Water Resources Assessment for Spring Valley

Presentation to the Office of the Nevada State Engineer

Prepared by

SOUTHERN NEVADA
WATER AUTHORITY

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Andrew Burns prepared this report entitled "*Water Resources Assessment for Spring Valley*", June, 2006. This report is one of several reports prepared in support of the Southern Nevada Water Authority groundwater applications 54003 through 54021 in Spring Valley (Hydrographic Area 184).

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Date

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List of Acronyms and Abbreviations

af	acre-feet
afy	acre-feet per year
amsl	above mean sea level
bgs	below ground surface
cfs	cubic feet per second
CWP	Cooperative Water Project
DEM	Digital Elevation Model
DRI	Desert Research Institute
DTW	Depth-to-Water
ET	Evapotranspiration
ft	foot (feet)
ft/yr	feet per year
GIS	Geographic Information System
HA	Hydrographic Area
LVVWD	Las Vegas Valley Water District
m	meters
MSAVI	Modified Soil Adjusted Vegetation Index
NAD83	North American Datum of 1983
NAVD88	North American Vertical Datum of 1988
NCDC	National Climatic Data Center
NDVI	Normalized Difference Vegetation Index
NDWR	Nevada Division of Water Resources
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
NWCG	National Wildfire Coordinating Group
NWIS	National Water Information System
NWS	National Weather Service
PRISM	Precipitation-elevation Regression on Independent Slopes Model
RASA	Regional Aquifer System Analysis
RAWS	Remote Automated Weather Stations
ROMAN	Real-time Observation Monitor and Analysis Network
SNOTEL	SNOwpack TELemetry
SNWA	Southern Nevada Water Authority
SWE	Snow Water Equivalence

LIST OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

US 50	U.S. Highway 50
USAF	U.S. Air Force
UNLV	University of Nevada, Las Vegas
USGS	U.S. Geological Survey
UTM	Universal Transverse Mercator
WRCC	Western Regional Climate Center

ES.1.0 EXECUTIVE SUMMARY

In 1989, the Las Vegas Valley Water District (LVVWD) filed 19 applications (54003 through 54021, inclusive) for the appropriation of groundwater resources in Spring Valley. By agreement with LVVWD, Southern Nevada Water Authority (SNWA) has assumed full interest in these applications. Since filing the applications, LVVWD and SNWA have been actively supporting the applications by establishing hydrologic monitoring networks to acquire groundwater and surface-water data and through the completion of hydrologic and geologic investigations within Spring Valley and adjacent basins. Data and information from these programs and previous studies serve as the basis for the analyses and conclusions presented in this report.

In 1965, the U.S. Geological Survey completed a Water Resources-Reconnaissance Series Report (Rush and Kazmi, 1965) and concluded that 100,000 acre-feet per year (afy) of water is available for perennial yield in Spring Valley. The State Engineer has relied on the research to conclude that 100,000 afy of groundwater is available for appropriation in Spring Valley (Scott et al., 1971). The purpose of this report is to apply modern scientific techniques using all available data to validate the Spring Valley perennial yield estimates of Rush and Kazmi (1965) and Scott et al. (1971).

This report presents, in part, the technical basis and justifications supporting SNWA's aforementioned groundwater applications in Spring Valley. The results of previous investigations and the available data, information, and data analyses presented in subsequent sections of this report are used to evaluate the hydrologic parameters used to derive estimates of the perennial yield for Spring Valley. These include the derivation of precipitation and natural recharge distributions, estimates of perennial streamflow, groundwater discharge by evapotranspiration (ET), groundwater occurrence and movement, and a water resources and groundwater budget. The focus of these analyses is primarily limited to Spring Valley, although some of the data that were used in the data analyses are from sites located in adjacent valleys.

ES.2.0 PREVIOUS INVESTIGATIONS

Section 2.0 provides descriptions of numerous studies related to Spring Valley and adjacent basins that have been conducted since the late 1940s to the present. These studies have included water-resource investigations, geologic and hydrogeologic investigations, recharge and discharge estimations, and other hydrologic studies. The most pertinent of the studies are those specific to Spring Valley. One of the most important of these studies is Rush and Kazmi (1965) which provided preliminary estimates of natural recharge (75,000 afy), groundwater discharge (70,000 afy), runoff from the mountain fronts (90,000 afy), subsurface flow (4,000 afy outflow to Hamlin Valley), and groundwater development (1,000 afy) (Rush and Kazmi, 1965). Rush and Kazmi (1965) served as the basis for the estimates of perennial yield and system yield reported in Scott et al. (1971). Scott et al. (1971) estimated the perennial yield and system yield to be 100,000 afy, including an estimate of subsurface inflow of 2,000 afy from Tippett Valley that was not included in the Rush and Kazmi (1965) report. The estimates of Scott et al. (1971) have been corroborated by subsequent studies, including those of Harrill et al. (1988), Brothers et al. (1994), and Nichols (2000).

ES.3.0 Precipitation and Natural Recharge

Section 3.0 presents an evaluation and analysis of available altitude and precipitation data from stations located at various altitudes within Spring Valley and surrounding basins, and presents the methods, results and conclusions of an analysis using this data to derive a precipitation distribution and corresponding estimate of natural groundwater recharge for Spring Valley using the standard Maxey-Eakin recharge efficiencies applied in Rush and Kazmi (1965). This analysis yielded an estimate of groundwater recharge for Spring Valley of 87,000 afy for the area above an altitude of 6,000 feet (ft). This estimate represents the average annual recharge for Spring Valley based on precipitation data compiled for 39 stations with periods of record greater than 20 years of "non-zero" annual precipitation.

The estimates of precipitation and recharge derived by this analysis are considered near the lower bound because the precipitation stations used in their derivation most likely underestimate the "true" precipitation at their respective locations. This conclusion is based on the conclusions of Groisman and Legates (1994) that gage measurements tend to underestimate the "true" precipitation due to wind-induced turbulence and wetting losses on the internal walls of the gage. Further, they indicate that these conditions effectively cause a bias of underestimating precipitation which can range between 5 and 25 percent of the annual values. An example of this condition is provided by the "Berry Creek" and "Cave Mountain" gages within the Schell Creek Range. The "Cave Mountain" gage reports approximately 7 inches less precipitation than the "Berry Creek" gage, but is located at an altitude that is approximately 1,000 ft higher. This is an unlikely scenario, particularly since the stations are located within the same mountain range and only approximately ten miles from each other in the north-south direction. These observations and an evaluation of the "Berry Creek" and "Cave Mountain" gage sites support the conclusion that precipitation gages underestimate the "true" precipitation. The bias of underestimating the "true" precipitation was not corrected in the precipitation datasets used to develop the altitude-precipitation relationship derived by this analysis, and therefore, it is still reflected in the results and must be considered in their application.

Independent estimates of precipitation and recharge for Spring Valley reported by Nichols (2000) and derived from the Precipitation-elevation Regression on Independent Slopes Model (PRISM) (SCAS, 2006) also support the conclusion that the estimates derived by this analysis are near, or at, the lower bound. Nichols (2000) estimated the recharge in Spring Valley to be 104,000 afy using independently derived recharge efficiencies and the 1961-1990 precipitation distribution from PRISM. Using the standard Maxey-Eakin recharge efficiencies and an assumption that no recharge occurs below an altitude of 6,000 ft-above mean sea level (amsl), the natural recharge was estimated to be 106,500 afy using the 1971-2000 precipitation distribution from PRISM. Based on these estimates, the 87,000 afy estimated by this analysis is clearly at or near the lower bound.

Many new precipitation stations have been installed, and approximately 40 years of additional data have been collected since the Rush and Kazmi (1965) reconnaissance study was completed. It is apparent that one of the fundamental assumptions of Rush and Kazmi (1965) that less than 8 inches of precipitation occurs below an altitude of 6,000 ft. is not valid. Based on new data and information collected since the completion of the Rush and Kazmi (1965) study, it is now known and observed at the "Shoshone 5 N" precipitation gage located in Spring Valley that the depth of precipitation is greater than 8 inches below an altitude of 6,000 ft. The period-of-record average annual precipitation at the "Shoshone 5 N" gage is 9.73 inches at an altitude of 5,930 ft (WRCC, 2006). This new data indicates that the precipitation at the lower altitudes of Spring Valley was underestimated by Rush and Kazmi (1965). Below an altitude of 6,000 ft, the difference between the results of this analysis and those of Rush and Kazmi (1965) is 117,000 afy, or 67 percent of the total difference. The remaining difference lies mostly within the 6,000-7,000 and 7,000-8,000 altitude intervals, where the difference between the two estimates is 67,500 afy of precipitation, and 17,000 afy of recharge.

ES.4.0 PERENNIAL STREAMFLOW

Section 4.0 provides a brief description of the perennial streams of Spring Valley and presents the objectives, data, methodology, and results of an analysis to estimate the average annual flow of each stream. Through an evaluation and analysis of miscellaneous discharge measurements for 22 ungaged perennial streams, the perennial streamflow for Spring Valley was estimated using the continuous gage records for Cleve Creek near Ely, Nevada and the concurrent measurement method described in Moore (1968). Using this method, the long-term average annual perennial streamflow for Spring Valley was estimated at 65 cubic feet per second (cfs), or 47,000 afy.

The perennial streamflow estimates derived by this analysis for ungaged streams are within the range of previous estimates by Rush and Kazmi (1965), in which an estimate of 50 cfs (36,000 afy) was reported for the total average annual streamflow. The estimate derived by this analysis is larger than the estimate reported by Rush and Kazmi (1965) because an additional eight perennial streams were included in the analysis. The perennial streamflow from these eight streams is estimated to be approximately 18 cfs and, when added to the 50 cfs reported by Rush and Kazmi (1965), an estimate of 68 cfs is computed. Based on the available data for perennial streams within Spring Valley, the perennial streamflow derived by this analysis is consistent with that reported by Rush and Kazmi (1965).

ES.5.0 Evapotranspiration

Section 5.0 describes previous studies related to ET within Spring Valley, including those studies by Rush and Kazmi (1965), Nichols (2000), and Devitt et al. (2006). Each of these studies provides an estimate of ET for groundwater discharge areas within Spring Valley based on different data and assumptions, but very similar mapping. The data, technical approach, results, and conclusions of each of these studies is described in general terms for the purpose of establishing the range of estimates for Spring Valley.

Rush and Kazmi (1965) provided a preliminary estimate of 70,000 afy for the average annual groundwater ET for Spring Valley. For 1985 and 1989, Nichols (2000) estimated the groundwater ET to be 77,500 acre-feet (af) and 102,000 af, respectively, for an annual average of 90,000 afy. For 2005, Devitt et al. (2006) estimated total ET for the phreatophytic zone and wetland meadows area to be 307,225 af. In this report, the Devitt et al. (2006) estimate and consumptive use estimates derived for irrigated crops, open-water evaporation, and playa groundwater evaporation were adjusted to exclude the precipitation component and, when combined, resulted in an ET estimate of approximately 159,000 af from groundwater and surface-water sources.

The range of groundwater ET estimates for Spring valley varies depending on the hydrologic conditions. The value reported by Rush and Kazmi (1965) and the 1989 estimate of Nichols (2000) likely represent the lower bound, while the estimate of Devitt et al. (2006) and the 1985 estimate of Nichols (2000) represent the upper bound. The average annual ET for Spring Valley is more likely the average of the two estimates reported by Nichols (2000) (90,000 afy) rather than the 70,000 afy estimated by Rush and Kazmi (1965). This conclusion is based on the fact that each of the 1985 and 1989 estimates of Nichols (2000) represents a range of hydrologic conditions rather than the hydrologic conditions for a single year. This average annual value of 90,000 afy is corroborated by the independent recharge estimate described Section 3.0.

ES.6.0 Groundwater Occurrence and Movement

Section 6.0 discusses groundwater occurrence, source, and movement for Spring Valley and provides an assessment of the current and recent water-level conditions based on an inventory of groundwater sites. Data from groundwater sites within Spring Valley and vicinity were compiled and analyzed so that the occurrence, source, and movement of groundwater within Spring Valley could be assessed. Groundwater within the valley occurs above the ground surface (i.e., flowing wells) and to depths of approximately 400 ft-below ground surface. Shallow depths-to-water are observed within the discharge areas and near springs and flowing wells. Water-level elevations in Spring Valley range from approximately 6,900 to 5,500 ft-amsl, with higher elevations occurring to the north and south, and near the margins of the valley. Based on the water-level elevation data, an apparent groundwater divide exists within the valley, north and west of the Limestone Hills. This divide is coincident with a gravity high that extends across the valley in the east-west direction. Groundwater movement on the southern side of this divide is interpreted to flow eastward through the Limestone Hills and into

Hamlin Valley. Groundwater to the north of this divide is interpreted to flow to the north, to discharge areas located in the central portion of the valley. In the northern portion of the valley, groundwater is interpreted to flow to the south, to discharge areas in the central portion of the valley. The movement of groundwater within Spring Valley is driven by hydraulic-head potential created by the significant recharge sources located within the Schell Creek and Snake Ranges and by other smaller recharge areas located in the Fortification and Antelope Ranges to the south and north, respectively.

Groundwater inflow to Spring Valley is limited to inflow from Tippett Valley to the north, which has been estimated to be 2,000 afy (Scott et al., 1971; Harrill et al., 1988) and 1,700 afy (Brothers et al., 1994). Groundwater outflow from Spring Valley to Hamlin Valley has been estimated to be 4,000 afy (Rush and Kazmi, 1965; Scott et al., 1971, Harrill et al., 1988; Brothers et al., 1994) and 10,000 afy (Nichols, 2000).

Temporal variations in water-level data for Spring Valley were evaluated to the extent that the limited data would allow. Very few wells have any significant periods of record, and all are located in the southern half of the valley. Given the limited amount of data, most of the hydrographs indicate a response to the recent drought conditions experienced from 1999 through 2004, although one well seemed unaffected and another indicated a water-level rise during this period. Groundwater production data are unavailable for the purpose of ascertaining the effects of the limited pumping that occurs in the valley.

ES.7.0 WATER RESOURCES AND GROUNDWATER BUDGET

Section 7.0 discusses the development of a water resources and groundwater budget for Spring Valley based on available data and the results of analyses presented in this report and other studies related to specific budget components. The estimates for each budget component were derived independently from each other, and represent an annual average value. In some cases simplifying assumptions were made to derive estimates for selected budget components.

The water resources budget presented here for Spring Valley is approximately 136,000 afy of inflow and outflow. This budget includes a significant component of perennial streamflow (47,000 afy) and groundwater recharge within the mountain block (87,000 afy), and a small amount of subsurface inflow from Tippett Valley (2,000 afy). The inflow is balanced by outflow from groundwater ET by natural vegetation (90,000 afy) and irrigated crops (5,780 afy), surface water ET and evaporation (35,250 afy), groundwater outflow to Hamlin Valley (4,000 afy), and other groundwater uses (346 afy).

The groundwater budget presented here for Spring Valley is approximately 101,000 afy of inflow and outflow, and includes significant components of groundwater recharge within the mountain block (87,000 afy) and from secondary recharge and seepage losses from the perennial streams and irrigation ditches (11,750 afy), and a small amount of subsurface inflow from Tippett Valley (2,000 afy). The inflow is balanced by outflow from groundwater ET by natural vegetation (90,000 afy) and irrigated crops (5,780 afy), groundwater outflow to Hamlin Valley (4,000 afy), and other groundwater uses (346 afy).

A comparison of the groundwater budget derived by this analysis with the groundwater budget developed by Rush and Kazmi (1965) is complicated because the budget terms are different in some cases. Rush and Kazmi (1965) did not provide estimates for secondary recharge or seepage losses from the perennial streams and irrigation ditches. The estimates derived by this analysis for the groundwater recharge within the mountain block and groundwater ET components are larger than those of Rush and Kazmi (1965). The difference between the groundwater recharge components is 12,000 afy, while the difference between the groundwater ET components is 20,000 afy. Despite these differences, the groundwater budget derived by this analysis supports the perennial yield estimate of Rush and Kazmi (1965) and Scott et al. (1971).

