineering, 2011). Assuming that the MDD is three times the ADD, the ADD is estimated at 146,000 gpd. The MDD is presently very nearly met by either of the two wells both of which are capable of producing 300 gpm, equivalent to 432,000 gpd. The Town's water use, particularly spring through fall, includes a disproportionately high demand to irrigate the Town Park. Meter data show that since the year 2011 irrigation of the Park accounts for approximately 25 percent of the annual water usage in the Town.

Table 6-4

Current and Future Water Demand for the Crescent Valley Town Water System

	Average Day Demand (gallons per day)	Maximum Day Demand (gallons per day)	Capacity (gallons per day)
Current Water Use	146,000 [b]	438,000 [a]	432,000
Estimated Current Water Use Assuming a 25 percent Reduction in Irrigation at the Town Park	137,000	411,000	
Estimated Water Use at 100% of System Buildout [b]	532,000	1,351,000 [c]	
Estimated Water Use in 2035 [d]	141,000	423,000	

a. 180 customers times 1.69 gpm/customer (Day Engineering, 2011)
b. MDD divided by 3.
c. 515 lots times 1.69 gpm/lot
d. Assumes a 25% reduction in irrigation at the Town Park

All water in the Crescent Valley Town system is treated to reduce the concentration of arsenic in the water supply. Irrigating the park with treated water may not be the highest and best use of the Town's water. A more efficient use of the Town's water supply includes reducing the amount of treated water consumed by the park. Reducing water consumption at the park is also a means of providing more water for growth other than developing new water supply wells.

There are a total of 515 building lots within the Town of Crescent Valley. Based on current water usage, the ADD at buildout is estimated to be 532,000 gpd and the MDD 1,351,000 gpd. Clearly, the current sources of supply cannot meet this demand and additional capacity would need to be developed at high cost, considering that the existing arsenic-removal treatment facility would need to be expanded.

However, if water consumption at the Town Park can be reduced by 25 percent, the present-day ADD and MDD may be reduced to approximately 137,000 gpd and 411,000 gpd, respectively, which are less than the present day capacity of the Town Water System. This change in water use allows for growth in the Town without the need for additional facilities.

As shown in Figure 6-3, although recent growth has been characterized as "flat" (Day Engineering, 2011) the Town of Crescent Valley's population has shown a modest upward trend. Assuming this trend will hold steady for the next 20 years, water usage in the Town can be expected to increase by about three percent by the year 2035. Assuming a 25 percent reduction in irrigation at the Town Park can be achieved, the ADD and MDD of the Crescent Valley Town Water System may approach 141,000 and 423,000 gpd, respectively, by the year 2035. These estimated demands are within the current system capacity of 432,000 gpd, such that no new facilities are anticipated to be needed within the 20 year planning horizon of this Plan. Without more efficient water usage at the Town Park, the MDD may someday outstrip the ability for the current facilities, requiring additional wells and expansion of the arsenic treatment plant. Alternatively, a separate well to irrigate the park might be considered, which would eliminate the practice of irrigating with treated water.

6.2.2.4 Domestic Wells

In Nevada, a well serving a single-family residence – a domestic well - is limited to a maximum annual withdrawal of 2.0 acre-feet per year for household use including watering of a family garden, lawns, and the watering of domestic animals (NRS 534.013). Although a water right is not required for a domestic well, they do have a "protectable interest" (NRS 533.024) with a priority equal to the date it was completed (NRS 534.080 (4)). In certain instances, such as in a Critical Management Area where groundwater is being depleted, the State Engineer may restrict pumping from domestic wells (NRS 534.110.7 (b) on the basis of priority.

Domestic well usage in Eureka County is small compared to agricultural and mining use, about 0.1 percent of the total amount of water pumped in 2013. Within the 16 HAs comprising Eureka County's water resource planning area, the NSE estimates 1,708 acre-feet were pumped from domestic wells in 2013 (see Table 6.2). Of this total, 65% was pumped in the Elko Segment HA and 19% was pumped in the Lower Reese River Valley HA, both of which are mostly outside of Eureka County, indicating the vast majority of domestic water pumpage in the planning area is pumped outside Eureka County. Because the NSE manages water on a basin scale, not according to political subdivisions, water use in the neighboring counties has the potential to affect water availability in the Eureka County portion of basins.

The NSE estimates 203 acre-feet of groundwater were pumped from domestic wells in Eureka County during 2013 based on an assumption that one acre-foot per year is pumped from a domestic well (NDWR, 2015). This amounts to approximately 12% of the water pumped from all domestic wells in the County's 16 HA planning area. An undocumented number of irrigation wells in Diamond Valley also serve as sources of domestic supply for some farms and the NSE estimate of domestic use does not include domestic supplies provided by these wells.

Table 6-5

Estimated Current (2013) and Future Domestic Well Pumpage in Eureka County's Water Resource Planning Area

Hydrographic Area Number	Hydrographic Area Name	Estimated 2013 Domestic Well Pumpage [a, b] (acre-feet per year)	Estimated Additional Domestic Wells that Potentially could be drilled and used in Eureka County Portion of HAs [d]
Humboldt River Basin			
49	Elko Segment	1,117	2
52	Mary's Creek	16	73
51	Maggie Creek	13	36 [e]
53	Pine Valley	77	137
54	Crescent Valley	5	1,574
59	Lower Reese River Valley	331	8
60	Whirlwind Valley	3	93
61	Boulder Flat	18	144 [e]
62	Rock Creek	2	20
Central Region			
138	Grass Valley	4	10
139	Kobeh Valley	7	27
140A	Monitor Valley (North)	4	0
151	Antelope Valley	11	1
152	Stevens Basin [c]	0	0
153	Diamond Valley	96	218
155A	Little Smokey Valley (North)	4	2
	Total	1,708	2,335

a) Source: NDWR, 2015
b) NSE estimated domestic wells each pump one acre-foot of water per year, on average
c) Only basin entirely within Eureka County
d) Assumes a domestic well might be drilled on all existing parcels larger than one acre and includes only those parcels outside of areas that are presently served by or likely to be served by Town of Eureka, Town of Crescent Valley and Devils Gate GID water systems.
e) Excludes parcels associated with or adjacent to mining operations.

There are 3,859 privately owned parcels of land within Eureka County. Subtracting parcels that are presently or can be served by municipal water systems within the Town of Eureka and the Town of Crescent Valley, parcels that are or can be served by the Devils Gate GID quasi-municipal system, parcels presently served by domestic wells, parcels too small to be served by individual septic systems (less than one acre), and parcels related to or adjoining active mining operations, there are approximately 2,300 parcels in the County which might be served by a domestic well at some time in the future. At an annual groundwater withdrawal of one acre-foot per year per domestic well assumed by the NSE, domestic well usage in the County potentially could approach approximately 2,500 acre-feet per year, more than 10 times the current domestic well usage in the County. At the current rate of growth, this additional usage is not expected to take place in the foreseeable future. However, a single large mining project could cause a sudden increase, but the overall effect on total water use in the county due to increased domestic use still would be small.

In Eureka County, large parcels can be divided so long as no lot proposed to be served by an individual domestic well and individual sewage disposal system is less than 2.5 acres. For each new parcel, 2.0 acre-feet of water rights must be dedicated to the County (Eureka County Code, Title 8, Chapter 150.10) and the ". . . form and type water rights . . . must be acceptable to Eureka County in all respects." For an assessment of future domestic well use, only existing parcels were counted and parceling existing parcels was not addressed.

7.0 FLOODPLAIN MANAGEMENT

Objective: Help stakeholders identify, evaluate and implement management strategies to address water-resource issues.

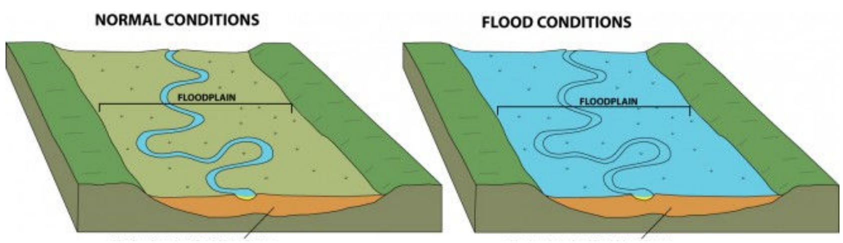


Figure 7-1. Typical Riverine Floodplain.

A riverine floodplain is the low-lying, relatively flat area along a stream that floods. In many parts of the US, this flooding occurs on fairly regular intervals in response to annual spring runoff. In northern Nevada, floodplains are generally associated with the Humboldt, Reese, Truckee, Carson, and Walker Rivers. In wet years, these rivers may overtop their banks to flood the lowlands along their courses at various locations and to different degrees. Less expansive floodplains in Eureka County are associated with the larger creeks such as Pine Creek and Maggie Creek. Playas in some of the valleys in Eureka County also occasionally flood and can be considered to be part of the floodplain.


Figure 7-2. Typical Alluvial Fan.

Nevada differs from many other states in that there are so few large streams in the state with riverine floodplains. Instead, flooding more frequently occurs on the alluvial fans situated below the fronts of the state's many mountain ranges. In this environment, the floodplain does not occupy the flat valley floor, but flooding takes place in the canyons and on the sloping alluvial fan. In contrast to riverine flooding, alluvial-fan flooding is more commonly the result of localized intense precipitation events such as a thunderstorm. High intensity, short duration precipitation falling on the watershed above the fan can generate large water flows moving at high velocity down the canyons and carrying considerable sediment and debris. Below the range front the flash flood spreads out, dispersing the water, debris and sediment. This process repeated over many years is what forms the characteristic fan shape. Alluvial-fan flash floods can be more damaging than riverine floods because of the very high velocity of the water and the associated debris flows. They are dangerous in that they are difficult to predict and the pattern of flooding at any one location can vary from one event to another. In extreme cases, the flash flood can travel beyond the fan to the valley floor. The Eureka County Road Department and the Nevada Department of Transportation periodically must clear roadways of the debris left by flash floods and repair culverts and roadside ditches damaged by erosion. Alluvial-fan flooding is especially dangerous to new residents of the state as well as travelers who may not be familiar with the desert environment.

7.1 FLOODPLAIN MANAGEMENT IN EUREKA COUNTY

According to the Nevada State Water Plan, “Floodplain management consists of planning and implementing programs designed to alleviate the impact of flooding on people and communities.” “The two overarching purposes of floodplain management at all levels are (1) to avoid or at least minimize the damage and disruption caused by floods, and (2) to protect natural floodplain resources and functions as much as possible.” (The Association of State Floodplain Managers, 2003. *Floodplain Management, 2003 State and Local Programs:* http://www.floods.org). The natural function of floodplains is to store and move floodwaters which help to reduce the flow velocity and the height of flood peaks. They also play crucial roles in maintaining biodiversity and ecosystem integrity: they filter nutrients and impurities, process organic wastes, moderate water temperature fluctuations, reduce sedimentation, promote water infiltration and enhance aquifer recharge. Recharge to the alluvial aquifers in Eureka County also takes place on the alluvial fans from the perennial and ephemeral streams that cross them. Occasional floods add to recharge of valley-fill aquifers. Floodplains provide open space, wildlife habitat, plant growth, and recreational opportunities. Periodic flooding is also responsible for the continued fertility of agricultural lands.

Small communities typically have no floodplain management program. If they do have one, it is often delegated to the building department. The Eureka County Public Works Department maintains flood-control facilities (roadside ditches, detention ponds, *etc*.) in the County. Eureka County has no zoning or building codes and, therefore, exerts no control over what happens in a flood plain. Common sense, however, dictates that it is unwise to build at the mouth of a canyon due to the risk associated with flash flooding or to construct facilities in areas subject to riverine flooding.