ES.8.0 UNAPPROPRIATED GROUNDWATER

Section 8.0 discusses the perennial yield of Spring Valley and presents the results of a water-rights survey conducted for the Spring Valley. Rush and Kazmi (1965) estimated the perennial yield for Spring Valley to be 100,000 afy, and describe the basis for the estimate as the groundwater discharge from ET and the salvageable portion of mountain-front runoff. Rush and Kazmi (1965) provided preliminary estimates for groundwater ET and mountain-front runoff of 70,000 afy and 90,000 afy, respectively. Based on Rush and Kazmi (1965), Scott et al. (1971) also estimated the perennial yield for Spring Valley at 100,000 afy.

The available data, recent studies, and the analyses presented in this report support the Rush and Kazmi (1965) and Scott et al. (1971) perennial yield estimates of 100,000 afy for Spring Valley. Although these data, studies, and analyses indicate that selected components of the Rush and Kazmi (1965) water budget were underestimated, the perennial yield estimate is valid.

Based on a water-rights survey conducted for Spring Valley (SNWA, 2006b), there are 9,610 afy of non-supplemental committed groundwater rights within Spring Valley. The consumptive use portion of these committed rights was estimated at 6,125 afy. Based on the perennial yield estimate of Scott et al. (1971) and the consumptive-use estimate of the non-supplemental committed groundwater rights, the unappropriated groundwater resources within Spring Valley is 93,875 afy.

The volume of unappropriated groundwater resources within Spring Valley is greater than the total combined duty of the pending SNWA applications (54003-54021), which amount to approximately 91,224 afy based on the maximum diversion rates for each application. Therefore, sufficient unappropriated groundwater resources are available for allocation up to the requested diversion rate of these applications.

1.0 INTRODUCTION

The purpose of this report is to present the technical basis and justifications supporting the Southern Nevada Water Authority's (SNWA) applications 54003 through 54021, inclusive. These applications were filed by the Las Vegas Valley Water District (LVVWD) in 1989 for the appropriation of groundwater resources in Spring Valley (Hydrographic Area [HA] 184). The technical basis and justifications for these applications are supported, in part, by the data, information and analyses presented in this report, including a description of the hydrology of Spring Valley and subsequent analyses of the hydrologic parameters that are commonly used to derive estimates of perennial yield.

1.1 Background

In 1989, LVVWD filed 19 applications (54003 through 54021, inclusive) for the appropriation of groundwater resources in Spring Valley. By agreement with LVVWD, SNWA has assumed full interest in these applications, which are the subject of this water-right hearing. The points-of-diversion for these applications are depicted on Figure 1-1.

Since filing the applications in 1989, LVVWD and SNWA have been actively supporting the applications by establishing hydrologic monitoring networks to acquire groundwater and surface-water data and through the completion of hydrologic and geologic investigations within Spring Valley and adjacent basins. Data and information from these programs and previous studies serve as the basis for the analyses and conclusions presented in this report.

1.2 Purpose and Scope

In 1965, the U.S. Geological Survey (USGS) completed a Water Resources-Reconnaissance Series Report (Rush and Kazmi, 1965, p. 26) and concluded that 100,000 acre-feet per year (afy) of water is available for perennial yield in Spring Valley. The State Engineer has relied on the research to conclude that 100,000 afy of groundwater is available for appropriation in Spring Valley (Scott et al., 1971, Table 1, p. 9). The purpose of this report is to apply modern scientific techniques using all available data to validate the conclusion of Rush and Kazmi (1965) and Scott et al. (1971) that 100,000 afy is available for perennial yield in Spring Valley.

This report presents, in part, the technical basis and justifications supporting SNWA's aforementioned groundwater applications in Spring Valley. The results of previous investigations and the available data, information, and data analyses presented in subsequent sections of this report are used to evaluate the hydrologic parameters used to derive estimates of the perennial yield for Spring Valley. These include the derivation of precipitation and natural recharge distributions, estimates of perennial streamflow, groundwater discharge by evapotranspiration (ET), groundwater occurrence and

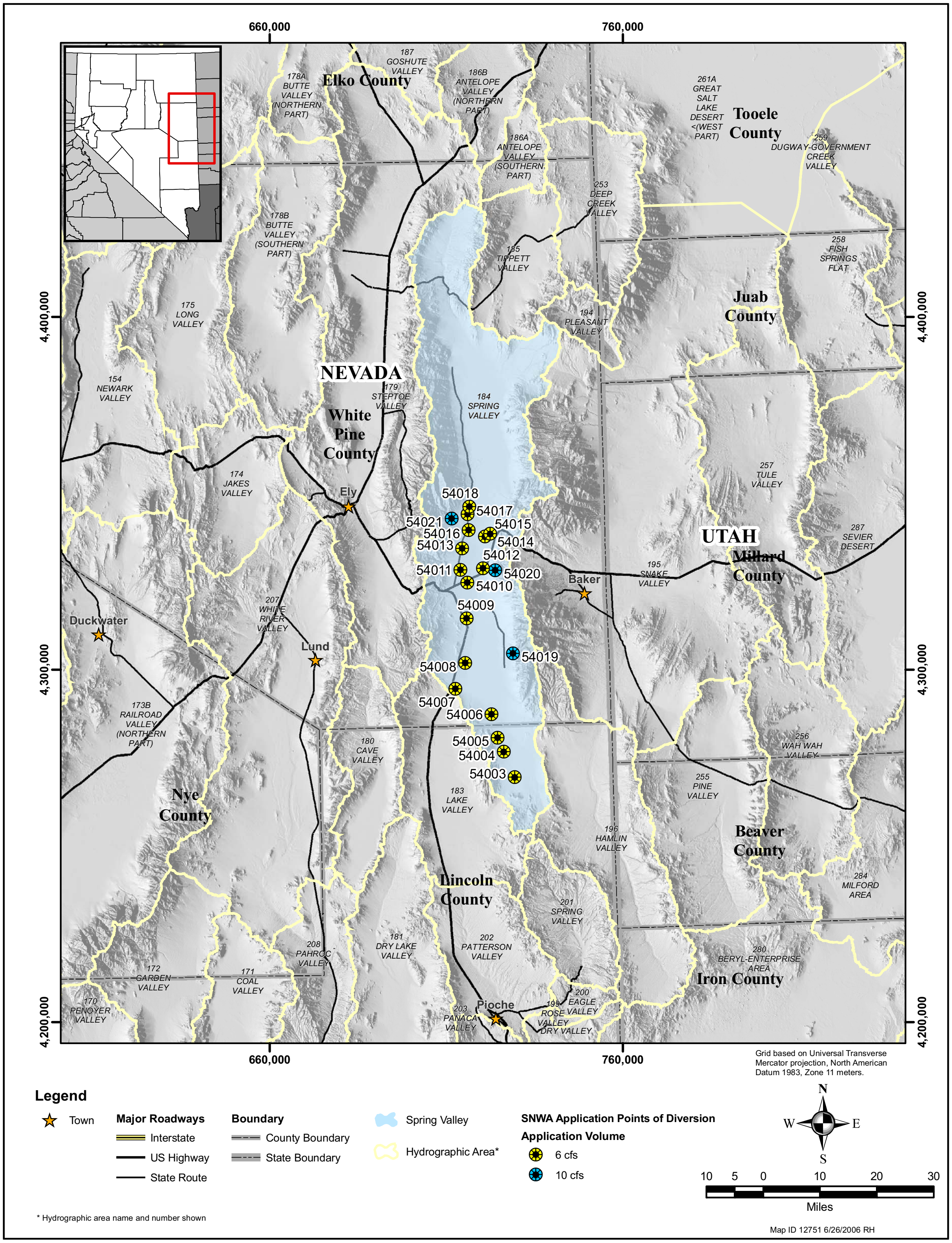

Figure 1-1
Location of Spring Valley and Study Area

movement, and a water resources and groundwater budget. The focus of these analyses is primarily limited to Spring Valley, although some of the data that were used in the data analyses are from stations located in adjacent valleys.

1.3 Document Organization

This report contains nine sections and four appendices. A brief description of each section and appendix follows:

- Section 1.0 is this introduction.
- Section 2.0 provides a general description of the previous investigations related to Spring Valley, including the purpose and objectives, data sources, methods, and conclusions of the investigations.
- Section 3.0 describes the compilation, evaluation, and processing of available altitude and precipitation-station data, and the methods, results, and conclusions of an analysis to derive an average annual precipitation distribution and corresponding natural recharge estimate for Spring Valley.
- Section 4.0 presents a brief description of the perennial streams of Spring Valley and presents the objectives, data, methodology, and results of an analysis to estimate the average annual flow of each stream.
- Section 5.0 summarizes previous studies related to ET within Spring Valley, including general descriptions of the data, technical approach, results and conclusions of each the study, and establishes the range of ET estimates for Spring Valley.
- Section 6.0 discusses groundwater occurrence, source, and movement for Spring Valley and provides an assessment of the current and recent water-level conditions based on an inventory of groundwater sites.
- Section 7.0 describes the derivation of a water resources and groundwater budget for Spring Valley, including descriptions of the data sources and simplifying assumptions related to each budget component.
- Section 8.0 discusses the estimate of the perennial yield for Spring Valley and presents an analysis quantifying the unappropriated groundwater within Spring Valley.
- Section 9.0 provides a list of references cited in the report.
- Appendix A contains a compilation of precipitation-station data.

- Appendix B contains a compilation of miscellaneous discharge measurements for ungaged perennial streams and the historical miscellaneous discharge measurements for the Cleve Creek near Ely, NV stream gage.
- Appendix C provides the annual discharge estimates for ungaged streams.
- Appendix D contains water-level data for wells and springs within Spring Valley and adjacent basins. In addition, it contains water-level Hydrographs for selected wells in Spring Valley.

2.0 PREVIOUS INVESTIGATIONS

Numerous studies related to Spring Valley and adjacent basins have been conducted since the late 1940s to the present. These studies have included water-resource investigations, geologic and hydrogeologic investigations, recharge and discharge estimations, and other hydrologic studies. The following sections describe, in general terms, the purpose, objectives, data sources, and conclusions for the most pertinent of these studies.

2.1 Hardman (1936), Hardman and Mason (1949), and Hardman (1965)

Hardman (1936) produced a precipitation map for the entire state of Nevada based on the distribution of vegetation communities within the state and precipitation data collected during the first decades of the 1900s. This map defined six precipitation zones for Nevada ranging from 0 to over 20 inches of precipitation per year. The map was also published in Hardman and Mason (1949, p. 10). This map was later updated to provide more detail in the southern Nevada area (Hardman, 1965).

Starting in the late 1940s to the early 1980s, the State of Nevada and the USGS completed hydrologic evaluations or reevaluations for nearly every valley in Nevada. To estimate the amount of groundwater recharge for these valleys, various precipitation maps were used. The earliest studies of this type, including Maxey and Eakin (1949) and Eakin et al. (1951) from the USGS Water Resources Bulletin Series, used the Hardman (1936) map directly. By contrast, precipitation estimates in the USGS Ground-Water Resources Reconnaissance Series reports typically used the precipitation maps from Hardman and Mason (1949) or Hardman (1965) in conjunction with updated topographic maps as first described in Eakin (1960, pp. 12-13).

The Hardman (1936), Hardman and Mason (1949, p. 10), and Hardman (1965) maps and the Maxey and Eakin (1949, p. 40) recharge estimation methodology used the same precipitation zones (5, 8, 12, 15, and 20 inches) indicating close association.

2.2 Rush and Kazmi (1965)

The water resources of Spring Valley were documented in the report titled "Water Resources Appraisal of Spring Valley, White Pine and Lincoln Counties, Nevada" (Rush and Kazmi, 1965). The report was published by the State of Nevada Department of Conservation and Natural Resources as part of their Water Resources-Reconnaissance Series. The purpose of the report was to provide a reconnaissance-level hydrologic evaluation of Spring Valley that included estimates of the groundwater recharge, groundwater discharge, and perennial yield for the valley. The specific observations from this report have been described and summarized in numerous other publications. Of specific interest, Rush and Kazmi (1965) estimated 75,000 acre-feet per year (afy) of natural recharge from precipitation, 70,000 afy of groundwater discharge by ET, and an additional 4,000 afy of groundwater outflow to Hamlin Valley (Rush and Kazmi, 1965, pp. 21-24). In a separately authored section of the report on surface water (Rush and Kazmi, 1965, pp. 12-18), D.O. Moore estimated 90,000 afy of runoff at the mountain-front for Spring Valley, including 50 cubic feet per second (cfs) of perennial streamflow. Rush and Kazmi (1965, Figure 6) also provided a generalized water budget for Spring Valley that integrated the natural recharge and runoff estimates for Spring Valley, and concluded that the perennial yield estimate is 100,000 afy (Rush and Kazmi, 1965).

2.3 Scott et al. (1971)

Scott et al. (1971) provided a hydrologic summary for the 232 HAs in the State of Nevada. The report was one in a series of reports being prepared for the development of a Nevada State Water Plan. The report was titled "Nevada's Water Resources" and included precipitation, surface water runoff, and groundwater recharge data in addition to perennial and system yield data for each of the HAs. Scott et al. (1971) indicates that the sources of much of the data used in the report are the Water Resources Bulletins and Water Resources Reconnaissance Series reports published by the Nevada Department of Conservation and Natural Resources. For Spring Valley, Scott et al. (1971) relied principally on the Rush and Kazmi (1965) reconnaissance report, and stated that there were 75,000 afy of groundwater recharge to Spring Valley from precipitation, 2,000 afy of groundwater inflow from Tippett Valley (HA 185), 70,000 afy of groundwater ET, and 4,000 afy of groundwater outflow to Hamlin Valley (HA 196) (Scott et al., 1971; Table 3, p. 8). The report also stated that the perennial yield of Spring Valley is 100,000 afy (Scott et al., 1971; Table 1, p. 9).

2.4 Hess and Mifflin (1978)

The Desert Research Institute (DRI) under contract with the Las Vegas Valley Water District published DRI Publication No. 41054. The report had a number of objectives including the following:

- Compile and interpret available hydrologic, geologic, geochemical, and geophysical data on the carbonate flow systems found in eastern and southern Nevada;
- Review the potential water management implications of withdrawing water from the carbonate aquifer system;
- Develop a comprehensive report incorporating the available information; and,
- Produce a detailed exploration plan and research program for future work (Hess and Mifflin, 1978, pp. 50-51).

The report contained a number of appendices that documented the Paleozoic rocks in eastern Nevada, the carbonate springs in eastern Nevada, cave lengths and lithologic units, and wildcat oil and gas wells found in eastern Nevada. This work identified that there is evidence for thick sequences of carbonate rocks beneath alluvial basins of eastern Nevada and data from petroleum well drilling indicates that intervals of cavernous carbonate rock exist to depths greater than 10,000 feet (ft) (Hess and Mifflin, 1978). One of the major areas of study identified in the exploration plan was to establish the degree of interconnection between the carbonate aquifer and the alluvial aquifers. The exploration plan described in the report proposed to use approximately seven wildcat oil wells and drill five exploratory wells in the Las Vegas Valley, Indian Springs/Corn Creek area, Kane Springs Valley, and Long Valley.

2.5 White Pine Power Project

According to Leeds et al. (1981a, p. i), the White Pine Power Project was a proposed electric generating facility that was to be located in White Pine County, Nevada. In support of this project, a number of reports were written to describe the surface water and groundwater resources in White Pine County (Leeds et al., 1981a; Leeds et al., 1981b; Leeds et al., 1983). The Phase 1 report was a reconnaissance-level report that summarized existing literature and data on the hydrology, geology, water rights, and water-right appropriations of White Pine County (Leeds et al., 1981a, p. i). The Phase 2 report verified and refined Phase 1 findings with geophysical fieldwork and testing of existing wells (Leeds et al., 1981b, p. i). The Phase 3 report documented the results of drilling, construction, and aquifer testing activities for wells in Spring and Steptoe Valleys (Leeds et al., 1983, p. i). The report also documented the results of electrical resistivity surveys performed in the valleys.