On account of its rural nature, Eureka County is not challenged with many of the issues associated with floodplains to the same degree as the more intensely developed areas of the state. For example, the largest areas of the county vulnerable to riverine flooding along the Humboldt River are primarily pasture land, which can be relatively unscathed by flooding. However, flooding can impact irrigated lands through erosion and sediment deposition. In urbanized areas, large tracts of land can be topped with impermeable surfaces (roads, parking lots, rooftops, *etc.*) that decrease infiltration of precipitation and increase runoff leading to increased flooding potential. The small population of Eureka County translates to a very small area overlain by impermeable surfaces such that development has not translated to large areas that have been paved or otherwise covered by impermeable surfaces. However, this means that development can lead to localized issues within the County. Mining can bring about large-scale changes in the landscape which can alter its runoff characteristics. Wildfires can remove virtually all vegetation in watersheds, leading to increased flood potential.

7.1.1 Floodplain Management and the Eureka County Natural Resource and Land Use Plan

The Eureka County Natural Resource and Land Use Plan, adopted in 2010, was

> *". . . designed to: (1) protect the human and natural environment of Eureka County, (2) facilitate federal agency efforts to resolve inconsistencies between federal land use decisions and County policy, (3) enable federal and state agency officials to coordinate their efforts with Eureka County, and (4) provide strategies, procedures, and policies for progressive land and resource management."*

Awareness of the potential for flooding to affect the human and natural environment is implicit in the County's Natural Resources and Land Use Plan which strives to protect the County's water resources.

7.2 DELINEATED FLOODPLAINS IN EUREKA COUNTY

The primary vestiges of flood plain management in Eureka County are the maps developed by the Federal Emergency Management Administration (FEMA) for the National Flood Insurance Program (NFIP). These maps depict approximate areas where there is a one percent chance that flooding will occur in any given year (the so-called 100-year flood) or that there is a 26 percent chance of flooding over the life of a 30-year mortgage. This area is referred to as "FEMA Zone A." The maps are tools to assess the necessity for and cost of flood insurance. Figure 7-3 shows the delineated floodplains in Eureka County as a whole and the subsequent figures provide greater detail for the various hydrographic areas within the county. In total, there are approximately 340 square miles of land currently defined as floodplain in the county. Note that FEMA's analysis did not include alluvial-fan areas that have a potential for flooding. Virtually every canyon in the mountains has a risk for a flash flood to occur, but as stated previously, these flash floods are nearly impossible to predict. The maps provided below should not take the place of a detailed study of flooding potential. Rather they serve as tools to alert the public to the fact that riverine flooding does occur in the county and incite individuals to assess for themselves whether or not a specific land use may be subject to adverse effects arising from flooding.

7.2.1 FEMA Zone A Lands in Eureka County Portions of Boulder Valley, Maggie Creek and Mary's Creek Hydrographic Areas

Figure 7-4 illustrates the land in the Eureka County portion of the Boulder Valley, Maggie Creek and Mary's Creek Hydrographic Areas classified by FEMA as Zone A. Note that no land in the Eureka County portion of the Rock Creek Valley HA is classified as FEMA Zone A. Within Zone A delineated in these basins, virtually all of the land is used for agricultural purposes.

Approximately 44,000 acres of land in the Boulder Flat Hydrographic Area are classified as FEMA Zone A. The largest contiguous area is located east of the Eureka County line near Dunphy and is associated with the Humboldt River, Boulder Creek and Rock Creek. Most of this land is used for pasture, but it includes approximately two-thirds of the fields Newmont irrigates with center pivots. Zone A for Boulder Flat also incorporates the land along the Humboldt River between Dunphy and Beowawe and a narrow strip of land north of the Humboldt River upstream of Beowawe eastward to the boundary with the Mary's Creek HA downstream of Palisade.

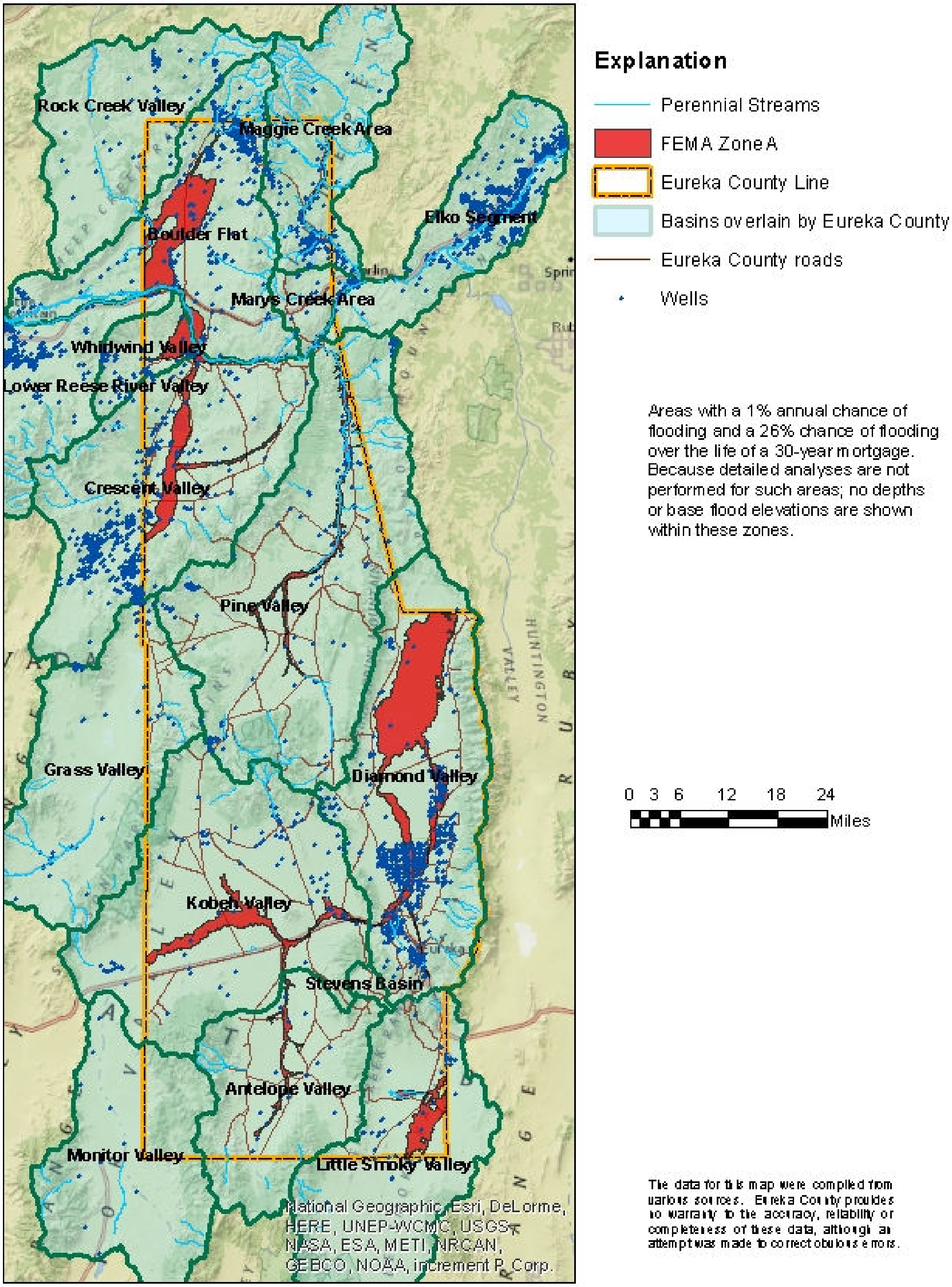


Figure 7-3. FEMA Zone A Lands in Eureka County.

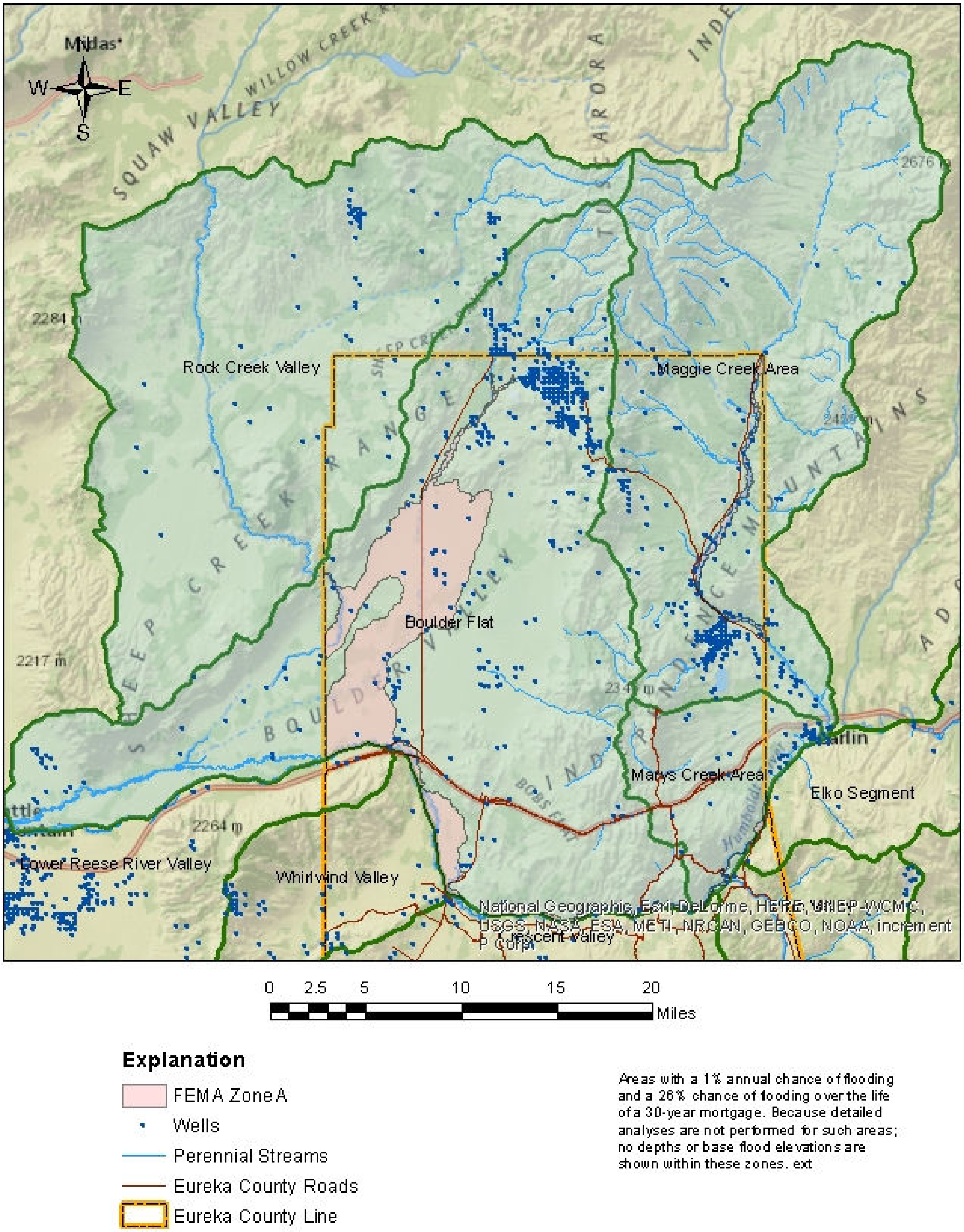


Figure 7-4. FEMA Zone A Lands in Eureka County Portions of Rock Creek Valley, Boulder Valley, Maggie Creek and Mary's Creek Hydrographic Areas.

In the Mary's Creek HA, land mapped as FEMA Zone A in Eureka County comprises a narrow strip of land north of the Humboldt River from the boundary with the Boulder Flat HA upstream to the Eureka County line. Approximately 500 acres are estimated for this part of the Humboldt River floodplain in Eureka County and the primary use of the land is pasture. FEMA Zone A is mapped for the portion of the Maggie Creek Hydrographic Area upstream of the Eureka County line. It represents a narrow strip of land along the creek in the canyon with an area of approximately 2,200 acres upstream of Newmont's Gold Quarry mine.

7.2.2 FEMA Zone A Lands in Eureka County Portions of Pine Valley and Elko Segment Hydrographic Areas

Figure 7-5 illustrates the land in the Eureka County portion of the Pine Valley and Elko Segment Hydrographic Areas classified by FEMA as Zone A. Nearly 13,000 acres are classified as floodplain in Pine Valley. The floodplain occupies a narrow strip that straddles Pine Creek from its confluence with the Humboldt River south to the Alpha Road a few miles north of Roberts Mountain. It contains land adjacent to major tributaries including Henderson Creek and Denay Creek. Virtually all of this land is used for agricultural purposes such as pasture and growing meadow hay and alfalfa.

In the portion of the Elko Segment HA within Eureka County, FEMA Zone A occupies 137 acres south of the Humboldt River.

7.2.3 FEMA Zone A Lands in Eureka County Portions of Lower Reese River Valley, Whirlwind Valley and Crescent Valley Hydrographic Areas

Figure 7-6 illustrates the land in the Eureka County portions of the Lower Reese River Valley, Whirlwind Valley and Crescent Valley Hydrographic Areas classified by FEMA as Zone A. In the small portion of the Lower Reese River HA within Eureka County near Dunphy situated between the Humboldt River and Interstate 80, approximately 700 acres south of the Humboldt River are classified as floodplain. The land in this area has been developed for commercial purposes.

In the Whirlwind Valley HA, approximately 8,600 acres are classified by FEMA as Zone A. It comprises most of the valley floor from the Humboldt River southwest to the Eureka County line. The principal use of this land is agriculture, including pasture and meadow hay land irrigated by surface water from the Humboldt River. The geothermal development in the valley is outside of the flood plain.

The approximately 25,000 acre floodplain in Crescent Valley comprises a strip of land approximately one to two miles wide, including a small playa, east of the Town of Crescent Valley and oriented along the axis of the valley from Beowawe south-southwest to the Eureka County Line. It includes a narrow band of land south of the Humboldt River east of Beowawe and a narrow strip of land trending east to northeast along the axis of the portion of Crescent Valley that lies between the Dry Hills and the Cortez Mountains. Development within the Crescent Valley floodplain is limited. A small number of residences are situated along its margin and there are a few stock-water wells in the floodplain. The major land use is grazing.

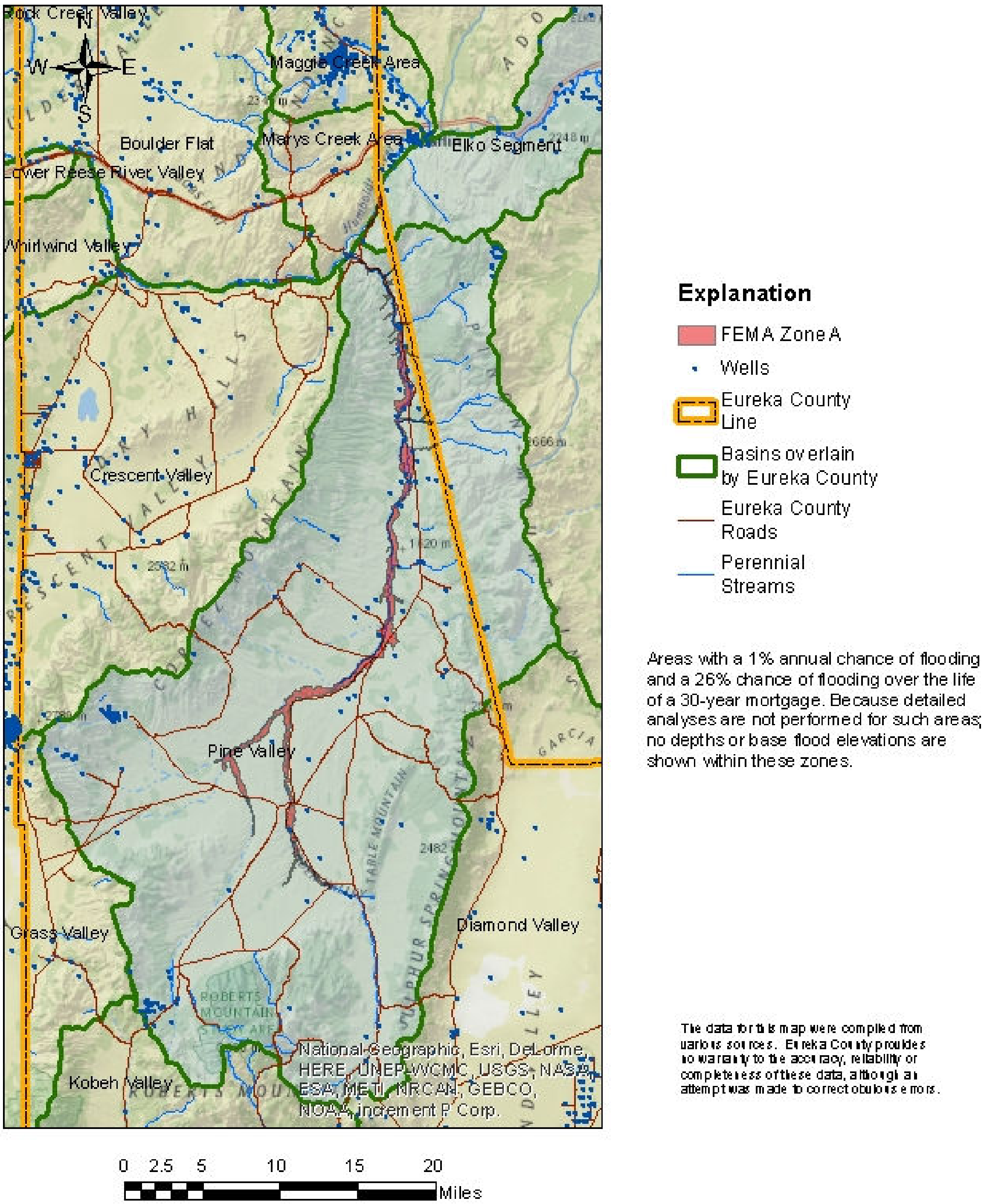


Figure 7-5. FEMA Zone A Lands in Eureka County Portions of the Pine Valley and Elko Segment Hydrographic Areas.

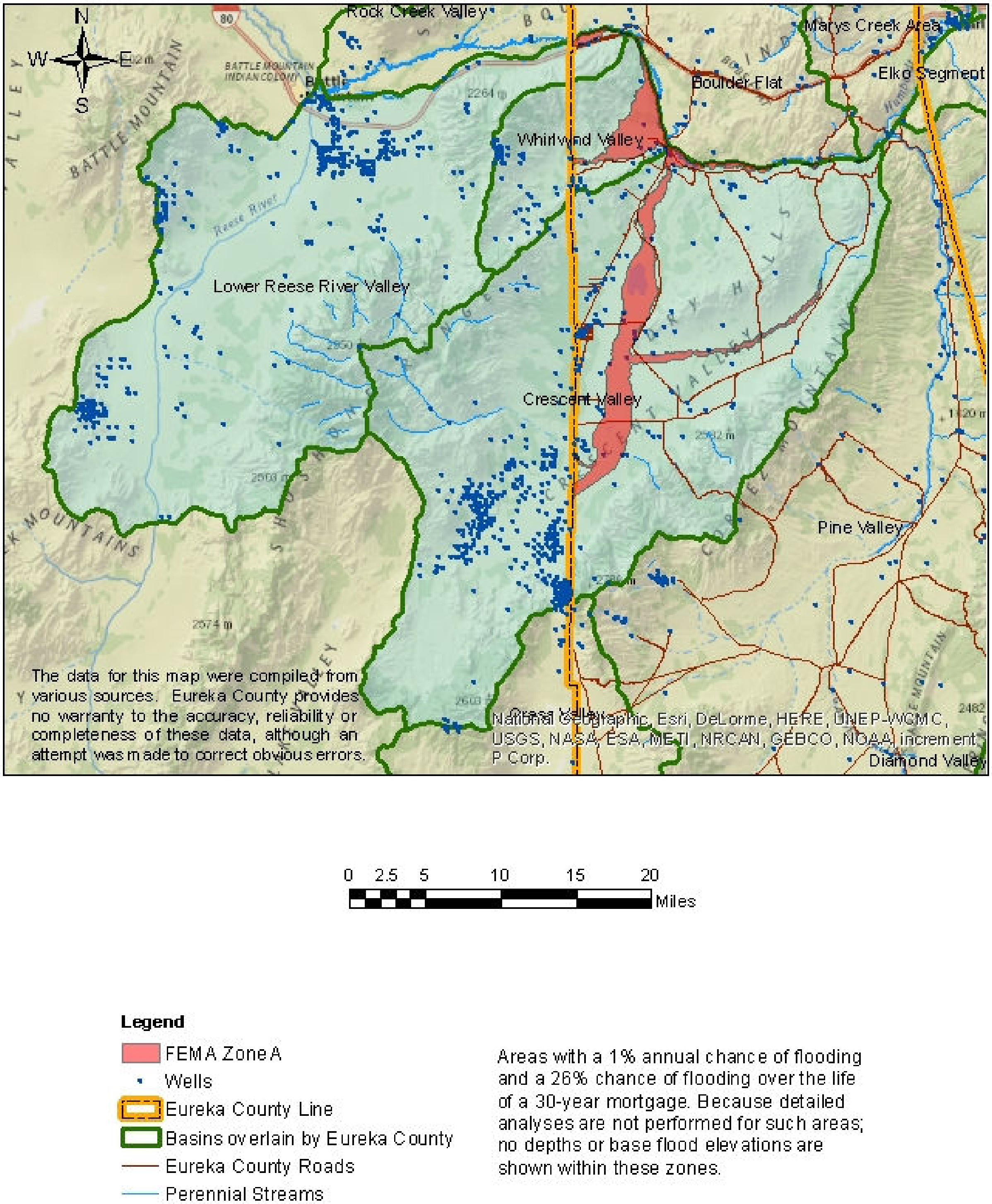


Figure 7-6. FEMA Zone A Lands in Eureka County Portions of the Lower Reese River Valley, Whirlwind Valley and Crescent Valley Hydrographic Areas.

7.2.4 FEMA Zone A Lands in Eureka County Portions of Grass Valley and Kobeh Valley Hydrographic Areas

Figure 7-7 illustrates the land in the Eureka County portion of the Kobeh Valley Hydrographic Area classified by FEMA as Zone A. Note that FEMA did not delineate any floodplain areas In the Eureka County portion of the Grass Valley HA.

FEMA delineated approximately 24,000 acres of land in the Kobeh Valley HA as Zone A. The floodplain is located in the southern half of the basin, north of Highway 50, and follows the Stoneberger Creek wash from the county line eastward toward Devils Gate. It includes the lower reaches the Coils Creek, Roberts Creek, Antelope Valley Wash, and Slough Creek. All of these streams are ephemeral, carrying water in response to snowmelt or as a result of thunderstorm activity. Occasionally, flash floods carry water, sediment and debris onto Highway 50. Slough Creek has historically recorded peak flows of about one to two cfs at Devil's Gate, but in 1983, it reportedly carried a large quantity of water out of the basin into Diamond Valley via Slough Creek. Land use within the Kobeh Valley floodplain is primarily grazing, although grass hay has been grown historically at a few locations such as the Hay Ranch and Bean Flat.