As part of the White Pine Power Project study, Leeds et al. (1981a, p. i) ranked the basins in White Pine County with respect to their capabilities to provide the volume of water required for the project. The criteria used by Leeds et al. (1981a) included water availability, availability of water rights, effects on environmentally sensitive areas, effects on existing water users, and costs of supply facilities and operation. Leeds et al. (1981a, p. ii) ranked Spring Valley as the most likely source of water for the White Pine Power Project, while Steptoe Valley was ranked as the next likely source of water for the project.

2.6 Ertec Western, Inc.

In the late 1970s and early 1980s, hydrogeologic evaluations associated with the MX missile-siting investigation were conducted by Ertec Western, Inc., or their subcontractors, for the U.S. Air Force (USAF) MX Missile Siting Program. These evaluations included 40 valleys in the Great Basin Region, including basins in east-central Nevada and western Utah. This program consisted of literature searches and field reconnaissance. Test drilling, aquifer testing, and the development of groundwater flow models to assist in predicting potential impacts of pumping were conducted in some valleys (Bunch and Harrill, 1984). These studies have been documented in numerous reports including those by Ertec Western, Inc. (1981a through e).

While discussing Spring Valley specifically, Ertec Western, Inc. (1981c, p 232) stated that much of the valley-fill aquifer is believed to be under unconfined conditions and that confined conditions exist in areas containing fine-grained playa deposits. They also stated that the carbonate aquifer has a high potential for water-supply development (Ertec Western, Inc., 1981c, p. 232).

2.7 Harrill et al. (1988)

The USGS Hydrologic Atlas HA-694-C is one of several products produced as part of the Great Basin Regional Aquifer System Analysis (RASA). Harrill et al. (1988) stated that the RASA program was intended to develop a geologic, hydrologic, and geochemical framework for regional aquifer systems nationwide. This publication delineated regional flow systems within the Great Basin. A map at a scale of 1:1,000,000 presented interpretations of general groundwater flow directions in basin-fill deposits, and flow directions and magnitudes of inter-basin flows. For Spring Valley specifically, the map showed that there were 75,000 afy of groundwater recharge to the valley, 2,000 afy of inflow into Spring Valley from Tippett Valley through permeable consolidated rock, and 4,000 afy of outflow to Hamlin Valley through permeable consolidated rock (Harrill et al., 1988).

2.8 Dettinger (1989)

Dettinger (1989) documented a chloride-balance method for estimating the average annual recharge to groundwater basins in the Basin and Range Province. The method discussed in the report requires estimates of the total precipitation on areas contributing recharge to the basin, average concentrations of chloride in bulk precipitation on areas contributing recharge, and chloride concentrations in groundwater as it enters a basin (Dettinger, 1989). The recharge results of the chloride-balance method were compared against the Maxey-Eakin and Water Budget methods with very similar results in many of the basins. Results from the report suggest that the method provides a reconnaissance level estimate for recharge to basins in Nevada.

Recharge for Spring Valley was estimated in the report to be approximately 62,000 afy (Dettinger, 1989, p. 69). The recharge estimate using the chloride-balance method for Spring Valley was much less than the Maxey-Eakin and Water Budget estimates which were in close agreement. He stated, however, that the method is sensitive to uncertainties in delineating recharge-source areas and chloride concentrations in precipitation and dry fallout (Dettinger, 1989, p. 76). Additional limitations in the use of the method specifically related to Spring Valley include a limited number of samples in the valley, the use of an assumed 0.4 milligrams per liter chloride concentration for precipitation (Dettinger, 1989, p. 70), and the inaccuracies introduced in valleys with large volumes of rejected recharge (Dettinger, 1989, p. 59).

2.9 Principia Mathematica Inc.

Between 1992 and 1994 Principia Mathematica Inc. prepared and published a series of seven reports on behalf of Nye, Lincoln, and White Pine Counties. The purpose of these reports was to assist Nye County in preparing a defense against the groundwater applications proposed by the LVVWD in 1989. These reports covered an array of topics including summarizing existing hydrologic information, reviewing observation well data, reviewing Cooperative Water Project (CWP) reports and groundwater flow models published by LVVWD, and reviewing a regional groundwater flow model developed by the USGS as part of the RASA.

2.10 Brothers et al. (1994)

The LVVWD published a series of 19 reports in support of groundwater applications filed with the Nevada State Engineer's Office in 1989 and as part of the CWP. The reports describe the hydrology, environmental setting, and other related topics for valleys in which the groundwater applications were filed. Brothers et al. (1994) is the thirteenth report of the series and specifically described the hydrologic assessment conducted for Spring Valley. According to Brothers et al. (1994), the purpose of the report was to define the hydrologic conditions in the valley and develop a calibrated steady-state groundwater flow model. To that end, the report summarizes information from Rush and Kazmi (1965) and includes additional information about the local geology, geochemistry (primarily from the USAF MX Missile Siting Program), and water rights for the valley. It also details the results of the steady-state groundwater flow model developed for the valley.

2.11 Broadbent et al. (1995)

Broadbent et al. (1995) is the seventeenth report of the CWP series. The purpose of the investigation was to evaluate anomalous mountain-front runoff estimates and how they are accounted for in basin water budgets. As a result, the report investigated the mountain front runoff component in Spring (HA 184), Snake (HA 195), and Railroad Valleys (HA 173A and 173B). The report also compared the volume of mountain-front runoff from primarily carbonate mountains with runoff from other types of mountain blocks (Broadbent et al., 1995, p. 1). The observations of Moore (1968), Watson et al. (1976), and Avon and Durbin (1992) were also discussed. Broadbent et al. (1995, pp. 2 and 13-14) suggested that a significant percent of runoff is infiltrating into the carbonate rocks that comprise the mountains in Spring, Snake, and Railroad Valleys.

2.12 Nichols (2000)

The USGS in cooperation with LVVWD and Nevada Division of Water Resources (NDWR) published USGS Professional Paper 1628 (Nichols, 2000). The report documented research conducted on 16 valleys in central and eastern Nevada, including Spring Valley. The professional paper was divided into three chapters. Chapter A of the report described a methodology to estimate groundwater ET from an estimate of plant cover. Chapter B of the report described a methodology to estimate groundwater ET at a regional scale. Chapter C of the report documents the regional groundwater budgets and groundwater flow for each of the 16 valleys in the study.

Nichols (2000, Chapter C, Plate 4) estimated 104,000 afy of groundwater recharge from precipitation and an average of 90,000 afy of discharge by ET for Spring Valley. In addition, Nichols (2000, Chapter C, Plate 4) estimated 4,000 afy of groundwater outflow from northern Spring Valley to Snake Valley and 10,000 afy of groundwater outflow from southern Spring Valley into Hamlin Valley.

2.13 Katzer and Donovan (2003)

As part of an investigation of the surface-water resources and basin water budget of Spring Valley, Katzer and Donovan (2003) described the surface-water and groundwater resources within the basin, including re-estimates of precipitation, groundwater recharge, and mountain-front runoff using the available data. Using these new estimates, a water-resources budget (groundwater and surface water) was assessed to determine estimates of system and perennial yield. Katzer and Donovan (2003 reported a perennial yield estimate of 110,000 afy for Spring Valley based on the average phreatophyte use and the capture of surface-water evaporation.

3.0 PRECIPITATION AND NATURAL RECHARGE

Precipitation is an important component of a basin's water balance as its occurrence contributes to both the groundwater and surface water budgets as natural recharge to the groundwater system, mountain-front runoff, sheet flow to lower elevations on the valley floor, and soil moisture. This section discusses the compilation, evaluation, and processing of available altitude and precipitation data for the purposes of deriving an average annual precipitation distribution and corresponding natural recharge estimate for Spring Valley.

3.1 Objectives

The objectives of this analysis were to (1) compile, evaluate, and process available altitude and precipitation data, (2) derive an average annual precipitation distribution for Spring Valley, (3) estimate the natural recharge by applying the standard Maxey-Eakin recharge efficiencies as they were applied in Rush and Kazmi (1965), and (4) compare the estimate of natural recharge derived by this analysis to the estimate of Rush and Kazmi (1965).

3.2 Altitude and Precipitation-Station Data

Precipitation in Nevada is greatly influenced by orographic effect as demonstrated by the available data and previous investigators (Quiring, 1965; Houghton et al., 1975; Mitchill, 1975; Hansen et al., 1977; Hevesi et al., 1992; Daly et al., 1994; Maurer and Halford, 2004). As the available data indicate, greater amounts of precipitation (rain and snow) occur at higher elevations than at lower elevations. This observation is a fundamental assumption and places particular emphasis on the altitude and precipitation data that define this relationship. The following sections describe the specific data required to accomplish the objectives of the analysis, the data sources and types, how the data were verified, evaluated, and processed, and an assessment of their quality and limitations.

3.2.1 Data Requirements

The minimum data required to accomplish the objectives of the analysis include precipitation measurements at individual stations over long periods, corresponding altitudes for those stations, and topographical data to delineate altitude-area distributions. Additional data were available and considered in this analysis, including data qualifiers, station attribution, and information from previous investigations.

3.2.2 Data Sources and Types

Altitude data for individual precipitation stations were reported by, and included in, the datasets obtained from the various precipitation-station data sources. Topographical data were also obtained from the USGS 30 meter (m) digital elevation model (DEM) (USGS, 1999).

The available precipitation-station data for Spring Valley and adjacent valleys were obtained from the following sources: NDWR, USGS, Western Regional Climate Center (WRCC), National Climatic Data Center (NCDC), Natural Resources Conservation Service (NRCS), and the Remote Automated Weather Stations (RAWS) network. In general, these datasets include site attribution, reported precipitation values, and summary statistics. Specific station attribution includes the following:

- Station Name
- Location data (x- and y-coordinates)
- Altitude
- Date
- Depth of Precipitation (inches)
- Other climate information such as temperature, wind speed, solar radiation, etc.

3.2.3 Methods of Measurements

The method of precipitation data collection is usually determined by the accessibility of the site, the type of precipitation measured (snow, rain, fog drip, hail, sleet, etc.), the precision desired by the researcher, and the available budget. For the purposes of this analysis, the accuracy of the altitude and the consistency, continuity, and period of record of precipitation measurements were considered most important.

Three types of precipitation gages are typically used within the area of interest: bulk-storage, weighing-bucket and tipping-bucket gages. Bulk-storage gages collect and store precipitation between intervals when the gage is serviced and the depth of precipitation is measured. In most instances, these gages are in remote areas where year-round access is problematic. Measurements are generally made on an annual or semi-annual basis. Conversely, weighing-bucket and tipping-bucket gages are continuous measuring devices, and are generally placed where accessibility is unhindered and work best where rain is the predominant type of precipitation.

The information included with the datasets acquired from WRCC and NCDC did not specify the types of devices used in the collection of the data. However, it is likely that the measuring devices and data collection procedures conform to the National Weather Service (NWS) and National Oceanic and Atmospheric Administration (NOAA) standards because the data records constitute part of their inventory. The NDWR, USGS, and NRCS sites use bulk-storage precipitation gages. The NRCS gages are equipped with pressure transducers that continuously record depth of precipitation. Maintenance records and descriptions of the measurement devices are available on the NRCS internet website (http://www.nrcs.usda.gov). The type of precipitation gages used for RAWS sites is unknown based on the information available on the RAWS internet website at the time of data retrieval.

3.2.4 Data Compilation, Verification, and Processing

Available precipitation-station data from the previously mentioned data sources were acquired through the 2005 calendar year. The data were then compiled electronically and organized by data source to facilitate subsequent verification and evaluation.

Once compiled, the precipitation data were processed to determine the period-of-record average annual precipitation for each station. The procedures by which individual datasets were processed varied due to the intervals in which the data were reported (i.e., daily, monthly, semi-annually, or annually). For daily reported precipitation data, values were summed to a monthly total. For monthly data, the average monthly value was calculated from monthly totals for the entire period of record. The average monthly data were summed to determine the period-of-record average annual precipitation. For annual data, the average was calculated for the period-of-record. The following discussion provides a brief description of the available datasets and the procedures by which they were processed.

The NCDC is a division of NOAA and is the national repository of weather data. These data are primarily collected by cooperating observers of the NWS, which is also a division of NOAA. In support of this analysis, NCDC Precipitation Climate Normals and monthly data from the NCDC archives were obtained for Nevada and Utah. For precipitation stations qualified as “climate normals,” the period-of-record averages were used in the analysis. For other NCDC stations, the period-of-record average annual value was calculated from the monthly data by averaging monthly data for the period of record, then summing those averages to calculate the annual average.

The WRCC is one of six regional climate centers in the United States that are administrated by NOAA. The WRCC maintains historical climate databases for the western region and serves as a focal point for coordination of applied climate activities. The historical climate databases include summarized monthly climate data for 5,240 locations in the western region. All stations qualified as NCDC “climate normals,” and many other NWS cooperator stations are reported on the WRCC website. For NWS Cooperator stations, the WRCC data were used when available, so that additional years could be included in the calculation of the period-of-record average, rather than just the “climate-normal” period (1971 to 2000). The WRCC provides summary statistics for each station, including average monthly precipitation and information on the number of missing daily records during each month. The number of missing daily records is an important statistic because the average for any month with greater than five missing days is not used in the calculation of the period-of-record average. This methodology is consistent with the recommendations of the World Meteorological Organization (1989, p. 5). The WRCC data compilation provides additional filtering of the NCDC data, and therefore, the values reported by WRCC will sometimes differ slightly from those reported by NCDC.

The NRCS has collected several types of weather data for over 100 years. Of particular interest to this analysis are the SNOwpack TELemetry (SNOTEL) sites in which continuous precipitation data are collected. Daily precipitation data from these sites were downloaded from the NRCS website (http://www.wcc.nrcs.usda.gov/snow/sntllist.html) and used to calculate the period-of-record annual average (NRCS, 2006). Because the data are continuous and 100 percent complete, calendar year or water-year totals can be calculated with relative ease. For the purposes of this analysis, the water-year period-of-record averages were calculated to ensure consistency with the other datasets.

The NDWR precipitation data are collected and reported on an annual basis and required little processing to calculate the period-of-record average. Processing the data included calculating the period-of-record average and deriving the summary statistics describing the individual station records.

The USGS (Nevada District) maintains a network of moderate to high altitude precipitation stations within the area of interest. Precipitation data from these stations are typically collected and reported on a semi-annual basis, usually at the beginning of the water year and once in the summer months. Because these stations are at high altitude, site visits are subject to accessibility issues, and the timeliness of site visits can vary between years, thus complicating the calculation of the period-of-record average. Rather than attempting to calculate semi-annual “seasonal” averages, water-year averages were calculated and used to calculate the period-of-record annual average for each station.

The RAWS network has been used for assisting land management agencies with a variety of projects including air-quality monitoring, rating fire danger, and providing information for research. RAWS data can be accessed on the WRCC website and Real-time Observation Monitor and Analysis Network (ROMAN). Of interest to this analysis are the precipitation data which are reported in hourly, daily, and monthly timeframes. Daily and monthly precipitation data were downloaded from the WRCC internet website (http://www.wrcc.dri.edu/wraws/nvut.html) and processed in the same manner used to compute the NWS Cooperator station period-of-record annual average (WRCC, 2006).

Upon completion of the data processing, summary statistics were generated for each precipitation station. The summary statistics include the period of record, period of record average annual precipitation, minimum and maximum annual precipitation, and the standard deviation of the annual average precipitation. For data reported monthly, the statistics were derived by summation of the period of record monthly values (average, minimums, maximums, standard deviations) for all twelve calendar months. One important summary descriptor is the total number of years during the period of record in which the annual precipitation value was reported as zero. This is an important statistic because for some stations, particularly those comprising the RAWS dataset, the annual precipitation was reported as zero for numerous consecutive years. This is a highly unlikely occurrence since the minimum average annual precipitation in Nevada is three to four inches (NDWR, 2006a and b), and calls into question the reliability of some of the RAWS Stations in terms of their usefulness in accomplishing the objectives of this analysis. The summary data for the station within Spring Valley and vicinity are presented in Appendix A, and their location is depicted in Figure 3-1.

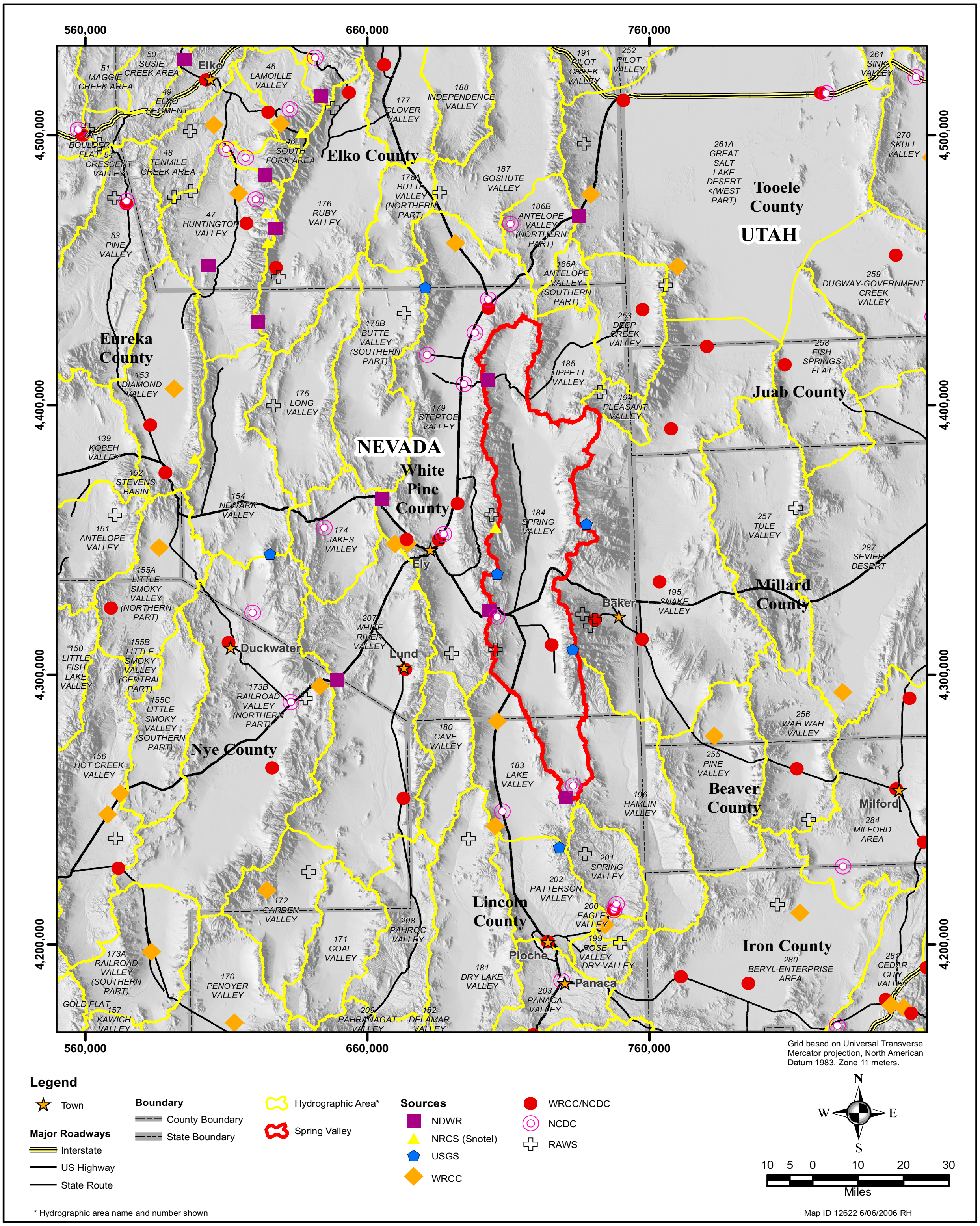

Figure 3-1
Precipitation Stations Located in Spring Valley and Vicinity

To verify the location and altitude data for each precipitation station, the coordinate and altitude data were first transformed to common datums (Universal Transverse Mercator [UTM] Zone 11, North American Datum of 1983 [NAD83]; North American Vertical Datum of 1988 [NAVD88]). Upon completion of this process, the station data were checked against the USGS 30m DEM to identify differences between their altitudes. In cases where the altitudes differed by greater than 100 ft, the DEM altitude value was used in the analysis. Through this process, the altitude of eighteen stations were adjusted. These data are also presented in Appendix A.

3.2.5 Data Quality Evaluation

The quality of the precipitation-station datasets was evaluated based on data qualifiers assigned by the originating entity, data documentation, methods of data collection, and reporting frequency. While this evaluation was not explicitly represented in the data analysis by applying weights or associated accuracies to the data, it was relied upon in discussing the results of the analysis. The following provides a general description of the data quality evaluation for each dataset.

The database maintained by NCDC is the most comprehensive climate source in the United States. NCDC also defines and qualifies “climate normals,” which have been subjected to strict quality-control procedures. The NCDC climate normal represents the arithmetic mean of a climatological element computed over three consecutive decades (WMO, 1989) and following a consistent methodology to produce a time series that best represents the measured data (NOAA, 2002). For the purposes of this analysis, data from these stations are considered to be the highest quality due to their level of quality control and long periods of record. The NWS Cooperator stations that are not qualified as climate normals are also available from the NCDC website. While these stations are not considered climate normals, they were subjected to further evaluations to determine their qualifications with respect to this analysis.

As stated previously, the WRCC precipitation dataset includes data for the NCDC climate-normal stations and other NWS Cooperator stations. These values were used for the NCDC climate-normal stations and were considered to be the highest quality data used in the analysis. The quality of NWS Cooperator stations that are not qualified as climate normals can vary significantly. For example, the “Desert Exp Range, Utah” station has a period of 35 years with 99.7 percent of the record being complete. Conversely, “Currie Hwy Stn, Nevada” has a period of record 31 years, but with 10 consecutive years (1975 to 1985) of no data.

The NRCS SNOTEL data-collection network measures precipitation, air temperature, and snow water equivalence (SWE) for numerous river basins in the United States. Within the area of interest, these stations are located within the mountain blocks and at high altitudes. Bulk-storage gages are used at these stations and are equipped with standard sensors to measure SWE, precipitation, temperature and snow depth, which combined give a relatively accurate record of precipitation. Site visits are conducted every year to ensure proper operation and calibration of the sensors and to perform routine maintenance on the gage. For the purposes of this analysis, the NRCS SNOTEL data were considered high-quality data because of their completeness and documentation.

The NDWR data is of long duration; most of the data has been collected at the same or a nearby location since the mid-1950s or 1960s. The locations of the sites are within the mountain blocks at moderate to high altitudes. As stated previously, precipitation is collected in bulk-storage gages, and the data is typically very reliable if the gages are well placed and properly maintained. Because of the long periods of record and strategic placement of these stations, the NDWR dataset provided important data for the data analysis. Although the stations are bulk-storage gages like the NRCS SNOTEL gages, they are not equipped to continuously measure precipitation. However, for the purposes of this analysis these data were important and were qualified as good data.

The USGS precipitation data included in this analysis were collected as part of a program initiated under joint-funding agreements between the USGS, LVVWD, and NDWR. The network was designed to augment the existing NDWR network by providing precipitation data from new locations and at higher altitudes. The sites are located in the mountain blocks at moderate to high altitudes, and accessibility restrictions due to the weather may cause maintenance delays. The gages are based on designs that are very similar to those of the NRCS SNOTEL bulk-storage gages. As stated previously, the sites are visited on a semi-annual basis. The gages are not equipped to continuously measure precipitation, but, like the NDWR gages, were considered important due to their strategic placement with respect to altitude. For the purposes of this analysis the USGS dataset was qualified as good.

Quality-control information related to the RAWS precipitation data is provided on the ROMAN website, which states “Quality control of precipitation data is limited to gross checks” (NOAA, 2005). The National Wildfire Coordinating Group (NWCG) reports that there has been no consistent station standards applied to maintenance, fire weather network analysis, communication, and archiving for the RAWS stations until May 2005 (NWCG, 2005). Because of these many deficiencies, the RAWS data were qualified as poor for the purposes of this analysis.

3.2.6 Data Limitations and Accuracy

Limitations of the data compiled for this analysis principally relate to the location accuracy (x, y, and z-coordinates) of the precipitation stations, the number and spatial distribution of precipitation stations, period of record of precipitation data, accuracy of the precipitation measurements, and accuracy of the topographical data.

The spatial distribution of precipitation gages is limited in Spring Valley; however, these stations are augmented by stations at various altitudes in surrounding basins. Precipitation stations generally do not have periods of record that coincide exactly, but for stations having long periods of record, the records overlap considerably. Perhaps the most important limitation is that of the accuracies associated with the location data for the precipitation stations. Inaccuracies in the coordinate data can translate into inaccuracies and uncertainty in the altitude data. The accuracy of precipitation measurements can vary based on the methods of measurement and can be a limiting factor on how the data can be applied in analysis. However, the accuracies associated with the altitudes, locations, and precipitation data compiled for this analysis were not defined and, therefore, could not be incorporated into the analysis.

Topographical data obtained from the USGS 30m DEM was not a principal limiting factor in this analysis. This dataset covers the entire area of interest and has an altitude accuracy better than 50 ft (USGS, 2006). This dataset is commonly used in data analyses involving Geographic Information System (GIS) applications.

3.3 Methodology

To accomplish the objectives of the analysis, precipitation and altitude data were compiled, evaluated, and selected for the purpose of determining the relationship between the two parameters for an area encompassing Spring Valley and vicinity. The quality of the datasets was assessed, and the period-of-record average annual precipitation and summary statistics were calculated for each precipitation station. As part of the quality assessment, the altitude data for the precipitation stations were verified using the USGS 30m DEM. A linear regression analysis was performed using altitude and precipitation data for selected stations. From the regression analysis the “best-fit” equation describing the altitude-precipitation relationship was defined and used to develop a precipitation distribution for Spring Valley. The precipitation distribution was partitioned into discrete altitude intervals coincident with the precipitation zones defined in Rush and Kazmi (1965), and the total precipitation within each zone was calculated. The standard Maxey-Eakin recharge coefficients were applied to the precipitation distribution to derive an estimate of mountain-block recharge for Spring Valley. The Maxey-Eakin recharge efficiencies applied in the analysis are listed in Table 3-1 corresponding to the precipitation range provided in Rush and Kazmi (1965).

Table 3-1
Standard Maxey-Eakin Recharge Efficiencies

Precipitation Range (inches)	Maxey-Eakin Recharge Efficiency (%)
> 20	25
15 - 20	15
12 - 15	7
8 - 12	3
< 8	0

Sources: Maxey and Eakin (1949); Rush and Kazmi (1965)

3.4 Data Analysis

The following sections describe the data analysis completed to derive an average annual precipitation distribution and corresponding recharge estimate for Spring Valley. These sections of the report describe the process of selecting altitude and precipitation data for use in a linear regression analysis, the results of the regression analysis, and how the altitude areas, precipitation distribution, and recharge estimate were derived.

3.4.1 Selection of Altitude and Precipitation Data for Regression Analysis

Altitude and precipitation data obtained from the aforementioned sources were processed, evaluated, and selected to accomplish the objectives of the analysis described in Section 3.1. The precipitation data were evaluated and selected so that the most temporally and spatially representative dataset from qualified stations was used in the regression analysis. The process and criteria by which the precipitation stations were evaluated and selected is depicted by the flow chart in Figure 3-2.

First, all stations qualified as climate normals by the NCDC were included in the analysis. The average annual precipitation as reported by WRCC was used for these stations. All remaining stations were evaluated to determine which had greater than 20 "non-zero" years of reported annual precipitation (i.e., years in which the reported annual precipitation was greater than zero). Stations with less than 20 non-zero years were excluded from the analysis. The 20 "non-zero" years criterion is based on the observation that 10 years is the minimum and 30 years are preferred for NCDC climate normals (NOAA, 2002, p. 3) and that a 20 year criterion ensures that the precipitation dataset has good temporal representation. The spatial distribution (location and altitude) of the qualified stations was assessed to determine whether or not there were a sufficient number of stations within Spring Valley to complete the regression analysis. Through this process, it was determined that only five qualified stations are located within Spring Valley and that additional stations would be required to complete the analysis. A review of the spatial distribution of precipitation stations indicated that a 50-mile buffer around Spring Valley would yield a sufficient number of representative stations to complete the regression analysis. The precipitation stations used in the regression analysis are listed in Table 3-2 and are presented in Figure 3-3.

3.4.2 Regression Analysis

A linear regression analysis was performed using the altitude and precipitation data from the 39 stations listed in Table 3-2 to determine the relationship between altitude and precipitation within the 50-mile buffer area around Spring Valley. An R^2 value of 0.82 was calculated, indicating that there is good correlation between the two parameters. The relationship is defined by the following "best-fit" equation:

$$P = 0.000237(A) - 0.537863 \qquad (3\text{-}1)$$

where

P = the average annual depth of precipitation, in ft
A = altitude, in ft-above mean sea level (amsl)

Summary statistics for this analysis are presented in Appendix A. Figure 3-4 provides a chart depicting the relationship between altitude and precipitation for these stations and the equation for the "best fit" line. A residual plot was constructed to evaluate how well the equation represents the data, and is presented in Figure 3-5.

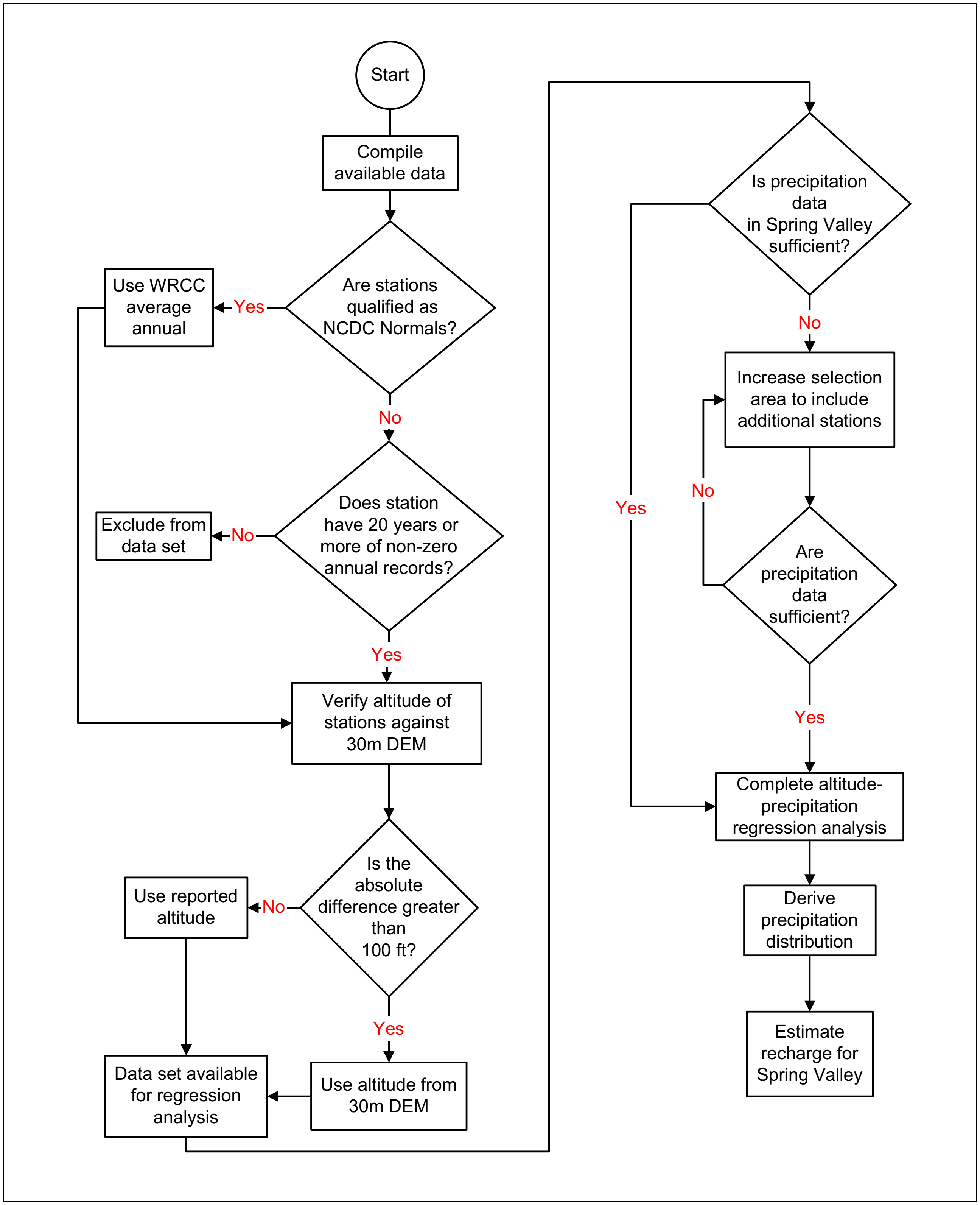

Figure 3-2
Precipitation-Station Data Evaluation Process

Table 3-2
Precipitation Stations Used for Deriving Altitude-Precipitation Relationship