7.2.5 FEMA Zone A Lands in Eureka County Portions of Monitor Valley (North Part), Antelope Valley, Stevens Basin and Little Smoky Valley (North Part) Hydrographic Areas

Figure7-8 illustrates the land in the Eureka County portions of the Monitor Valley (North Part), Antelope Valley, Stevens Basin, and Little Smoky Valley (North Part) Hydrographic Areas classified by FEMA as Zone A. Note that FEMA did not delineate any floodplain areas In the Eureka County portion of the Monitor Valley (North Part) HA or Stevens Basin.

The floodplain in Antelope Valley represents a narrow strip that traces Antelope Wash oriented along the axis of the valley from a point about three miles north of the Eureka County line to a location about five miles south of Highway 50 at the boundary with Kobeh Valley. It covers approximately 5,600 acres used almost exclusively for grazing. Antelope Wash continues northward in Kobeh Valley to its confluence with Slough Creek near Highway 50.

FEMA delineated approximately 14,000 acres of land in the Little Smoky Valley (North Part) HA as Zone A. The floodplain occupies the central portion of the broad valley floor in the Eureka County portion of the basin. It also includes land along Fish Creek, which flows from the west and continues to the northeast toward the county line. Irrigated agriculture is practiced in the floodplain along Fish Creek, but for the vast majority of the floodplain the principal use is grazing and there is virtually no development in the floodplain outside of Fish Creek Ranch.

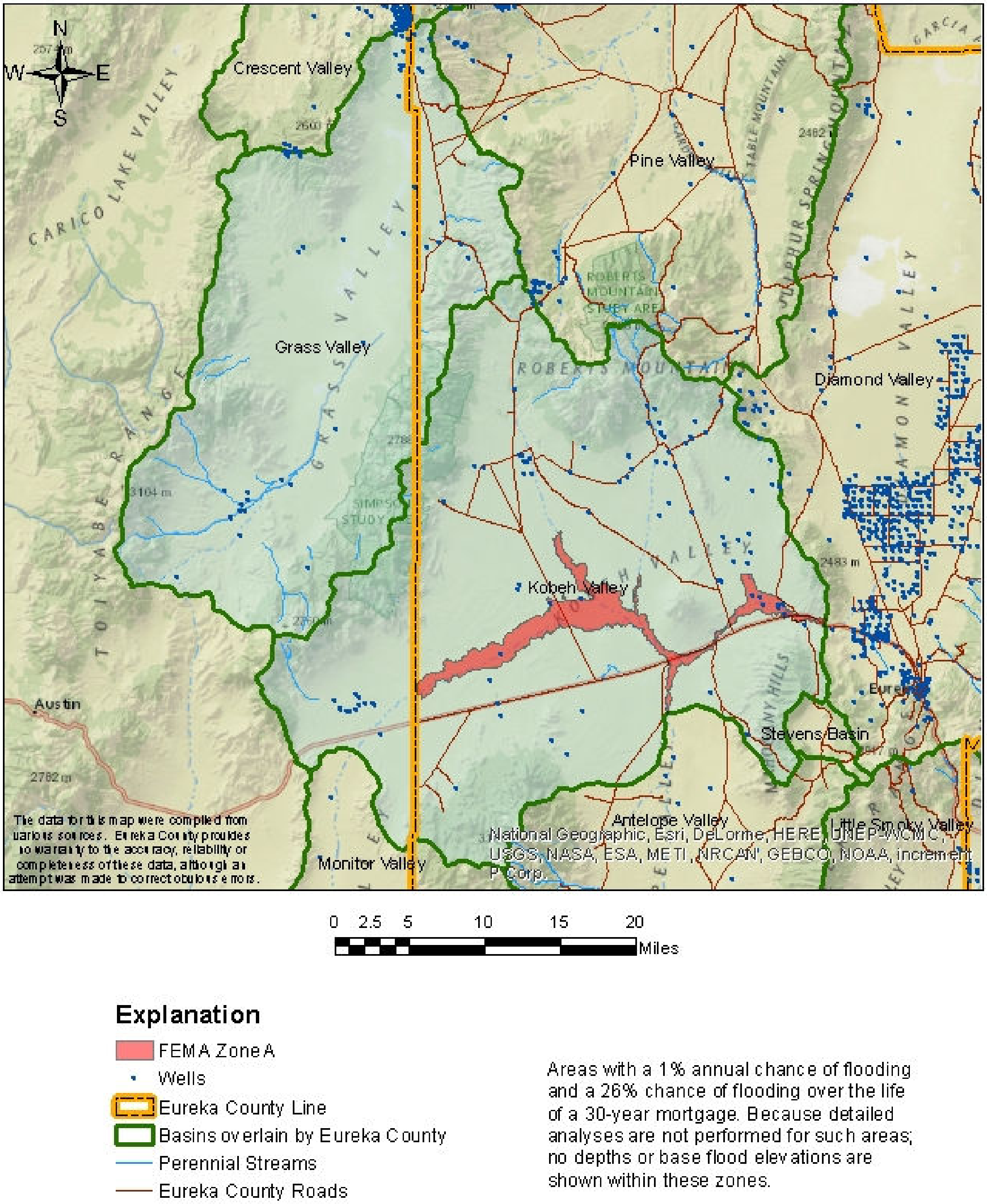


Figure 7-7. FEMA Zone A Lands in Eureka County Portions of the Grass Valley and Kobeh Valley Hydrographic Areas.

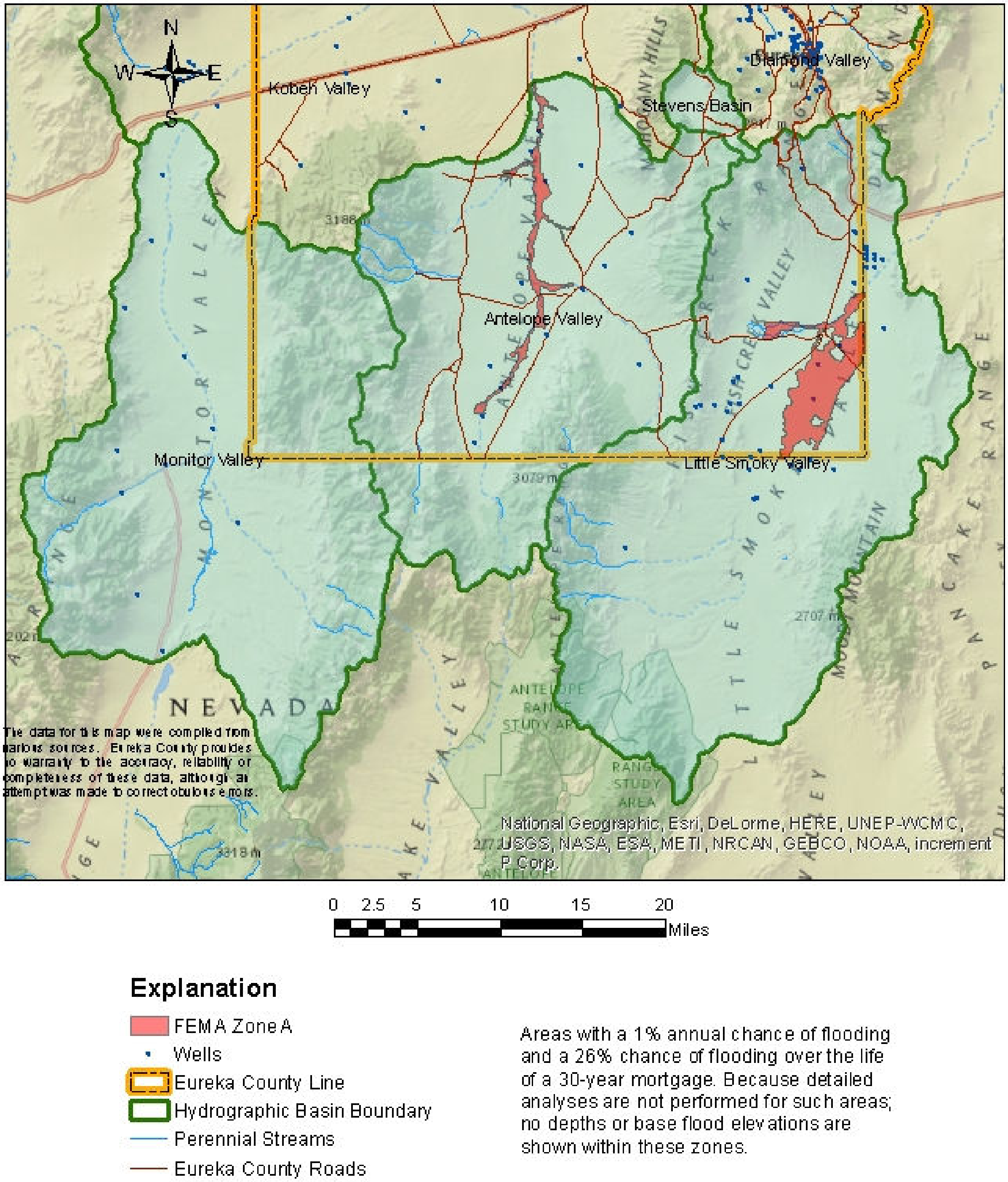


Figure 7-8. FEMA Zone A Lands in Eureka County Portions of the Monitor Valley (North Part), Antelope Valley, Stevens Basin and Little Smoky Valley (North Part) Hydrographic Areas.

7.2.6 FEMA Zone A and Zone AE Lands in Eureka County Portions of Diamond Valley

Figure 7-9 depicts the approximately 81,000 acres delineated in Diamond Valley as FEMA Zone A floodplain. Of this, approximately 60,000 acres are coincident with the playa in northern Diamond Valley. The remainder is primarily related to floodways that run from Devil's Gate to the playa. An approximately one-half to one-mile wide floodway extends approximately eight miles northeasterly from Devil's Gate to the axis of the valley midway between 7th and 9th Streets. There it bifurcates into a floodway that roughly parallels the range front in the eastern portion of the basin and the other more or less tracks along the axis of the basin for several miles before gradually shifting to the western margin of the basin as it nears the playa. These delineated floodplains incorporate land used to grow alfalfa and grass hay where perhaps as many as 60 fields or parts of fields are located so as to be potentially affected by a 100-year flood. Several residences are also situated along the floodplain.

Land in the canyon along Eureka Creek from the valley floor north of town to approximately one mile south of town is also classified as Zone A. Through the town itself, the floodplain is mapped as Zone AE, signifying that base flood elevations for a flood that has a one percent chance of occurring in any given year have been evaluated. Zone AE is about 450 feet across at its widest point and a number of commercial and residential properties are located within the floodplain. In addition, a stockpile of contaminated soil removed by the U.S. Environmental Protection Agency to remediate high concentrations of lead and arsenic is partially located within the floodplain. The Town has been ravaged by disastrous floods in the past. Long-time residents are aware of the flooding history of the town, but new residents may not be knowledgeable.

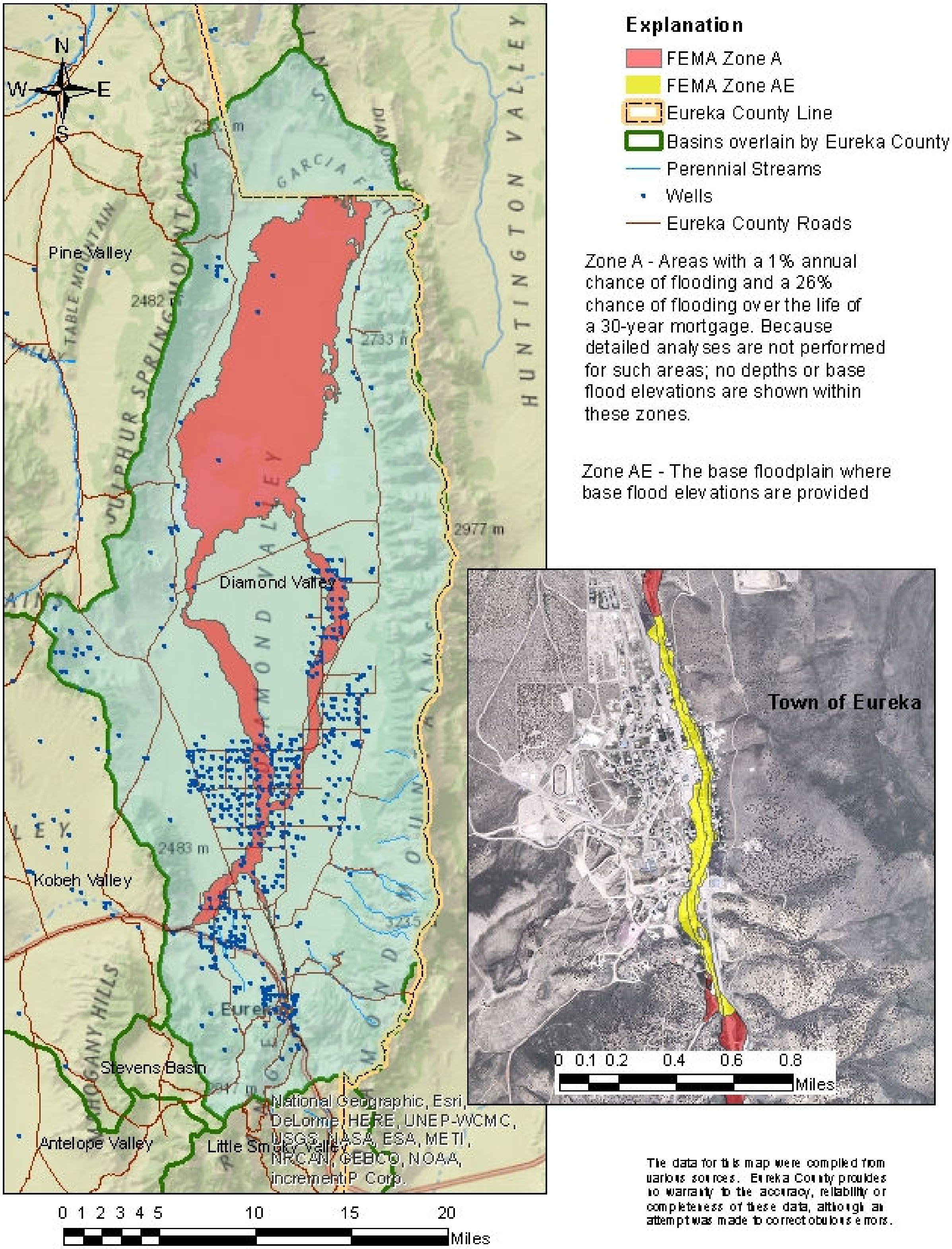


Figure 7-9. FEMA Zone A and Zone AE Lands in the Eureka County Portion of the Diamond Valley Hydrographic Area.

8.0 MANAGEMENT ALTERNATIVES

Objective: Ensure that water and water resource related management actions are consistent with Eureka County plans, policies, and desires through local, grass-roots planning and management of the water resources within Eureka County.

Objective: Help stakeholders identify, evaluate and implement management strategies to address water-resource issues.

Objective: Coordinate with the Nevada Division of Water Resources, other federal, state and local agencies (e.g., Eureka Conservation District), the Central Nevada Regional Water Authority, and the Humboldt River Basin Water Authority, to efficiently manage the resource to the benefit of all stakeholders in a manner consistent with County plans and policies and the letter of the applicable laws.

The goal of Eureka County's Water Resources Master Plan is based on existing Eureka County policies as stated in the Eureka County Code and Eureka County Natural Resources and Federal or State Land Use Element of the Master Plan.

County Code 9.30.060.C (3) & (5):

> *"Eureka County mandates the use of peer-reviewed science in the assessment of impacts related to water resource development."*

and

> *"Eureka County will continue to work to maintain its water resources in a condition that will render it useable by future generations for the full range of beneficial uses that further a viable and stable economic and social base for its citizens."*

Master Plan 6.1.4:

> *"[I]t is the policy of Eureka County that Federal and State programs make progress towards improved resource quality, greater multiple uses of the federal lands, preservation of custom, culture and economic stability of Eureka County, and protection of the rights of its citizens. Eureka County will continue to urge state and federal employees to participate in this effort to coordinate in order to resolve inconsistencies between federal proposals and County policy.*
>
> *Successful implementation of this Plan requires that the Eureka County…stay involved with analysis and evaluation through all stages of federal, state and local planning efforts. County involvement must include, at minimum, review of data for scientific and factual soundness, plan development, implementation, monitoring, and evaluation of plan implementation."*

Consistent with these goals and policies, Eureka County has actively monitored water rights applications in the County which has resulted in formal protests and participation in administrative hearings before the Nevada State Engineer to assess whether or not new water right appropriations or changes to existing permits conflict with existing water rights of County residents and business interests. The County is also diligent in working to ensure that federal land management agencies, primarily BLM and USFS, properly coordinate their land use management and planning activities for consistency with County plans, policies, and desires to the maximum extent possible, as required by various federal laws and regulations. The County is also a cooperating agency with respect to the NEPA process for nearly all projects proposed for public lands administered by Federal agencies. County staff and its consultants possess special expertise in a number of fields and this expertise constitutes a resource that must be welcomed by these agencies.

8.1 Water Management Alternatives

There are at least four alternatives available to Eureka County with respect to meeting the County's goal and the management objectives related to the water resources within the 16 hydrographic areas affecting Eureka County. While the alternatives listed below address water resources that are under the purview of the Nevada State Engineer they are also germane to water-dependent resources and water infrastructure on public lands managed by federal agencies. Four alternatives include:

1. Rely solely on the Nevada State Engineer (NSE) and other agencies to manage water resources and water dependent resources, respectively, within the county.
2. Rely on the NSE and other agencies to properly manage the resources, but intervene when the County's Master Plan, County Code, or other County plan or policy may be or is violated by an action of the NSE or other agency.
3. Provide data and technical assistance to and actively engage with the NSE and other applicable agencies to enhance science-based decision making consistent with county plans, policies, and desires.
4. Develop comprehensive land-use regulations which will enable the County to fully administer its water management plans and policies in parallel with the NSE and other applicable agencies.

These four management alternatives are not mutually exclusive; provisions and strategies within each may be selected to target a hybrid water management strategy that meets changing conditions and needs of Eureka County and its citizens.

8.1.1 THE NO-ACTION ALTERNATIVE – Rely Solely on the NSE to Manage Water Resources in Eureka County.

The NRS and NAC spell out the authority of the NSE with respect to the appropriation of the State's water resources (refer to Chapter 2) and Eureka County recognizes the NSE's authority explicitly granted by the State Legislature. Under the No-Action Alternative, Eureka County would merely rely on the NSE to manage the County's water resources with no input from the County.

As was discussed in previous sections, the NSE, mostly prior to the current NSE, has over-appropriated several of the hydrographic areas affecting Eureka County and present-day consumptive use in some basins exceeds the perennial yield. Allowing appropriations and, more importantly, consumptive water use in a basin to continually exceed the perennial yield of a basin leads to "mining" the water resource, rendering it unavailable at its customary level of use to future generations.

Large groundwater withdrawals in one hydrographic area can affect water levels in adjacent basins. The long-term consequences of this inter-basin drawdown are, as yet, undetermined and it may take decades to fully understand the long-term implications. Additionally, it is likely that this inter-basin drawdown may persist for decades after the stress on the aquifer in the adjoining basin, *i.e*. the large-scale pumping, ceases.

Also discussed in previous sections is the obligation of the NSE to deny applications for new appropriations or changes in existing rights if there is no unappropriated water (committed groundwater rights exceed perennial yield) in a basin or if the new appropriation or change will conflict with existing rights or is not in the public interest. For the County to stand idly by while a basin becomes over-appropriated, consumptive use of the resource is allowed to exceed the perennial yield, or for appropriations to conflict with prior rights or the local public interest is clearly inconsistent with the County Master Plan in general and County Code, which states "Eureka County mandates the use of peer-reviewed science in the assessment of impacts related to water resource development (EC Code, 9.30.060.C.(3)). Consequently, the Master Plan and County Code may need to be amended for the County to adopt the No-Action Alternative.

In the short term, the No-Action Alternative saves the County the cost of participating in the water resource management process. However, over-appropriation of the resource or appropriations in conflict with local public interest will lead to long-term financial and social costs far greater than the cost to participate in resource management. It also sends a message that the County has no interest in water planning or management of the resource. To adopt the No-Action Alternative may imply the County has forsaken its right to intervene in an action by the NSE or federal agencies. This action might also interfere with county participation in monitoring programs.

8.1.2 THE REVIEW AND REACT MANAGEMENT ALTERNATIVE – Rely on the NSE to Properly Manage the Resource, but Intervene when the County's Master Plan, Water Resource Master Plan, County Code, or Other Plan or Policy May Be or Is Violated.

The County's current water management approach might be termed the Review and React Management Alternative. Eureka County recognizes the NSE's authority to regulate the appropriation of water resources in Nevada. However, there have been occasions when the County has concluded that applications for new appropriations or applications to change an existing right were inconsistent with current water law, would be detrimental to the public interest, conflict with existing rights, or could not be justified by rigorous analysis. In these instances, the County has protested the applications or has sought judicial review to overturn decisions by the NSE which the County considered to be inconsistent with the County's land-use policies, the Eureka County Code, or a clear reading of Nevada water law.

The County is also diligent in working to ensure that federal land management agencies, primarily BLM and USFS, properly coordinate their land use management and planning activities for consistency with County plans, policies, and desires to the maximum extent possible, as required by various federal laws and regulations. The County is also a cooperating agency with respect to the NEPA process for nearly all projects proposed for public lands administered by federal agencies. The County's approach to its interactions with the NSE and other agencies is guided by the Eureka County Code and Master Plan referenced above.

The County's current management approach can result in significant expenditures to cover the costs of its mandated peer review of the technical reports prepared by project proponents, independent analysis conducted by County staff and its consultants. This participation is often fruitless in convincing the NSE or other agencies to make sound decisions consistent with County plans, policies, and desires. This frequently results in pursuit of costly, protracted legal remedies in administrative hearings or appeal of decisions. However, as with the No Action Alternative, failures through this strategy to manage the water resources will have large future consequences and socio-economic costs.

Perhaps the greatest disadvantage of this management alternative is that it does not provide the County with any clearly defined authority to locally manage the water resources and water related resources of the basins affecting Eureka County. In many cases, this lack of clearly defined authority has led to disagreements and distrust with the NSE and federal agencies when these agencies fail to manage the resource or fail to make decisions consistent with County plans, polices, and desires.

8.1.3 THE COORDINATED MANAGEMENT ALTERNATIVE – Provide Data and Technical Assistance to and Actively Engage with the NSE and Federal Agencies to Enhance Science-Based Decision Making.