Station Name	Source	NCDC Normals	UTM Northing (m)	UTM Easting (m)	Reported Altitude (ft)	Altitude from 30m DEM (ft)	Start	End	Duration	Years of Non-zero Precipitation	Average Annual Precipitation (in.)
Berry Creek[a]	NRCS (Snotel)	No	4,354,622	705,390	9,100	9,681	1981	2005	25	25	27.35
Callao	WRCC/NCDC	Yes	4,421,801	780,345	4,330	4,349	1948	2005	58	58	5.84
Cave Mountain	USGS	No	4,337,547	706,108	10,650	10,621	1984	2005	22	22	20.41
Cherry Creek Range[a]	USGS	No	4,443,655	680,594	9,700	9,106	1984	2005	22	22	15.67
Connors Pass	NDWR	No	4,323,835	703,315	7,732	7,783	1954	2005	52	46	14.72
Current Creek[a]	NDWR	No	4,298,199	649,245	5,999	6,913	1954	2005	52	48	13.71
Currie Highway Stn	WRCC	No	4,460,144	691,236	5,820	5,796	1961	1991	31	21	7.16
Desert Exp Range	WRCC	No	4,277,393	782,964	5,250	5,239	1950	1984	35	35	6.22
Ely WBO	WRCC/NCDC	Yes	4,350,044	685,372	6,250	6,280	1897	2005	109	80	9.57
Eskdale	WRCC/NCDC	Yes	4,334,515	763,613	4,980	4,979	1966	2005	40	41	6.44
Fish Springs Refuge[a]	WRCC/NCDC	Yes	4,415,084	808,023	4,340	4,471	1960	2005	46	46	7.94
Garrison	WRCC/NCDC	Yes	4,313,196	757,384	5,260	5,276	1951	1990	40	40	7.61
Geyser Ranch	WRCC	No	4,282,815	706,113	6,020	5,972	1948	2002	55	28	8.67
Gold Hill	WRCC	No	4,451,436	769,871	5,250	5,257	1966	1990	25	25	11.11
Great Basin Natl Park[a]	WRCC/NCDC	Yes	4,320,446	740,673	6,830	6,949	1948	2005	58	58	13.24
Ibapah	WRCC/NCDC	Yes	4,435,448	757,623	5,280	5,302	1948	2005	58	58	9.77
Lages[a]	WRCC/NCDC	Yes	4,436,011	702,945	5,960	6,091	1984	2005	22	22	8.35
Lake Valley Steward[a]	WRCC	No	4,243,927	705,365	6,350	6,481	1971	1998	28	28	15.69
Lund - NV[a]	WRCC/NCDC	Yes	4,302,024	673,483	5,570	5,721	1957	2005	49	49	10.26
McGill[a]	WRCC/NCDC	Yes	4,363,530	691,944	6,300	6,490	1914	2005	92	92	8.82
Modena	WRCC/NCDC	Yes	4,188,089	771,110	5,460	5,473	1901	2004	104	103	10.26
Mt. Hamilton[a]	USGS	No	4,344,777	625,555	10,600	10,448	1984	2005	22	20	19.51
Mt. Washington	USGS	No	4,309,377	732,764	10,440	10,508	1984	2005	22	22	26.13
Mt. Wilson[a]	USGS	No	4,236,086	728,118	9,200	9,088	1984	2005	22	21	19.68
Overland Pass 2	NDWR	No	4,430,934	621,103	6,790	6,848	1966	2005	40	39	14.43
Partoun	WRCC/NCDC	Yes	4,391,336	767,708	4,780	4,768	1950	2005	56	56	6.74
Pioche[a]	WRCC/NCDC	Yes	4,201,109	724,042	6,180	6,068	1948	2005	58	58	13.25
Robinson Summit	NDWR	No	4,365,136	665,201	7,800	7,708	1954	2005	52	47	14.05
Ruby Lake[a]	WRCC/NCDC	Yes	4,451,025	627,593	6,010	6,412	1948	2005	58	58	13.19
Ruth	WRCC/NCDC	Yes	4,350,154	673,938	6,840	6,845	1958	2005	48	41	12.05
Schellbourne Pass[a]	NDWR	No	4,409,348	702,800	7,100	7,277	1954	2005	52	45	13.67
Shoshone 5 N	WRCC/NCDC	Yes	4,311,105	725,336	5,930	5,942	1988	2005	18	18	9.73
Spring Valley St Pk	WRCC/NCDC	Yes	4,212,891	747,440	5,950	5,850	1974	2005	32	32	12.16
Sunnyside	WRCC/NCDC	Yes	4,254,266	672,777	5,300	5,368	1948	2005	58	44	9.44
Unnamed Peak NW of Mt. Moriah[a]	USGS	No	4,355,941	737,695	9,300	8,836	1984	2005	22	20	16.72
Wah Wah Ranch	WRCC/NCDC	Yes	4,265,142	812,231	4,880	4,889	1955	2005	51	51	6.77
Ward Mountain[a]	NRCS (Snotel)	No	4,333,562	677,114	9,200	9,437	1981	2005	25	25	24.22
White Horse Pass[a]	NDWR	No	4,470,279	735,178	6,000	5,881	1954	2005	52	43	9.41
Wilson Creek Summit[a]	NDWR	No	4,254,601	730,436	7,200	7,413	1954	2005	52	48	17.51

[a]Altitude adjusted for regression analysis.

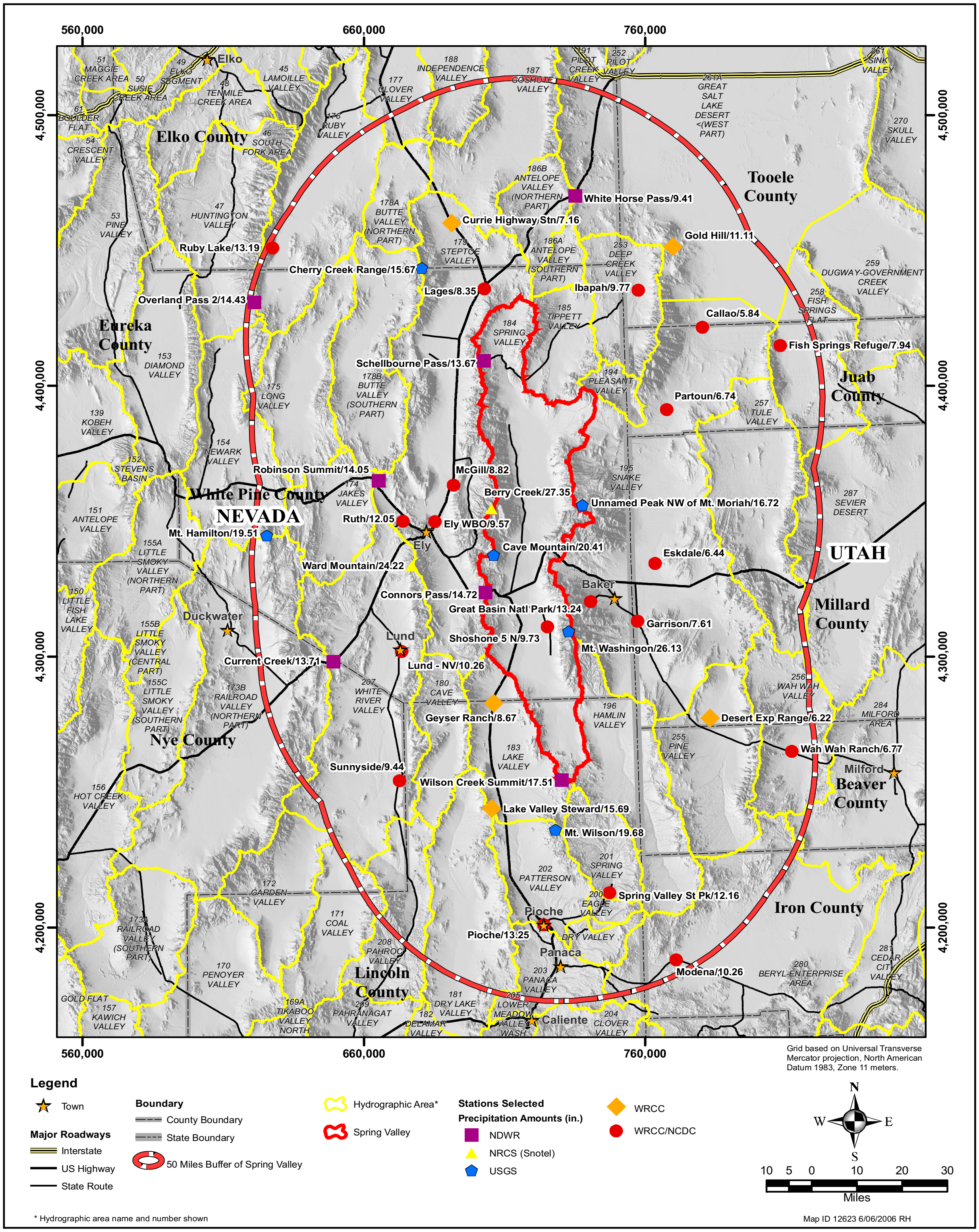

Figure 3-3
Precipitation Stations Used to Derive Altitude-Precipitation Relationship

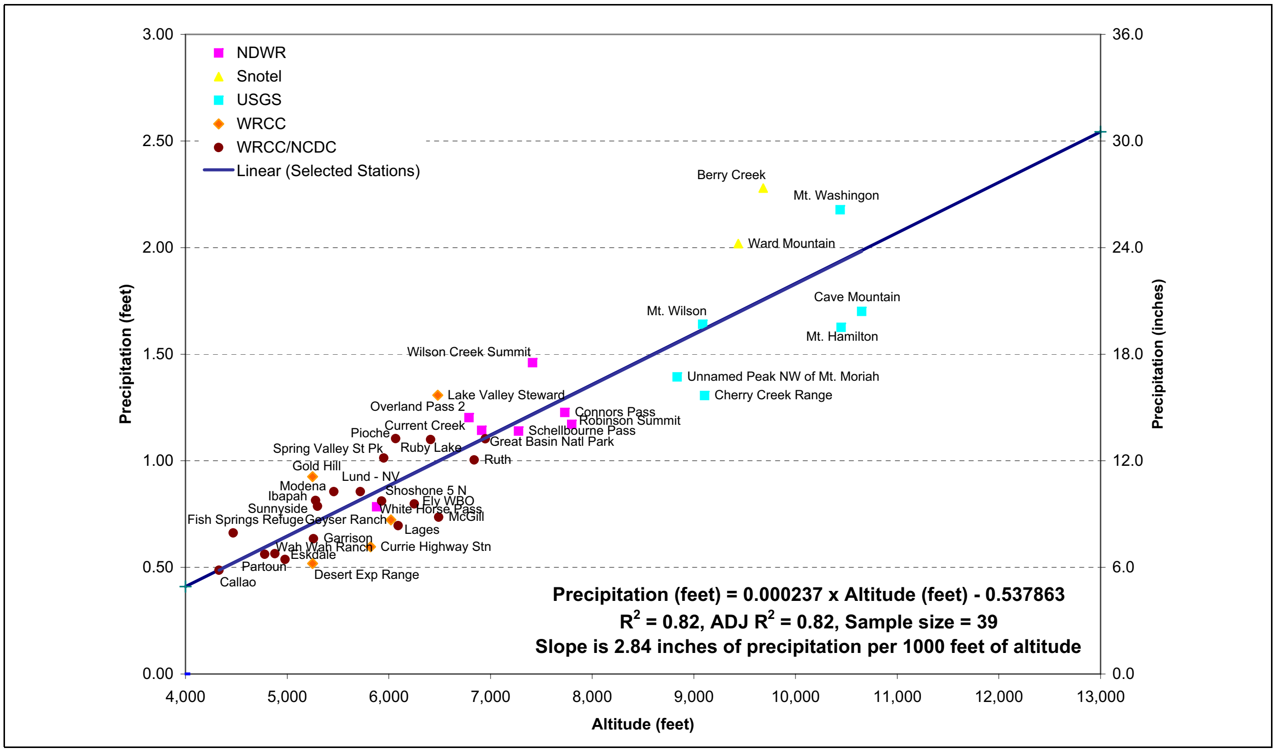

Figure 3-4
Altitude-Precipitation Relationship for Spring Valley and Vicinity

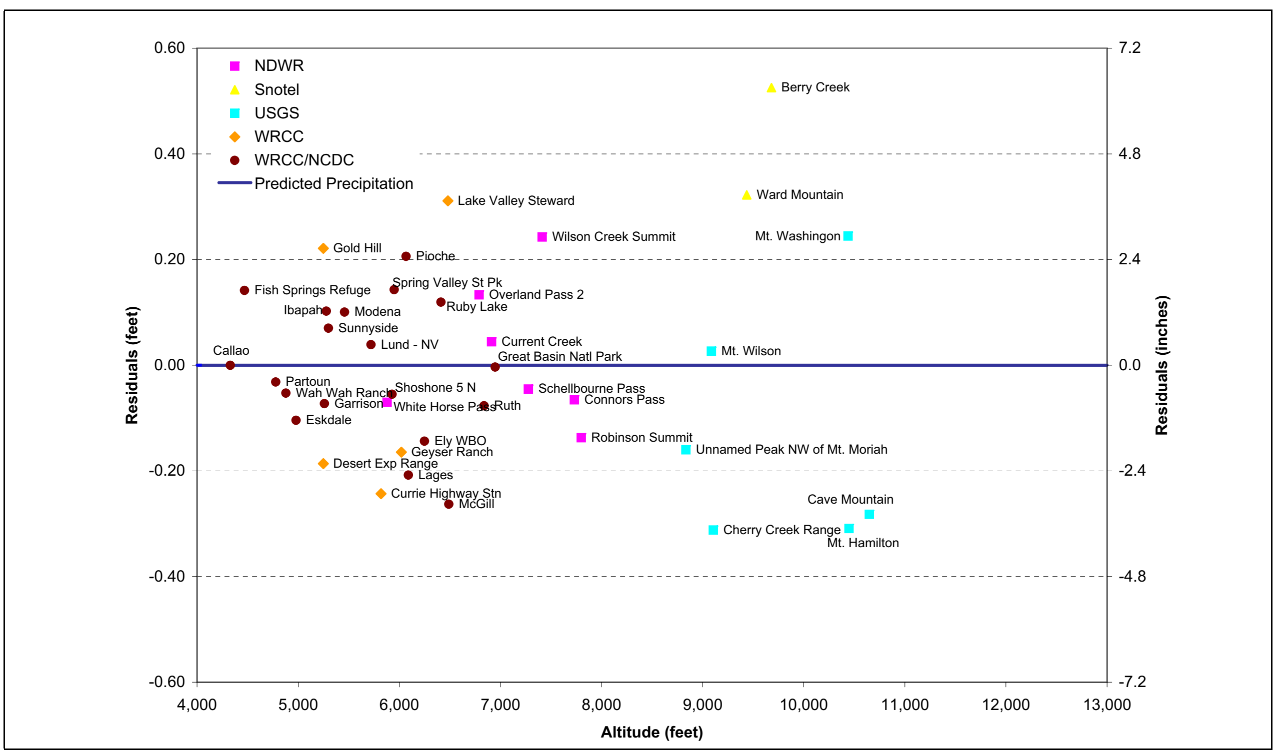

Figure 3-5
Residual Plot of Predicted Precipitation

The regression equation represents the reported values quite well; and the random distribution of the residuals indicate a good model fit. It is noted however, that slightly greater variation occurs at the higher elevations. This variation might be explained if the degree to which some of the gages underestimate the actual precipitation were known. Groisman and Legates (1994, p. 224) observe that gage measurements tend to have a bias towards underestimating the "true" precipitation value and that this bias ranges from 5 to 25 percent for annual totals, with larger biases occurring at higher altitudes and latitudes. For the data used in the regression analysis it was observed that the NRCS SNOTEL stations report higher values of precipitation than do the USGS stations for similar altitudes. Based on the likely scenario that the precipitation stations used in the regression analysis underestimate the "true" precipitation, the resultant equation likely underpredicts the precipitation, particularly at higher elevations.