Eureka County and its staff and its consultant team have demonstrated, relevant technical expertise and program experience that can benefit the NSE's and federal agencies' decisions regarding water resource management in the county. Additionally, the County has entered into joint funding agreements with the United States Geological Survey which have led to the acquisition of data with which to better understand the water resources within the County's water resource planning area. The work by the USGS includes collection and analysis of evapotranspiration data with which to refine basin water budgets and to better assess the aggregate groundwater resources of the Diamond Valley Flow System. The USGS also conducts surface water monitoring in the County which is partially funded by the County. Additionally, the County maintains a network of wells in Diamond Valley equipped with data loggers to closely monitor the seasonal variation in water levels and these data complement annual measurements collected by the NSE and the USGS.

Under the Coordinated Management Alternative, the data and information acquired by and on behalf of the County and the interpretations of the data by staff or consultants would be provided to the NSE and other agencies to help manage the resource. While the Legislature declared it is the policy of the State to encourage the NSE to consider the best available science (NRS 533.024 1 (c)), the NSE is not obliged to agree with the County's analysis of the data and still may render a decision which the County considers to be inconsistent with its master plans, goals and policies. Such a decision could compel the County to revert to its Review and React Management Alternative and seek legal remedies.

Eureka County, under general coordination and as a Cooperating Agency in the NEPA process for projects proposed for public lands affecting the county, provides special expertise to Federal agencies in general land management decisions and actions and in preparation of Resource Management Plans (RMPs), Environmental Assessments (EAs) and Environmental Impact Statements (EISs). Under the

Coordinated Management Alternative, the County would continue to provide special technical expertise and guidance regarding local land use plans and policies to ensure BLM, USFS or other federal agency actions are consistent with local plans, policies and desires.

An advantage of this alternative is that it is more proactive than the alternatives above and has a potential to influence management decisions consistent with County policies. However, it can be expensive to acquire and analyze the data, but, if an acceptable NSE or federal agency decision is reached, the cost may be less than the expense of seeking relief through the administrative hearing process or through the courts. The principal disadvantage of this approach is the NSE and federal agencies may *not* come to the same conclusion as the County and the County has no local authority or jurisdiction by law, over the use of water resources in the county necessary to over-ride a NSE or agency decision that is inconsistent with County plans, goals and policies. These kinds of disagreements have lead the County to seek legal remedies to protect the County's and its residents' interests.

8.1.4 THE ACTIVE MANAGEMENT ALTERNATIVE – Develop comprehensive land use or other regulations, plans or policies which will enable the County to administer water management plans and policies in parallel with the NSE and other applicable agencies.

The State (through NRS) encourages, and even empowers, water use planning at the local level. Not all counties in the state have local regulations that enable them to exert local control over water resources in the basins which affect them. One approach to local control is to institute local land-use regulations. There are some impediments to local land use regulations; specifically:

- The vast majority of Eureka County comprises public land administered by the BLM. The Federal Government has ultimate jurisdiction over these lands, not the County. While FLPMA and NEPA require consultation and coordination with the County, consistency with local plans and policies is often not attained.
- Eureka County residents currently have little appetite for comprehensive land use regulations or zoning.

8.1.4.1 Land Use Controls and Legal and Regulatory Frameworks

As discussed in Section 2.2, water planning in Nevada has largely been entrusted to local entities following the elimination of the Division of Water Planning and creation of the Water Planning Section within the Division of Water Resources. Chapter 278 of the Nevada Revised Statutes addresses all aspects of planning in Nevada. Inclusion of a water resource element of a land use master plan is authorized under NRS 278.160.1.(b)) which plainly states a master plan may include a Conservation Plan:

> *"For the conservation, development and utilization of natural resources, including, without limitation, water and its hydraulic force, underground water, water supply."*

Eureka County recognizes the NSE's authority over statewide use of Nevada's water resources, but also that it is permissible for local governments to enact regulations which indirectly regulate water resource development by exerting control over land uses. For example, a county can enact basic land use regulations that might require new projects of a certain size, type or scope to undergo review and obtain or be denied special-use permits. The local governing body may divide the county into land-use districts. The regulations must be adopted in accordance with the master plan for land use and be designed to:

> *Preserve the quality of air and water resources.*
> *Provide for recreational needs*
> *To promote health and the general welfare* (NRS 278.250.1 and 278250.2(a)).

The Eureka County Code (9.20.020.A) states

> *"When, in the opinion of the Board of Commissioners, the public health, safety, convenience or general welfare require imposition of requirements in addition to the minimum requirements set forth herein, this Title shall be construed to permit the County to impose such additional requirements as may be found necessary after an appropriate public hearing."*

The 2010 Master Plan addressed the protection of existing property rights from three perspectives. First, the right to use land should not be enjoined through restrictive land use designations or zoning ordinances. Second, the potential for erosion of property value through incompatible adjacent land uses is recognized and discouraged. Finally, the adverse consequences of certain land use decisions by federal, state, and local governments on adjacent private lands is recognized and discouraged.

Eureka County residents were polled as to their preferences regarding local land use regulation as part of the process leading up to the County's 2010 Land Use Master Plan. Of those who responded to the 2010 Eureka County Master Plan Update Survey, 36% agreed to "no zoning but general land use regulation and 27.4% agreed with "broad policies and general land use regulation" such that a majority (63.4%) were in favor of some type of land use regulation. County wide, residents ranked water as 1.22 (on a scale of 1 to 5, with 1 being very important and 5 being very unimportant). Based largely on these responses, it was concluded that water and open space should be the first elements addressed through the planning process. The 2010 Master Plan determined that implementation of nominal regulations will serve to maintain the existing character and patterns of land use in Eureka County. Minimization of land use conflicts through encouragement of compatible adjacent land uses will prevent adversarial decline of land value and loss of use rights. However, since the plan was adopted, no land use regulation has been enacted in Eureka County.

If the Active Management Alternative is adopted, the County would need to adopt comprehensive land use regulation consistent with NRS 278. The regulations could incorporate provisions for special use permits for a contemplated activity such that water resource development for a "significant use" could require a rigorous analysis of changes to the associated resources, including the water resources regime; a science-based assessment of potential conflicts with existing rights or water-dependent resources; and may require a plan to monitor and to document impacts, manage the use to avoid or minimize impacts or conflicts, and mitigate any impacts or conflicts that occur. Project proponents currently need to address these components through the NEPA or water right permitting process to which Eureka County is already a participant. However, if this alternative is adopted, the County could assert formal jurisdiction rather than simple being an "affected local government" which could strengthen the County's ability to prohibit additional stress placed on the already over-appropriated water resources.

Other Nevada Laws

Other Nevada statutes will be considered in pursuit of any of the above management alternatives.

Senate Bill 157 (SB 157)

Eureka County was successful in helping with the passage of SB 157 during the 2015 Nevada legislative session and amendments to NRS 277 to create the Local Government Cooperation Act. This purpose of this Act was

> *"To encourage communication, cooperation and coordinated working relationships between state agencies and local governments."*

This bill requires state agencies and counties to:

1. Inform each other of intentions to adopt plans (or amendments to plans) that may affect each other;
2. Solicit and consider comments on the plan or amendment; and
3. Strive for consistency with each other's plans.

Senate Bill 133 - NRS 533.353

In 2013, Eureka County proposed SB 133 and was successful in seeing its passage which became NRS 533.353. This law requires that:

1. …if the State Engineer requires a monitoring, management and mitigation plan as a condition of appropriating water for a beneficial use, the State Engineer shall, within 30 days after requiring the plan and if requested by the county where the State Engineer has approved the point of diversion, allow the county to participate in an advisory capacity in the development and implementation of the plan.
2. Before approving any plan developed pursuant to subsection 1 and during the period in which the plan, if approved, is carried out, the State Engineer shall consider any comment, analysis or other information submitted by the participating county. The State Engineer is not required to include any comment, analysis or other information submitted by a participating county in a monitoring, management and mitigation plan required pursuant to this section.
3. A decision by the State Engineer whether or not to include in the plan or to follow any comment, analysis or other information submitted by a participating county pursuant to this section is not subject to judicial review pursuant to NRS 533.450.

Eureka County will use these State laws to assert influence over NSE water planning efforts and monitoring, management, and mitigation schemes.

Other Federal Laws and Regulations

The Eureka County Code and Eureka County Natural Resources and Federal or State Land Use Element of the Master Plan both contain language recognizing the legal and regulatory mandates of federal land management agencies to coordinate their resource management and planning efforts for consistency with County plans, policies, and controls. Those policy statements and objectives are incorporated by reference into this plan.

It is imperative that Eureka County leaders, staff, and citizens understand the mandates required of federal agencies, listed below, so that they are held accountable with their decisions and actions affecting water resource use. Items of particular note are emphasized in bold print.

Federal Land Policy and Management Act (FLPMA), 43 USC 1712(c)(9)

(c) In the development and revision of land use plans, the Secretary **[BLM] shall**-

(9) to the extent consistent with the laws governing the administration of the public lands, **coordinate the land use inventory, planning, and management activities of or for such lands with the land use planning and management programs of other…local governments** within which the lands are located....In implementing this directive, the Secretary shall, to the extent he finds practical, **keep apprised of…local…land use plans**; **assure that consideration is given to those…local…plans** that are germane in the development of land use plans for public lands; **assist in resolving, to the extent practical, inconsistencies between Federal and non-Federal Government plans**, and shall **provide for meaningful public involvement of…local government officials, both elected and appointe**d, in the development of land use programs, land use regulations, and land use decisions for public lands, including early public notice of proposed decisions which may have a significant impact on non-Federal lands….**Land use plans of the Secretary under this section shall be consistent with…local plans** to the maximum extent he finds consistent with Federal law and the purposes of this Act.

BLM Regulations Implementing Planning Under FLPMA

43 CFR 1610.3-1, Coordination of Planning Efforts

(a) …The objectives of the coordination are for the State Directors and Field Managers to:
(1) ***Keep apprised*** of non-Bureau of Land Management plans;
(2) ***Assure that BLM considers*** those plans that are germane in the development of resource management plans for public lands;
(3) Assist in ***resolving, to the extent practicable, inconsistencies*** between Federal and non-Federal government plans;
(4) ***Provide for meaningful public involvement*** of…local government officials, ***both elected and appointed...***in the development of resource management plans…; and
(5) Where possible and appropriate, ***develop resource management plans collaboratively with cooperating agencies***.
(b) ….

(c) ***State Directors and Field Managers shall provide… local governments... opportunity for review, advice, and suggestion on issues and topics which may affect or influence other agency or other government programs***….

(f) …***Should they notify the Field Manager, in writing***, of what they believe to be specific inconsistencies between the Bureau of Land Management resource management plan and their officially approved and adopted resources related plans, ***the resource management plan documentation shall show how those inconsistencies were addressed and, if possible, resolved***.

43 CFR 1610.3-2, Consistency Requirements

(a) ***Guidance and resource management plans and amendments to management framework plans shall be consistent with officially approved or adopted resource related plans, and the policies and programs contained therein***, of…***local governments…***so long as the guidance and resource management plans are also consistent with the purposes, policies and programs of Federal laws and regulations applicable to public lands….

(b) ***In the absence of officially approved or adopted resource-related plans*** of … local governments … ***guidance and resource management plans shall, to the maximum extent practical, be consistent with officially approved and adopted resource related policies and programs*** of … ***local governments….***

(c) State Directors and Field Managers shall, to the extent practicable, keep apprised of …local governmental … policies, plans, and programs***, but they shall not be accountable for ensuring consistency if they have not been notified, in writing, by …local governments…of an apparent inconsistency.***

(d) Where State and local government policies, plans, and programs differ, those of the higher authority will normally be followed.

(e) ***Prior to the approval*** of a proposed resource management plan, or amendment to a management framework plan or resource management plan, the ***State Director shall submit to the Governor of the State***(s) involved, ***the proposed plan or amendment and shall identify any known inconsistencies with State or local plans, policies or programs***. ***The Governor(s) shall have 60 days in which to identify inconsistencies and provide recommendations in writing to the State Director***. If the Governor(s) does not respond within the 60-day period, the plan or amendment shall be presumed to be consistent. ***If the written recommendation(s) of the Governor(s) recommend changes in the proposed plan or amendment which were not raised during the public participation process on that plan or amendment, the State Director shall provide the public with an opportunity to comment on the recommendation(s). If the State Director does not accept the recommendations of the Governor(s), The State Director shall notify the Governor(s) and the Governor(s) shall have 30 days in which to submit a written appeal to the Director of the Bureau of Land Management. The Director shall accept the recommendations of the Governor(s) if he/she determines that they provide for a reasonable balance between the national interest and the State's interest.*** The Director shall communicate to the Governor(s) in writing and publish in the Federal Register the reasons for his/her determination to accept or reject such Governor's recommendations.

FLPMA Summary:

FLPMA requires that the Bureau of Land Management must coordinate its "land use inventory, planning and management actions" with any local government which has engaged in land use planning for the federal lands managed by the federal agencies.

Congress did not leave the definition of the word "coordination" to chance, or to the whim of the federal management agencies. Congress defined the word by specifying the duties and responsibilities of the BLM regarding local plans. The statute REQUIRES the following:

1. BLM must keep apprised of local land use plans;
2. BLM must assure consideration is given to the local plans when federal plans are being developed;
3. BLM must attempt to resolve inconsistencies between federal and state local plans;
4. BLM must provide "meaningful...involvement" of local government officials in the development and revision of plans, guidelines and regulations;
5. The Secretary must, finally, compare local and federal plans and make sure they are consistent "to the maximum extent"...consistent with federal law.

BLM regulations also set forth a very clear process by which the local government, which has developed a plan, is able to "coordinate" with the BLM and this process elevates the participation level of the local government to a point of "prior notice" and "meaningful" participation above and ahead of "public participation."

Consistency review is particularly important because it is intended to highlight and work out a method to eventually find consistency with state and local government plans, policies, and controls. The Governor's consistency review is particularly powerful and allows local governments with concerns and inconsistencies to work with the Governor to elevate the issue, if necessary, to the Director of the BLM. The BLM Director ***shall*** accept the Governor's recommendations if they provide a reasonable balance between the national and State interest.

This process provides for an additional check on consistency not only with documented State or local plans, but also with "policies" or "programs" and can give a Governor an opportunity to influence the final RMP even after most other forms of public involvement are no longer available. When submitting recommendations, the Governor should focus on both the specific inconsistencies (with plans, policies or programs) and the manner in which the recommendations for changes to the plan or amendment strike a reasonable balance between the BLM/federal interest and the interests of the State. Of high importance is that the Governor is not limited to issues relating to State plans, policies or programs and can also raise issues pertaining to local or regional plans, policies or programs.

Case Law on FLPMA:

BLM has often argued that the coordination and consistency requirements are limited and only apply to development or amendments of Resource Management Plans. This is incorrect. See *Uintah County v. Gale Norton*, Civil No. 2:00-cv-0482J where "The defendants [BLM] suggest that this statute [FLPMA] requires coordination only when revising land use plans or amending or developing resource management plans. As the Decision does not concern a land use plan, and is not a formal amendment to an existing RMP, the defendants contend that they were under no obligation to consult with the Tribe. However, FLPMA's coordination and consistency review requirements apply 'when the Secretary is making decisions directly affecting the actual management of the public lands,' whether formally characterized as 'resource management plan' activity or not." Further, in *State of Utah v. Babbitt*, 137 F. 3d at 1208, the court was clear that "the requirements [of 43 USC § 1712] apply… when the Secretary is making decisions directly ***affecting the actual management of the public lands"*** (emphasis added).

National Environmental Policy Act

Section 4331 - Congressional Declaration of National Environmental Policy

(a) The Congress, recognizing the profound impact of man's activity on the interrelations of all components of the natural environment, particularly the profound influences of population growth, high-density urbanization, industrial expansion, resource exploitation, and new and expanding technological advances and recognizing further the critical importance of restoring and maintaining environmental quality to the overall welfare and development of man, declares that it is ***the continuing policy of the Federal Government, in cooperation with State and local governments,*** and other concerned public and private organizations, to ***use all practicable means and measures***, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and ***fulfill the social, economic, and other requirements of present and future generations*** of Americans.

(b) In order to carry out the policy set forth in this Act, it is the continuing responsibility of the Federal Government to use all practicable means, consistent with other essential considerations of national policy, to ***improve and coordinate Federal plans, functions, programs, and resources*** to the end that the Nation may —

1. fulfil the responsibilities of each generation as trustee of the environment for succeeding generations;
2. assure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings;
3. attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences;
4. preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity, and variety of individual choice;
5. achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities; and
6. enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

NEPA Implementing Regulations, Council on Environmental Quality (CEQ), 40 CFR 1500

Section 1501.2 Apply NEPA early in the process.
Agencies shall integrate the NEPA process with other planning at the earliest possible time to insure that planning and decisions reflect environmental values, to avoid delays later in the process, and to head off potential conflicts. Each agency shall:

(a) Comply with the mandate of section 102(2)(A) to "***utilize a systematic, interdisciplinary approach*** which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and in decisionmaking which may have an impact on man's environment," ….
(b) Identify environmental effects and values in adequate detail so they can be compared to economic and technical analyses. Environmental documents and appropriate analyses shall be circulated and reviewed at the same time as other planning documents.
(c) Study, develop, and describe appropriate alternatives to recommended courses of action in any proposal which involves ***unresolved conflicts concerning alternative uses of available resources….***

Section 1501.7 Scoping.
(a) As part of the scoping process the lead agency shall:

(1) ***Invite the participation of affected…local agencies....***

Section 1502.16 Environmental consequences.
It shall include discussions of:

(c) ***Possible conflicts between the proposed action and the objectives*** of Federal, regional, ***State, and local (and in the case of a reservation, Indian tribe) land use plans, policies and controls for the area concerned***. (See §1506.2(d).)

Section 1506.2 Elimination of duplication with State and local procedures.

(a) Agencies authorized by law to cooperate with State agencies of statewide jurisdiction pursuant to section 102(2)(D) of the Act may do so.
(b) ***Agencies shall cooperate with…local agencies to the fullest extent possible*** to reduce duplication between NEPA and State and local requirements, unless the agencies are specifically barred from doing so by some other law. Except for cases covered by paragraph (a) of this section, such cooperation shall to the fullest extent possible include:

(1) Joint planning processes.
(2) Joint environmental research and studies.
(3) Joint public hearings (except where otherwise provided by statute).
(4) Joint environmental assessments.

(c) ***Agencies shall cooperate with….local agencies to the fullest extent possible*** to reduce duplication between NEPA and comparable State and local requirements, unless the agencies are specifically barred from doing so by some other law. Except for cases covered by paragraph (a) of this section, such cooperation shall to the fullest extent possible include joint environmental impact statements. In such cases one or more Federal agencies and one or more State or local agencies shall be joint lead agencies. Where State laws or local ordinances have environmental impact statement requirements in addition to but not in conflict with those in NEPA, Federal agencies shall cooperate in fulfilling these requirements as well as those of Federal laws so that one document will comply with all applicable laws.
(d) To better integrate environmental impact statements into State or local planning processes, statements shall discuss any inconsistency of a proposed action with any approved State or local plan and laws (whether or not federally sanctioned). Where an inconsistency exists, the statement should describe the extent to which the agency would reconcile its proposed action with the plan or law.

Section 1508.27 Significantly.
Significantly as used in NEPA requires considerations of both context and intensity:

(a) *Context.* This means that the significance of an action must be analyzed in several contexts such as society as a whole (human, national), ***the affected region, the affected interests, and the locality***. Significance varies with the setting of the proposed action. For instance, in the case of a site-specific action, significance would usually depend upon the effects in the locale rather than in the world as a whole. Both short- and long-term effects are relevant.
(b) *Intensity*. This refers to the severity of impact. ***Responsible officials must bear in mind that more than one agency may make decisions about partial aspects of a major action***. The following should be considered in evaluating intensity:

…(4) ***The degree to which the effects on the quality of the human environment are likely to be highly controversial***.
…(6) The degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration.
…(***10) Whether the action threatens a violation*** of … ***local law*** or requirements imposed for the protection of the environment.

Memorandum for Federal NEPA Liaisons, Federal, State, and Local Official and Other Persons Involved in the NEPA Process **(March 16, 1981)**

Conflicts with "Proposed plans should also be addressed if they have been formally proposed…in a written form, and are actively pursued by officials of the jurisdiction" and "The term "policies" includes ***formally adopted statements*** of land use policy as ***embodied in laws*** or regulations. It also includes proposals for action such as the initiation of a planning process, or a ***formally adopted policy statement*** of the local, regional or state executive branch, ***even if it has not yet been formally adopted*** by the local, regional or state legislative body."

"In the Record of Decision, the decisionmaker must explain what the decision was, how it was made, and what mitigation measures are being imposed to lessen adverse environmental impacts of the proposal, among the other requirements of Section 1505.2. ***This provision would require the decisionmaker to explain any decision to override land use plans, policies or controls for the area."***

National Forest Management Act (NFMA) 16 U.S.C. 1604

The NFMA outlines the obligations under which the US Forest Service is bound. It states that "the Secretary of Agriculture shall develop, maintain, and, as appropriate, revise…plans for units of the National Forest System, ***coordinated with the land and resource management planning processes of…local governments***."

USFS Regulations Implementing Planning Rule (2012), 36 CFR 219.4

(b) ***Coordination with other public planning efforts***.

(1) The responsible official ***shall coordinate land management planning*** with the equivalent and related planning efforts of federally recognized Indian Tribes, Alaska Native Corporations, other Federal agencies, and ***State and local governments***.

8.2 Other Management Options

8.2.1 Groundwater Management Areas

Groundwater Management Areas represent a reactive approach to an existing problem instead of a proactive plan to avoid a future problem because it arises from poorly-regulated groundwater appropriation which could have been avoided through strict adherence to Nevada Statutes. They are included in this section mainly because the County would likely be an active participant in the development of a Groundwater Management Area along with the other water appropriators and users as opposed to serving as the entity which develops and implements the plan. The alternative to local groundwater management is for the Nevada State Engineer to curtail pumping purely on the basis of priority. This action could result in the loss of more than 50% of the irrigated acreage in Diamond Valley.

Nevada Statutes provide for Critical Management Areas and Areas of Active Management. Similarities and differences between the two are discussed below.