3.4.3 Derivation of Altitude Areas, Precipitation Distribution, and Recharge Estimate

Based on the USGS 30m DEM, 100-ft altitude intervals were delineated using GIS applications. Once delineated, the area for each interval was determined. The average altitude for each interval was applied in the regression equation discussed in Section 3.4.2 to compute the depth of precipitation for each altitude interval.

The precipitation distribution was derived by first multiplying the depth of precipitation for each 100-ft altitude interval by the corresponding interval area to determine the total precipitation. To compute the total precipitation for the precipitation zones identified in Rush and Kazmi (1965), the precipitation for the corresponding 100-ft altitude intervals were summed.

The recharge estimate was derived by first multiplying the depth of precipitation for each 100-ft altitude interval by the corresponding Maxey-Eakin recharge efficiency listed in Table 3-1. The recharge for each precipitation zone identified in Rush and Kazmi (1965) was calculated by summing the recharge computed for the corresponding 100-ft altitude intervals.

3.5 Results and Discussion

The objectives of this analysis were achieved through the compilation, processing, and evaluation of available precipitation data and the derivation of a precipitation distribution and recharge estimate for Spring Valley. The results are based on a relationship between altitude and precipitation that was defined for Spring Valley and vicinity using a simple linear regression analysis that included data from 39 precipitation stations in Spring Valley and surrounding basins. The technical approach applied in this analysis is consistent with those used in previous investigations by Quiring (1965), Daly et al. (1994), Maurer and Halford (2004), and NDWR Reconnaissance Series Reports 38, 39, and 50, where altitude-precipitation relationships were established and, for some of the more recent studies, defined by regression models.

Using the regression equation, estimates of precipitation and recharge were derived for the precipitation zones identified by Rush and Kazmi (1965) and are listed in Table 3-3. Also listed in

Table 3-3
Estimates of Precipitation and Recharge for Spring Valley

Precipitation Zone (altitude-ft)	Rush and Kazmi (1965)			SNWA		
	Area (acres)	Precipitation (acre-ft)	Recharge (acre-ft)	Area (acres)	Precipitation (acre-ft)	Recharge (acre-ft)
> 9,000	59,100	103,000	26,000	61,800	111,000	25,000
8,000 - 9,000	107,300	156,000	23,000	92,400	135,500	20,000
7,000 - 8,000	183,500	206,000	14,000	181,000	222,000	23,000
6,000 - 7,000	393,000	326,000	10,000	382,000	377,500	18,000
Subtotal	***742,900***	***791,000***	***75,000[a]***	***718,200***	***846,000***	***87,000***
< 6,000	342,000	171,000	0	348,800	288,000	0
TOTAL	**1,085,000**	**960,000**	**75,000[a]**	**1,066,000**	**1,134,000**	**87,000**

[a]Total as reported in Rush and Kazmi (1965, Table 6, p. 21). Actual values reported in Table 6 sum to 73,000 acre-feet.

Table 3-3 are the areas corresponding to each precipitation zone and the values reported by Rush and Kazmi (1965).

For this analysis, total precipitation within the valley is estimated at 1,134,000 afy as compared to the 960,000 afy reported by Rush and Kazmi (1965, p. 21), a difference of 174,000 afy. This difference can be explained by the assumptions made by Rush and Kazmi (1965). The most important assumption was that eight inches of precipitation occurs at an altitude of 6,000 ft-amsl and, based on the standard Maxey-Eakin recharge efficiencies, precipitation below this altitude does not recharge the groundwater system. Because of new data and information since the completion of their study in 1965, it is now known and observed that the depth of precipitation is greater than 8 inches below an altitude of 6,000 ft. Within Spring Valley and at an elevation of 5,930 ft, the period-of-record average annual precipitation at the “Shoshone 5 N” gage is 9.73 inches per year (WRCC, 2006). This indicates that the precipitation at the lower altitudes was underestimated by Rush and Kazmi (1965). Below an altitude of 6,000 ft, the difference between the results of this analysis and those of Rush and Kazmi (1965) is 117,000 af (acre-feet), or 67 percent of the total difference. The remaining difference lies mostly within the 6,000-7,000 and 7,000-8,000 altitude intervals, where the difference between the two estimates is 67,500 afy. This difference translates to a difference in the estimated recharge of 17,000 afy. The precipitation distribution derived by this analysis is presented in Figure 3-6.

Based on the standard Maxey-Eakin recharge efficiencies, the assumption that the 8-inch precipitation contour is synonymous with the 6,000 ft altitude contour effectively limited groundwater recharge to elevations above altitudes of 6,000 ft. Like Rush and Kazmi (1965) and despite the precipitation data for the “Shoshone 5 N” gage, it was assumed in this analysis that groundwater recharge does not occur below an elevation of 6,000 ft. This assumption is inconsistent with the standard Maxey-Eakin recharge efficiencies, but it allows for the comparison of this estimate with that of Rush and Kazmi (1965). For this analysis, groundwater recharge was estimated at

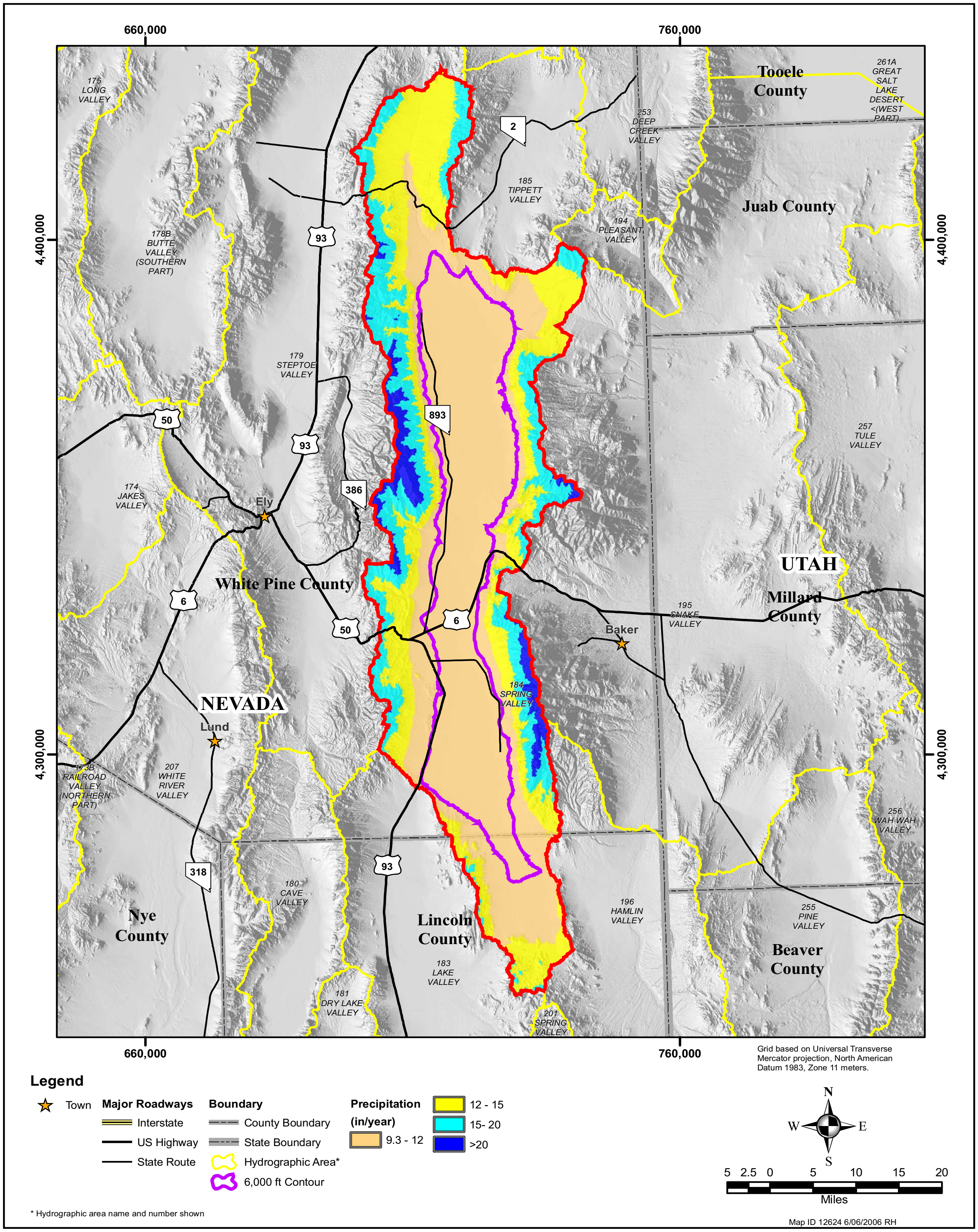

Figure 3-6
Spatial Distribution of Precipitation Within Spring Valley

87,000 afy as compared to the 75,000 afy reported by Rush and Kazmi (1965). The recharge distribution is depicted in Figure 3-7.

These estimates are compared in Table 3-4 to an estimate reported by Nichols (2000) and an estimate based on Precipitation-elevation Regression on Independent Slopes Model (PRISM) (1971-2000) (SCAS, 2006) derived as part of this analysis. Groundwater recharge estimates for this analysis, Rush and Kazmi (1965), and the PRISM (1971-2000) were derived based on the Maxey-Eakin recharge efficiencies. Nichols (2000) derived different recharge efficiencies, and applied them to the PRISM (1961-1990) precipitation distribution to derive an estimate of recharge. Recharge estimates derived by this study and those of Rush and Kazmi (1965, p. 20) and PRISM (1971-2000) assumed that no recharge occurs below an altitude of 6,000 ft. The Nichols (2000) estimate specifically allows a small percentage of recharge below an altitude of 6,000 ft based on the stated efficiencies derived by the study. Based on these estimates, the 87,000 afy estimated by this analysis is clearly at or near the lower bound.

Table 3-4
Estimates of Average Annual Precipitation and Recharge for Spring Valley

Source	Precipitation above 6,000 ft (acre-ft)	Total Precipitation (acre-ft)	Recharge (acre-ft)
Rush and Kazmi (1965)	791,000	960,000	75,000
This Study	846,000	1,134,000	87,000
Nichols (2000)	Not Specified	1,141,444	103,569[a]
PRISM (1971 to 2000)	874,000	1,176,000	106,500

[a]Estimate based on recharge efficiencies defined in Nichols (2000)

3.6 Uncertainty

Uncertainty in the results is principally derived from the accuracy and temporal variation associated with precipitation measurements, inaccuracies of altitude data, scaling point measurements to derive areal distributions, and the inherent limitations in applying the Maxey-Eakin recharge efficiencies to derive recharge estimates.

In many instances the accuracy of precipitation measurements is either unknown or not reported, and can be influenced by environmental conditions observed at the gage site. Gage measurements tend to underestimate the true precipitation, due to wind-induced turbulence and wetting losses on the internal walls of the gage (Groisman and Legates, 1994, p. 216). These conditions effectively cause a bias of underestimating precipitation, which can range between 5 and 25 percent of the annual values (Groisman and Legates, 1994). This bias was not corrected in the precipitation data used to develop the altitude-precipitation relationship derived by this analysis, and therefore, it is still reflected in the results.

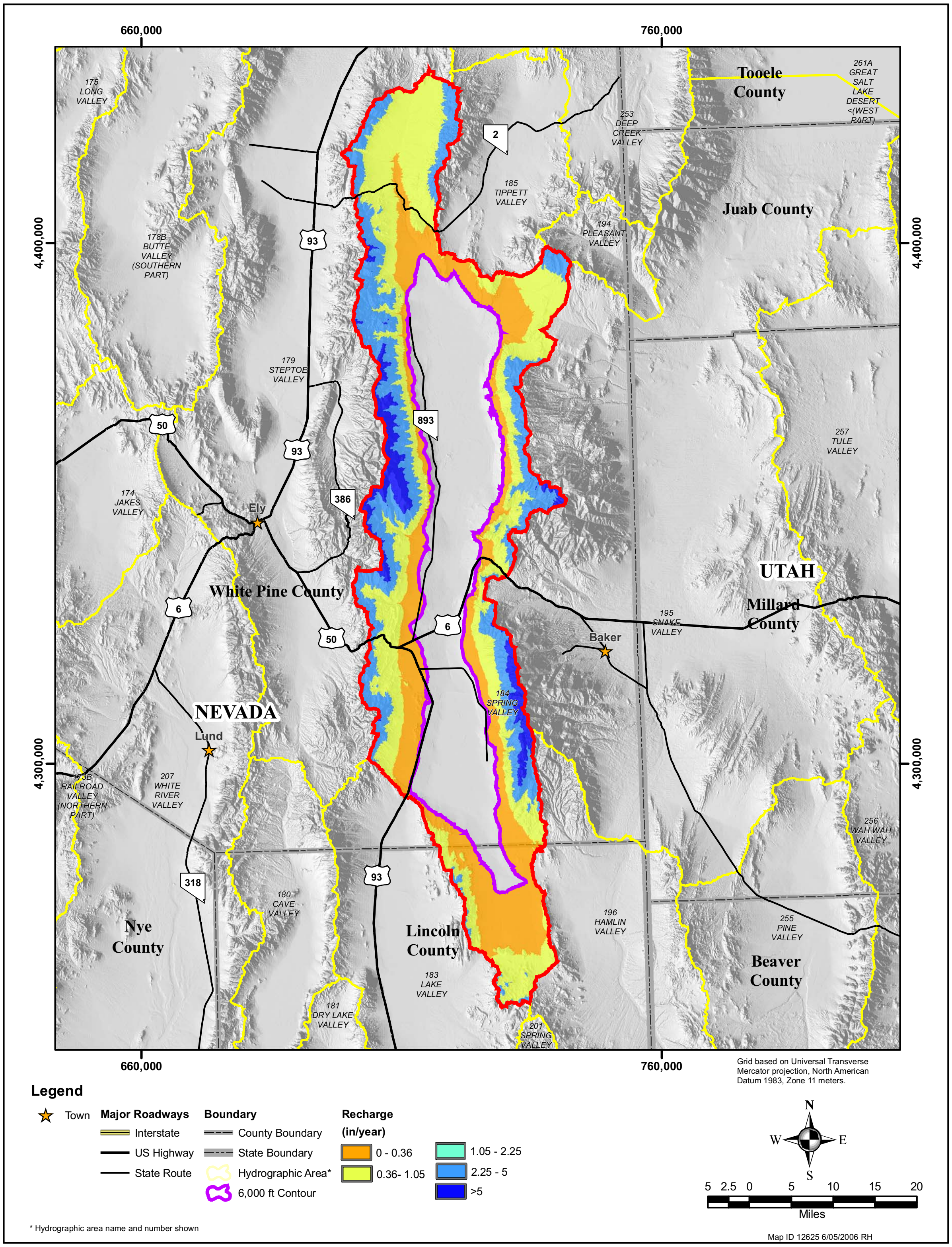

Figure 3-7
Spatial Distribution of Recharge Within Spring Valley

Additional uncertainty is introduced by inaccuracies associated with the altitude data reported for the precipitation stations. In some instances these inaccuracies can be large, resulting from the inaccuracies of the location data (x, y-coordinates) and/or the method by which the altitude was derived (e.g., map, survey, etc.). To partially account for these inaccuracies, the altitude data represented by the USGS 30m DEM were compared to the station data and used to adjust the altitude of stations where the difference was greater than 100 ft. This effectively increased the R^2 value from 0.76 to 0.82 and resulted in a 0.8 percent decrease in the volume of precipitation over the entire area.

The temporal variation in precipitation data is an important consideration when deriving average annual estimates and can contribute additional uncertainty into the period-of-record average annual values. A short period of record can be misrepresentative of the long-term average by including data collected during a mostly wet period or a mostly dry period. The temporal variation was partially accounted for through the station evaluation and selection process, which excluded stations with fewer than 20 years of “non-zero” records.

Scaling point measurements to derive areal precipitation distributions adds additional uncertainty to the analysis, but it is the only way that precipitation can be expressed spatially for the entire valley. Point measurements can be incorporated into the development of precipitation contour maps, or in this case, used to define a relationship between altitude and precipitation from which a precipitation distribution can be derived using DEMs such as the USGS 30m DEM. The uncertainty is derived from the simplifying assumption that the altitude-precipitation relationship derived from point measurements is representative of all local-scale conditions.

3.7 Summary and Conclusions

Through an evaluation and analysis of available altitude and precipitation data located at various altitudes within Spring Valley and surrounding basins, a relationship between altitude and precipitation was defined. This analysis yielded an estimate of groundwater recharge for Spring Valley of 87,000 afy for the area above an altitude of 6,000 ft (Table 3-3). This estimate represents the average annual recharge for Spring Valley based on precipitation data compiled for stations with periods of record greater than 20 years of “non-zero” annual precipitation.

The estimates of precipitation and recharge derived by this analysis are considered near the lower bound because the precipitation stations used in their derivation most likely underestimate the “true” precipitation at their respective locations. This conclusion is based on the findings of Groisman and Legates (1994) that gage measurements tend to underestimate the true precipitation due to wind-induced turbulence and wetting losses on the internal walls of the gage. Further, they indicate that these conditions effectively cause a bias of underestimating precipitation that can range between 5 and 25 percent of the annual values.

Underestimation of precipitation occurs, and may be a plausible explanation for the differences observed between the NRCS SNOTEL and USGS datasets in which significant differences between the reported depths of precipitation are observed for similar altitudes. For example, the NRCS SNOTEL station “Berry Creek” has a period-of-record average annual precipitation of 27.35 inches at an adjusted altitude of 9,681 ft (USGS 30m DEM), while the USGS “Cave Mountain” gage has a period-of-record average annual precipitation of 20.41 inches at an altitude of 10,650 ft. In this case, the “Cave Mountain” gage reports approximately 7 inches less precipitation than the “Berry Creek” gage, which is 1,000 ft lower in altitude. This is an unlikely scenario, particularly since the stations are located within the same mountain range (Schell Creek Range) and only approximately 10 miles from each other in the north-south direction. Upon further examination of these two stations and based on photographs of the gage sites, it is apparent that the environmental conditions at the sites are significantly different (Figures A.1-2 and A.1-3). Based on the photographs, the “Cave Mountain” gage is much more susceptible to the “wind-induced turbulence” described by Groisman and Legates (1994) that cause underestimation of precipitation. These observations support the conclusion that precipitation gages underestimate the “true” precipitation, and that some underestimate more than others. This bias of underestimating the “true” precipitation was not corrected in the precipitation datasets used to develop the altitude-precipitation relationship derived by this analysis, and therefore, it is still reflected in the results and must be considered in their application.

Independent estimates of precipitation and recharge for Spring Valley reported by Nichols (2000, p. C-25) and derived from PRISM also support the conclusion that the estimates derived by this analysis are near, or at, the lower bound (Table 3-4). Using a completely different analysis involving PRISM and derived recharge efficiencies, Nichols (2000, p. C-25) estimated the recharge to be 104,000 afy. Using the PRISM (1971-2000) precipitation distribution, the standard Maxey-Eakin recharge efficiencies, and recharge cutoff at an altitude of 6,000 ft (i.e., no recharge below 6,000 ft), the recharge for Spring Valley was estimated to be 106,500 afy (Table 3-4). Based on these estimates, the 87,000 afy estimated by this analysis is clearly at or near the lower bound (Table 3-4).

Many new precipitation stations have been installed, and approximately 40 years of additional data have been collected since the Rush and Kazmi (1965) reconnaissance study was completed. It is apparent that one of the fundamental assumptions of Rush and Kazmi (1965) that less than 8 inches of precipitation occurs below an altitude of 6,000 ft. is not valid. Based on new data and information collected since the completion of the Rush and Kazmi (1965) study, it is now known and observed at the “Shoshone 5 N” precipitation gage located in Spring Valley that the depth of precipitation is greater than 8 inches below an altitude of 6,000 ft. The period-of-record average annual precipitation at the “Shoshone 5 N” gage is 9.73 inches at an altitude of 5,930 ft (WRCC, 2006). This new data indicates that the precipitation at the lower altitudes of Spring Valley was underestimated by Rush and Kazmi (1965). Below an altitude of 6,000 ft, the difference between the results of this analysis and those of Rush and Kazmi (1965) is 117,000 afy, or 67 percent of the total difference. The remaining difference lies mostly within the 6,000-7,000 and 7,000-8,000 altitude intervals, where the difference between the two estimates is 67,500 afy of precipitation, and 17,000 afy of recharge.

4.0 PERENNIAL STREAMFLOW

Perennial streamflow is an important component of the water resources budget for Spring Valley. It contributes to both the surface-water and groundwater budgets of the valley. The flow of the perennial streams is typically diverted and applied to agricultural and stock uses, the excess of which infiltrates and recharges the groundwater system, is consumed by natural vegetation through transpiration, or evaporates enroute to lowland areas such as the Yelland Dry Lake. This section of the report provides a brief description of the perennial streams of Spring Valley and presents the objectives, data, methodology, and results of an analysis to estimate the average annual flow of each stream.

4.1 Description of Perennial Streams

There are numerous perennial streams within Spring Valley, most of which flow from the eastern flank of the Schell Creek Range, north of U.S. Highway 50 (US 50). However, there are also several perennial streams that originate in the western flank of the Snake Range, both north and south of US 50. Figure 4-1 depicts the location of these streams with respect to the topography and surficial geology of the valley. Table 4-1 presents summary statistics regarding each of the streams, that were generated from USGS DEMs and from geologic maps that were compiled by SNWA.

4.2 Objectives

The objectives of this analysis were to compile and evaluate all available streamflow data for Spring Valley and estimate the average annual flow of the ungaged perennial streams by applying the concurrent measurement method described in Moore (1968).

4.3 Perennial Streamflow Data

Estimating the perennial streamflow requires selected data and information that describe the location and attribution of the measurement, including the date, time, magnitude, and conditions in which the measurement was made. The following sections describe the specific data needed to accomplish the objectives of the analysis, the data sources and types, how the data were verified, evaluated, and processed, and an assessment of their quality and limitations.

4.3.1 Data Sources and Types

Miscellaneous discharge measurements for perennial streams in Spring Valley were compiled from the USGS National Site Inventory System and Water Resources for Nevada annual data reports from

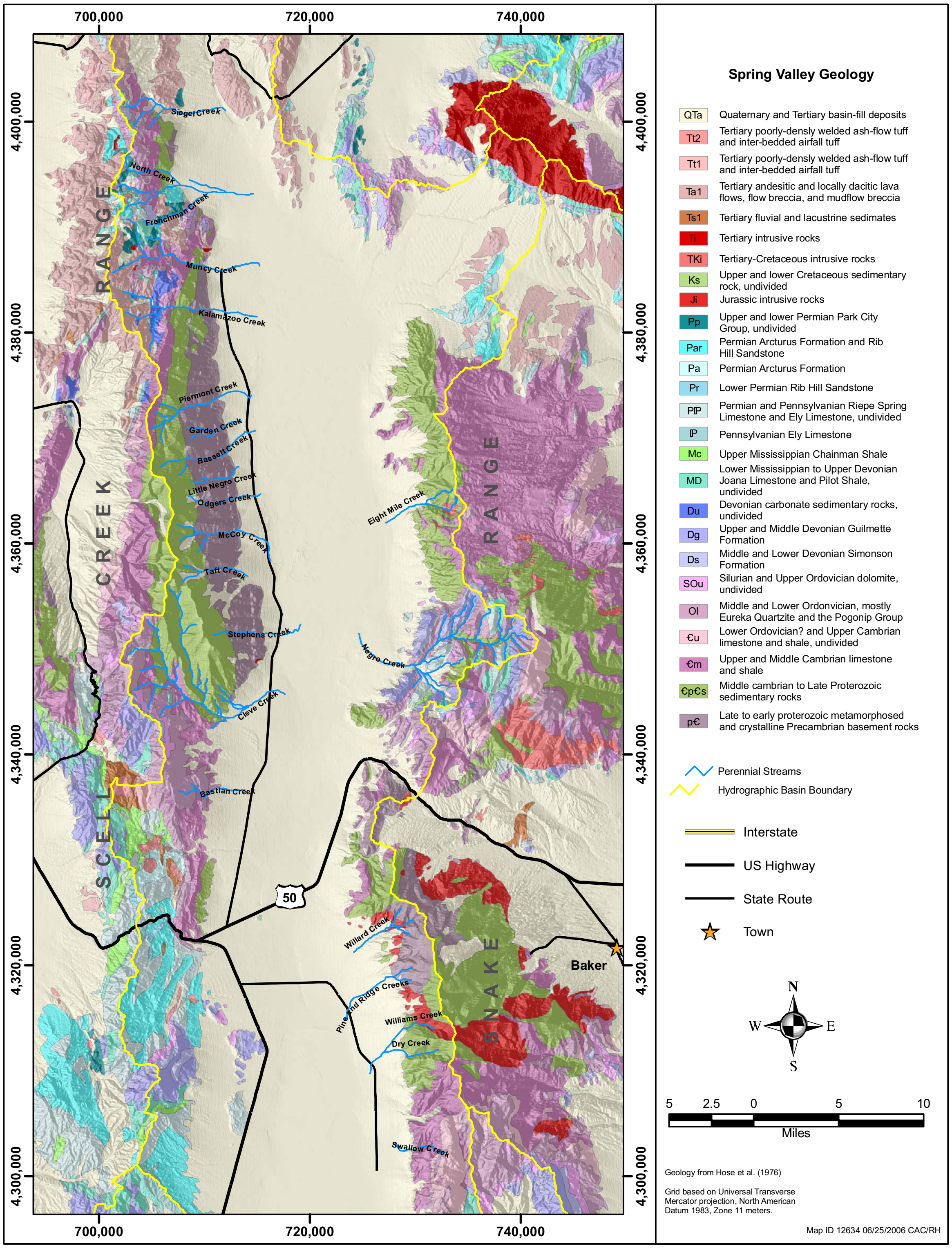

Figure 4-1
Location of Perennial Streams in Spring Valley

Table 4-1
Summary Statistics for Perennial Stream Drainages

Miscellaneous Measurements				Physiographic Description					Surficial Geology Description					
Station ID	Stream Name	Years of Record	Total Number	Length (mi)	Slope (ft/mile)	Average Altitude (ft)	Total Area (mi^2)	Area Above 8,000 ft-amsl (%)	Alluvial (%)	Volcanic (%)	Carbonate (%)	Clastic (%)	Metamorphic (%)	Intrusive (%)
1840201	Siegel Creek	9	10	3.3	499	8,212	5.5	54	18	11	71	0	0	0
1840401	North Creek-184	10	16	2.5	581	8,615	3.2	82	0	9	91	0	0	0
1840501	Frenchman Creek	5	6	3.0	441	7,694	4.8	27	4	33	63	0	0	0
1840602	Muncy Creek	4	7	5.1	316	8,270	14.0	69	8	28	59	3	1	1
1840704	Kalamazoo Creek	19	34	5.2	352	8,252	14.6	63	4	40	39	13	4	0
1840802	Piermont Creek	17	50	3.4	565	8,896	7.5	82	0	0	19	54	27	0
1840901	Garden Creek	3	3	2.4	1,279	8,397	2.9	62	0	0	0	12	88	0
1841002	Bassett Creek	25	80	3.4	850	9,437	6.3	87	0	0	0	65	35	0
1841101	Little Negro Creek	7	9	3.0	1,171	8,610	3.0	66	0	0	0	32	68	0
1841201	Odgers Creek	17	46	3.1	1,008	9,139	3.9	81	11	0	0	49	40	0
1841302	McCoy Creek	13	26	3.2	893	9,398	6.2	85	10	0	0	53	37	0
1841401	Taft Creek	7	12	3.1	992	9,799	4.3	94	20	0	0	55	25	0
1841501	Stephens Creek	1	2	2.4	1,343	8,970	2.9	76	0	0	0	58	42	0
1841611	Cleve Creek	34[a]	--	6.6	300	8,865	32.0	73	2	0	41	57	0	0
1841701	Bastian Creek	8	10	2.6	996	8,183	2.7	52	1	0	99	0	0	0
1841901	Eight Mile Creek	7	9	2.2	756	8,092	3.1	57	3	0	13	83	0	1
1842003	Negro Creek	6	12	7.2	356	8,222	27.4	55	9	0	78	13	0	0
1842101	Willard Creek	3	5	2.4	698	8,833	3.8	81	10	0	0	1	76	13
1842201	Swallow Creek	9	14	2.0	1,258	8,468	3.5	65	2	0	98	0	0	0
1842601	Dry Canyon	1	1	3.0	1,323	9,630	2.9	92	0	0	4	96	0	0
1842701	Pine and Ridge Creeks[b]	1	1	3.1	1,496	9,096	4.0	75	14	0	0	15	64	7
1842801	Williams Canyon[c]	--	--	3.2	1,048	9,676	3.2	93	1	0	0	49	0	50

[a]Period of record listed in Table 4-2.
[b]Pine and Ridge Creeks were considered one creek because of their confluence near the mountain-block/alluvial interface.
[c]Williams Canyon was measured below its confluence with Dry Canyon.

1964 to 2005, and reports prepared by Ertec Western, Inc. for the USAFs MX Missile Siting Program (Ertec, 1981a through e). Data from these sources augment the miscellaneous discharge measurements conducted by SNWA since 1993.

In general, these datasets include site attribution and the measured or reported miscellaneous discharge values, including the date, time, and magnitude of the measured flow. Where available, accuracy qualifiers were included so that the accuracy and quality of the discharge measurements could be assessed. Specific data types include the following:

- Site ID
- Location data
- Measurement date (mm/dd/yy) and time
- Measured/Reported Discharge (cfs)
- Measurement Accuracy Rating
- Data Source

Additionally, continuous data were obtained from the USGS for Cleve Creek near Ely, Nevada (10243700). This dataset includes the mean daily discharge, including the corresponding year, month, and day for each value. The period of record is listed in Table 4-2.

Table 4-2
Period of Record for Cleve Creek near Ely, Nevada (10243700)

Station Name	Period of Record
Cleve Creek near Ely, NV (10243700)	June 1914-December 1916, October 1959-September 1967, October 1976-September 1981, December 1982-September 1987, March 1990-current year

4.3.2 Methods of Measurement

Discharge values compiled from the various sources listed in Section 4.3.1 represent miscellaneous discharge measurements that were conducted using current meters. In some instances these values were estimated.

Miscellaneous discharge measurements made by SNWA were conducted by selecting a suitable site to measure the discharge based on access to the channel, channel geometry, bed material, and observations of flow. Location data for each site were collected using global positioning system equipment. The measurements were made using either Price AA or Pygmy vertical-axis current meters, each having a standard rating. The measurements were then calculated and checked. Each measurement was assigned a qualifying factor of “excellent”, “good”, “fair”, or “poor” based on Rantz et al. (1982) and Sauer and Meyer (1992).