8.2.1.1 Critical Management Area

Nevada law allows for some local control over groundwater resources in areas where the resource is incontrovertibly being depleted due to over-appropriation of the resource. Local control may be accomplished through the designation of a basin as a Critical Management Area and the development of a Groundwater Management Plan by the appropriators. Upon approval of the plan by the NSE, it becomes the basis for regulating use of the resource. In a Critical Management Area the water users can exert a degree of control over their destiny even if extreme measures might be required to address the problem. Under NRS 534.110(7) the NSE:

> *(a) May designate as a critical management area any basin in which withdrawals of groundwater consistently exceed the perennial yield of the basin.*
>
> *(b) Shall designate as a critical management area any basin in which withdrawals of groundwater consistently exceed the perennial yield of the basin upon receipt of a petition for such a designation which is signed by a majority of the holders of certificates or permits to appropriate water in the basin that are on file in the Office of the State Engineer.*
>
> *If a basin has been designated as a critical management area for at least 10 consecutive years, the State Engineer shall order that withdrawals, including, without limitation, withdrawals from domestic wells, be restricted in that basin to conform to priority rights, unless a* ***groundwater management plan*** *[emphasis added] has been approved for the basin pursuant to NRS 534.037.*

Key aspects of a Groundwater Management Plan are found in NRS 534.037

> *A petition signed by a majority of the holders of permits or certificates in the basin for the approval of a groundwater management plan.*
>
> *The petition must be accompanied by the groundwater management plan, which must set forth the necessary steps for removal of the basin's designation as a critical management area.*
>
> *In determining whether to approve a groundwater management plan, the State Engineer shall consider, without limitation:*
>
> > *(a) The hydrology of the basin;*
> >
> > *(b) The physical characteristics of the basin;*
> >
> > *(c) The geographic spacing and location of the withdrawals of groundwater in the basin;*
> >
> > *(d) The quality of the water in the basin;*
> >
> > *(e) The wells located in the basin, including, without limitation, domestic wells;*
> >
> > *(f) Whether a groundwater management plan already exists for the basin; and*

(g) Any other factor deemed relevant by the State Engineer.

Once approved by the NSE, the plan becomes the means by which groundwater use in the local management area is regulated. The Diamond Valley Hydrographic Area is a poster child of over-appropriation in Nevada and there is little doubt the resource is being depleted. The Nevada State Engineer designated Diamond Valley as a Critical Management Area on August 25, 2015 (NSE Order 1264). The 10-year clock to develop and implement a Groundwater Management Plan (GMP) started on that date. When a GMP is ratified by the appropriators and approved by the NSE, it will be incorporated into the County's Water Resource Master Plan.

8.2.1.2 Area of Active Management

To some, the term "Critical" Management Area carries a negative connotation which they believe could lead to undesirable economic consequences. A possible alternative suggested by the NSE is an Area of Active Management, described as an area

> *In which the State Engineer is conducting particularly close monitoring and regulation of the water supply because of heavy use of that supply; and*
>
> *Which has received that designation by the State Engineer pursuant to NRS 534.030.*

At a workshop held in Eureka in February 2014, the NSE indicated that an Area of Active Management could possibly function much the same as a Critical Management Area, but it might require changes to the statutes. However, for Diamond Valley, the issue is moot since the basin has been designated as a Critical Management Area.

8.3 EUREKA COUNTY WATER RESOURCE MANAGEMENT EFFORTS TO DATE

Over the years, Eureka County has intervened in the water rights appropriation process where the County concluded applications for specific water rights would not be in the public interest, would conflict with existing rights or be contrary to County plans, policies and desires. In these circumstances, the County participated in administrative hearings before the NSE, providing information to fully consider new appropriations. When deemed appropriate, the County has appealed decisions by the NSE to District Court and even to the Nevada Supreme Court.

8.3.1 Diamond Valley Groundwater Management Plan

Eureka County is not spearheading, but is actively participating in the development of the Groundwater Management Plan (GMP) as a water rights holder with the desire to protect the socioeconomic base in Diamond Valley. The GMP effort is being primarily led by irrigators that use 95% of the groundwater pumped in the basin. In anticipation of the designation of Diamond Valley as a Critical Management Area, Eureka County supported efforts in Diamond Valley to help address the basin overdraft. These efforts have intensified since the basin's designation as a CMA in August 2015. To date the County has sponsored or been involved with:

1. A study of the feasibility of forming a general improvement district to retire water rights in order to reduce the overdraft in Diamond Valley (HEC, 2013). The study was funded by

Eureka County through a grant to the Diamond Natural Resources Protection and Conservation Association (DNRPCA).

2. Research and analysis of a Diamond Valley "set-aside" program to quantify water savings, potential costs of such a program, and whether or not a set-aside program was economically feasible (HEC, 2014). The study was funded by the University of Nevada Cooperative Extension Service in cooperation with Eureka County.
3. Providing a grant to the Eureka County Conservation District to host scoping sessions for an eventual Diamond Valley Groundwater Management Plan. Walker and Associates held three public meetings to identify relevant issues and possible solutions. In addition, individual interviews were held with domestic well owners, irrigators, and commercial interests.
4. Multiple meetings with the staff of the NSE to outline groundwater management options.
5. The Eureka Conservation District (ECD) has hosted and continues to host workshops to work toward developing a Groundwater Management Plan. Eureka County has a role on the ECD through a County appointed supervisor on its Board of Supervisors.

8.4 Summary of Management Options

Table 8-1 provides a summary of the management alternatives available to the County.

8.5 Master Plan Maintenance

The Eureka County Water Resources Master Plan epitomizes a "living" document. As such, it should be updated or amended as conditions change within the hydrographic areas affecting Eureka County. Changes to the Plan require the same procedures used to develop the plan. That is, the Eureka County Planning Commission would be required to hold at least one public hearing regarding proposed changes before it could approve the amendments. The amended plan would then be submitted to the Board of County Commissioners for them to consider the proposed changes. The BOCC would hold a public hearing to receive comment from the public. If the Amended Plan is approved by the BOCC, it would subsequently be submitted the Nevada Division of Water Resources for its approval.

8.5.1 Plan Maintenance Schedule

Water usage within Eureka County will receive a cursory review every five years. If the conditions within the county have changed little, then no change to the plan would be warranted.

Major changes in water use or land use may also trigger a modification to the plan before the five-year period expires. The Eureka County Planning Commission or BOCC would determine whether or not changes in use are sufficient to warrant a revision to the plan.

The plan will receive a major review every 10 years. A major review would incorporate an analysis of changes in water use, land use and whether or not water policies and ordinances have served their intended purposes.

Table 8-1

Summary of Management Alternatives

Alternative	Description	Advantages	Disadvantages
1-THE NO-ACTION ALTERNATIVE	Rely solely on the NSE to manage water resources and Federal Agencies to manage water-related resources in Eureka County	1. Little to no out of pocket expense to Eureka County.	1. May require amendment to Eureka County Code and Land Use Master Plan. 2. Possible high socio-economic costs if there is a conflict with County residents' interests. 3. May cause Eureka County to forfeit opportunity to challenge adverse decisions by agencies.
2-THE REVIEW AND REACT MANAGEMENT ALTERNATIVE	Rely on the NSE to properly manage the resources, but intervene when the County's Land Use Master Plan, Water Resource Master Plan or County Code or other plan or policy is violated.	1. Little to no initial out of pocket expense to Eureka County unless a conflict with County Code or Policies arises.	1. May cost more to appeal an adverse decision than to proactively try to resolve issues. 2. Possible high socio-economic costs if there is a conflict with County residents' interests.
3-THE COORDINATED MANAGEMENT ALTERNATIVE	Provide data and technical assistance to and actively engage with the NSE and Federal Agencies to enhance science-based decision making,	1. The NSE is encouraged by the Legislature to utilize the best available science in rendering decisions. 2. Reduces the likelihood for agencies to make a decision inconsistent with Eureka County Code or other plans and policies.	1. Data collection and analysis is expensive. 2. Agencies may ignore County data, information and analysis. 3. May result in an expensive appeal of a "bad" decision.
4-THE ACTIVE MANAGEMENT ALTERNATIVE	Develop comprehensive land use or other regulations, plans or policies which will enable the County to administer water management plans and policies in parallel with the NSE or other applicable agencies.	3. Provides authority for local control over water resource development. 4. Provides an opportunity for close cooperation between Federal and local governmental entities.	1. The current culture within Eureka County is strongly opposed to zoning. 2. The vast majority of land in Eureka County comprises public land administered by the BLM. The Federal Government, not Eureka County, has primacy over these lands. 3. Requires close cooperation between Federal Agencies and the County which is often difficult to achieve.
Note: Eureka County currently relies on a combination of Alternatives 2 and 3 to help manage water resources within the County.			

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APPENDIX

Written Public Comment and Commissioners’ Responses

Eureka County Water Resources Master Plan

Eureka County Planning Commission Public Hearing held August 1, 2018

Public Comments`

Written comments provided by Carol Bailey via email to the Eureka County Planning Commission	
Comment	Response
The Water Master Plan accurately depicts some of the concerns of the residents regarding mining issues such as Temporary Use of the resource (p.2-17) and Open Pit Mining (p. 2-18).	Comment noted.
Page 4-50 states that the deep aquifer in South West Pine Valley is declining by 50 feet/per year from mine dewatering in an adjacent basin. Large groundwater withdraws may take decades to understand long-term implications (p.8-3). Mines receive Temporary Permits, even in excess of perennial yield (p. 1-7, 2-17).	Comment noted.
The Water Master Plan say [sic] that irrigation is the largest user in the county by far, with wells declining 1-3 feet/per year. If the mine permits and temporary mine permits were calculated, would mining be the largest user with 50 foot declines recorded from dewatering?	Current information regarding water use in Eureka County in part was obtained from a presentation given by the Nevada State Engineer in the Town of Eureka. This presentation illustrated irrigation pumpage to be approximately three times the pumpage by mines in Eureka County. The Plan includes the water pumped by the mines in the discussions of current water use for each of the hydrographic basins within the Plan study area where the mines pump groundwater. The 1-3 feet/year water level decline referenced in the comment relates to observed declines in the alluvial aquifer in Diamond Valley. The 50 foot declines referenced in the comment refer to the deep bedrock aquifer in southwest Pine Valley and no effect has yet to be observed in the overlying alluvial aquifer.
The Water Master Plan does not address "Projected Future Water Demand for Mines" in chapter 1.6. The Water Master Plan does not address Future Demand for Mines in chapter 6.2.	The Plan does not attempt to predict future pumping by mining operations because it is impossible to predict water usage by projects that have not publicly announced their future plans. Where estimates of future usage are available and applications for water rights for future uses have been filed with the Nevada Division of Water Resources, such as Barrick's project in Pine Valley or General Moly's Mt. Hope Project, these are incorporated into to Plan.

Comment	Response
The plan to designate Diamond Valley a CMA using Assemblyman Goicoechea's Bill 419, NRS 534.110, and then create a GMP scheme to avoid curtailment of junior appropriators will create a water market, but it will not solve the water budget problem if large groundwater withdraws are allowed in the Diamond Valley Hydrograpic [sic] Area for mining.	For the record, Diamond Valley was designated as a Critical Management Area (CMA) in August 2015. Designation as a CMA allows water rights holders to develop a Groundwater Management Plan (GMP) to systematically reduce groundwater use in Diamond Valley. The GMP addresses the "water budget problem" and mining is one of the uses in the valley that will be subject to the GMP. Eureka County, although a participant in the GMP process, has no authority with respect to a Critical Management Area or the GMP. The GMP is developed by the water rights holders and must be approved by the State Engineer.
It is true that Eureka County can decrease agriculture by 66% or 100% while increasing the tax base, or GDP, temporarily, with large mining, industrial, military or high security projects. Current water law would necessarily have to be replaced because those projects will cause harm to current water rights.	Comment noted.
Eureka County cannot effectively manage the water resource unless it can effectively manage water for mining and other uses besides irrigation. Large water withdraws from Diamond Valley or in adjacent basins will negate the conservation efforts of the agricultural sector	The comment places an exclamation point to the Plan's Goal and Objectives. The Eureka County Planning Commission agrees with the need to protect water resources within the County from over-development. At present, neither the Eureka County Planning Commission nor the Board of County Commissioners has any legal authority to manage water resources within the county. The County's plans, policies and ordinances, however, require that it be actively involved in the review of large projects that have the potential to affect resources within Eureka County and dictate the best available science to be employed in this review. The Plan proposes management alternatives available to the County, some of which promote continued review of large projects.