4.3.3 Data Verification, Compilation, and Processing

To verify the location of each measurement site, the coordinate data were first transformed to a common datum, UTM Zone 11, NAD83. Upon completion of this process, the station locations were plotted to a basemap depicting the perennial streams (from the National Hydrology Dataset, 2003), surficial geology, and topographic contours. The basemap was used to determine the relative location of the measurement site with respect to the mountain block-alluvial interface. In instances where the reported measurement site did not plot on the basemap at, or near, the corresponding stream reaches and within the accuracy of the coordinate data, the site was removed from the dataset. Figure 4-2 depicts the locations of all stations and their spatial distribution relative to the mountain block-alluvial interface. The data is presented in Appendix B, including site attribution, measured discharge, and accuracy rating.

4.3.4 Data Quality

The compiled data are generally considered fair to good in terms of their quality. This assessment is based on their documentation and the presumption that some level of quality check and assurance was performed on the published data. The quality of the USGS data is considered good as it is typically well documented and archived in the National Water Information System (NWIS) database or reported in the annual reports. The quality of SNWA miscellaneous measurements is considered good as it has been quality checked and assigned accuracy ratings. The quality of the miscellaneous measurements retrieved from published reports ranges from fair to good. Some of the reported values are estimated, while others were measured. Estimated values were considered less accurate than measured values and were considered to be of lesser quality.

4.3.5 Data Limitations and Accuracy

The dataset of miscellaneous discharge measurements for the ungaged perennial streams within Spring Valley is limited in its temporal and spatial distribution. Measurements have been made intermittently since 1964, and for most ungaged streams, the measurements were made during mid- to late summer. There are a number of ungaged streams in which quarterly measurements were conducted for a period of time, and these streams typically have a more comprehensive distribution of measurements. However, the temporal distribution of data for the ungaged streams is insufficient to precisely determine the period during which baseflow conditions exist; therefore, the periods of baseflow were assumed to coincide with the period identified for Cleve Creek. Lending to the data limitations are the conditions affecting the accuracy of the measurements. These include the weather conditions during which the measurement was made, the channel cross section and control, and instrumentation. While these conditions may affect the accuracy of the measurement, they are accounted for by the accuracy rating assigned to the measurement. The accuracy ratings were not explicitly represented in the data analysis, but were relied upon in discussing the results of the analysis.

The miscellaneous measurements used in this analysis range from “good” (within 5 percent error) to “poor” (greater than 8 percent error), which was assigned to estimated values and measurements

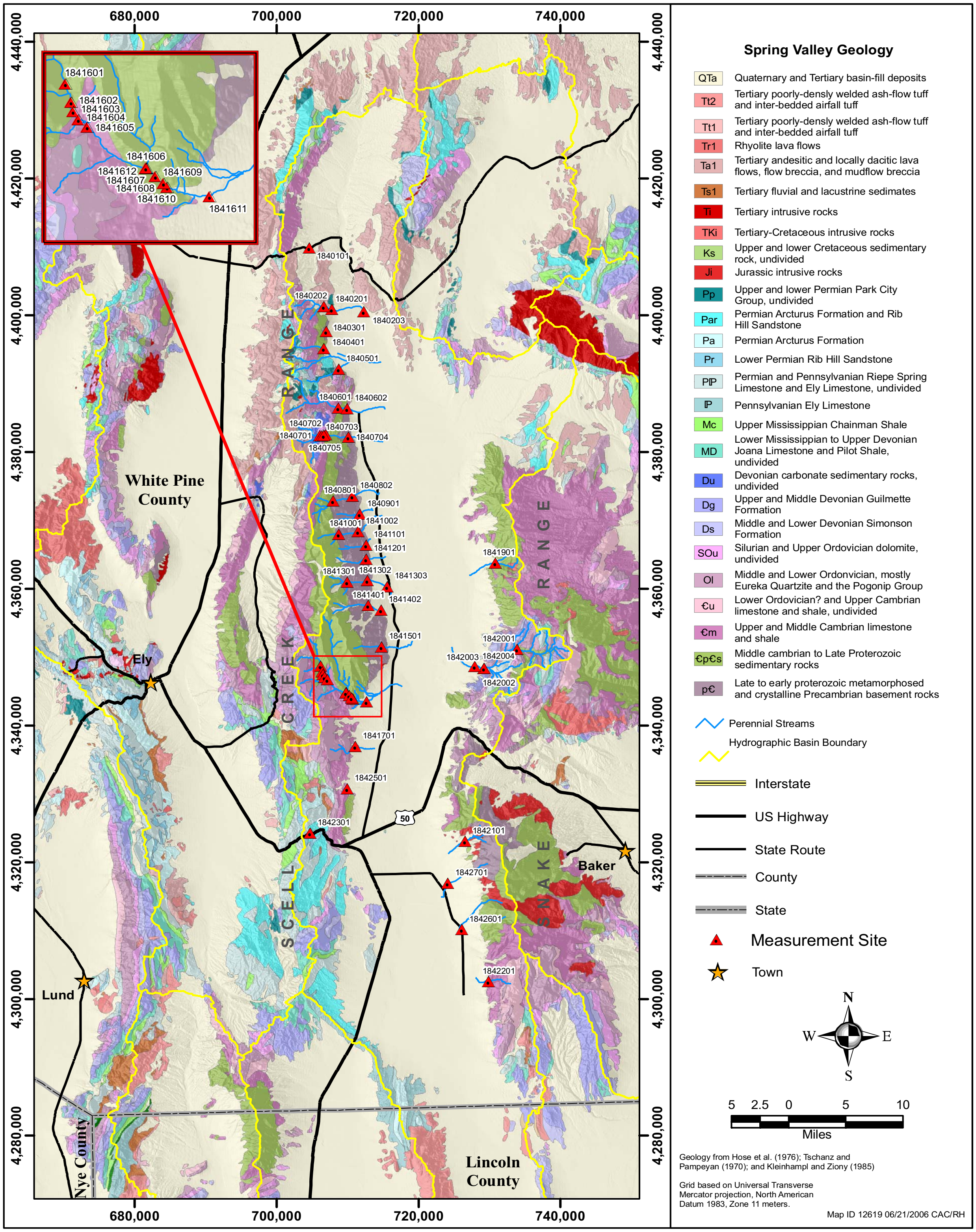

Figure 4-2
Location of Miscellaneous Measurement Sites

made under unfavorable conditions (Buchanan and Somers, 1969, p. 58). However, most of the discharge measurements used in this analysis were rated as "good" to "fair," with corresponding accuracies ranging from within 5 to 8 percent of the true value. For the instances in which an accuracy rating was not provided, the discharge value was qualified as "fair."

The availability of continuous gage records for Spring Valley is limited. The Cleve Creek near Ely, Nevada gage has been the only streamflow gaging station established within the valley. The accuracy of the discharge records depends on the stability of the stage-discharge relationship, which is defined, in part, by the frequency of discharge measurements, accuracy of the stage and discharge measurements, and the record computation. The period of record for the gage extends back to 1914 (USGS, 2005) and the record has intermittent periods in which the gage was not in operation. The accuracy of the data is rated from "good" to "fair" by the USGS, and estimated values are rated as "poor." A rating of "good" to "fair" indicates that about 95 percent of the daily discharges are within 10 to 15 percent of the true value. The rating of "poor" indicates that about 95 percent of the daily discharges exceed 15 percent of the true value (USGS, 2005). However, given the long period of record, these estimated days have little influence on the calculation of the mean annual discharge.

4.4 Methodology

Available miscellaneous discharge measurements for each of the ungaged perennial streams were evaluated to determine which were suitable for use in estimating the average annual flow using the concurrent measurement method described in Moore (1968, p. 35). To apply this method of estimation, the required data needed to compute the estimate includes miscellaneous discharge measurements for the ungaged perennial streams and the mean daily and mean annual flows for a gaged stream of similar runoff characteristics. The method is represented by the following equation:

$$Q_m = Q_M(Q_a/Q_b) \tag{4-2}$$

where

Q_m = the unknown long-term mean annual flow at the ungaged stream,
Q_M = the long-term mean annual flow at the gaged stream,
Q_a = the measured discharge at the ungaged stream, and
Q_b = the mean daily discharge at the gaged stream for the same day Q_a was measured.

Values for Q_M and Q_b are derived from the record of mean daily flows from the gaged site.

One of the observations noted by Moore (1968, p. 35) is that the surface-runoff characteristics between two streams are typically different to some degree. This is understandable since the physical attributes of each drainage area are likely different (Table 4-1); thereby, influencing the shape of the runoff hydrograph. To minimize these potential differences, Moore (1968, p. 35) recommends that the method should only be applied to concurrent measurements acquired during baseflow conditions.

4.5 Data Analysis

Miscellaneous discharge measurements for the ungaged perennial streams listed in Table 4-1 were compiled for this analysis. These data were evaluated to determine which were suitable for inclusion into the dataset used in the analysis to estimate the annual flow of the ungaged stream. Mean daily and mean annual streamflows reported for the Cleve Creek near Ely, Nevada gage were obtained from the USGS (NWIS, 2006) and used to assist in determining baseflow conditions, the concurrent measurement value for Q_b, and the mean annual flow, Q_M. The miscellaneous discharge measurements for the ungaged streams were used in conjunction with the mean annual and mean daily streamflows for Cleve Creek to calculate the annual flow for the ungaged streams using the concurrent measurement method described by Moore (1968).

4.5.1 Determination of Base Flow Conditions

The surface-runoff characteristics between two nearby catchments can vary due to differences in precipitation, temperature, drainage area, geology (lithology and structure), type and density of vegetative cover, and stream-channel morphology. These characteristics influence the shape of the runoff hydrograph; therefore, it is important that concurrent discharges applied in the analysis represent baseflow conditions as described by Moore (1968). Based on the Cleve Creek record and the observations of Rush and Kazmi (1965, p. 12), baseflow conditions occur between July and March, during which time the source is largely from groundwater sources. This period is also coincident with the intersection of the mean annual flow and the runoff hydrograph for Cleve Creek as depicted in Figure 4-3. The mean annual flow for Cleve Creek is 10.4 cfs (USGS, 2005).

4.5.2 Selection of Miscellaneous Discharge Measurements

The process and criteria by which the miscellaneous discharge measurements were evaluated are depicted in Figure 4-4 and incorporate the number and location of the measurements, when they were taken, and whether they were made above or below points of diversion. Measurements conducted during the period July through March were used since that period largely represents the baseflow conditions as described in the previous section.

The miscellaneous measurements for individual perennial streams were evaluated and grouped into specific sites based on coordinate data, comments regarding the site location, and field reconnaissance to determine whether or not there are anthropogenic influences or geologic features that would effect the streamflow between sites. Each site was assigned an index number. Sites and their associated measurements were excluded from the analysis if (1) the site location was not near or at the mountain block-alluvial interface and (2) the measurements were made below a diversion and did not represent the total streamflow. Measurements were also excluded if their records were assigned date accuracy codes of month or year because without the specific day of the measurement a mean daily flow cannot be determined to complete the analysis.

Of the 880 miscellaneous measurements available for Spring Valley listed in Appendix B, 399 were made at the Cleve Creek near Ely, Nevada gaging station and 33 along other reaches of the stream.

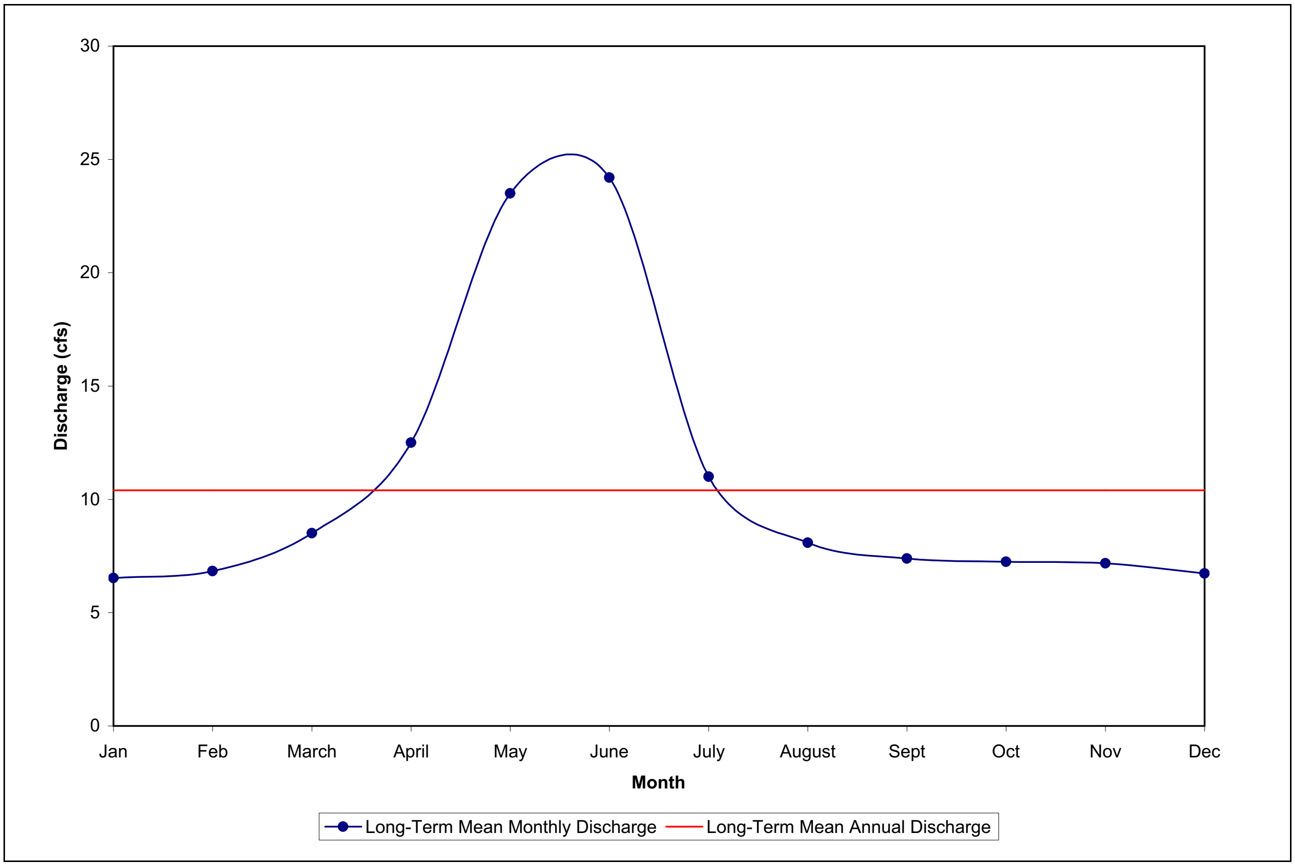

Figure 4-3
Mean Monthly Runoff Hydrograph for Cleve Creek near Ely, NV (10243700)

The remaining 448 miscellaneous measurements were made at the 22 ungaged perennial streams, 206 of which were excluded by the evaluation criteria. The remaining 242 were used in the analysis to calculate the annual flows (Q_m). The locations of the measurement sites used in the analysis are depicted in Figure 4-5. The data is provided in tabular form in Appendix C.

4.5.3 Calculation of Annual Flows (Q_m)

Many of the miscellaneous measurements compiled for the ungaged perennial streams qualified for the analysis based on the evaluation criteria. Rather than choose just one miscellaneous measurement for the calculation of the annual flow (Q_m), it was determined that all qualified measurements had value and should be incorporated into the analysis. This was accomplished by using each miscellaneous measurement to calculate an annual flow (Q_m) for the corresponding stream. In this way, all of the qualified data were considered in the analysis.

An annual flow (Q_m) was calculated for each miscellaneous measurement using the discharge value for the measurement, the mean daily flow for Cleve Creek corresponding to the date of the miscellaneous measurement (Q_b), and the mean annual flow for Cleve Creek (Q_M). The annual flows (Q_m) calculated for each of the miscellaneous measurements are listed in Appendix C and are grouped

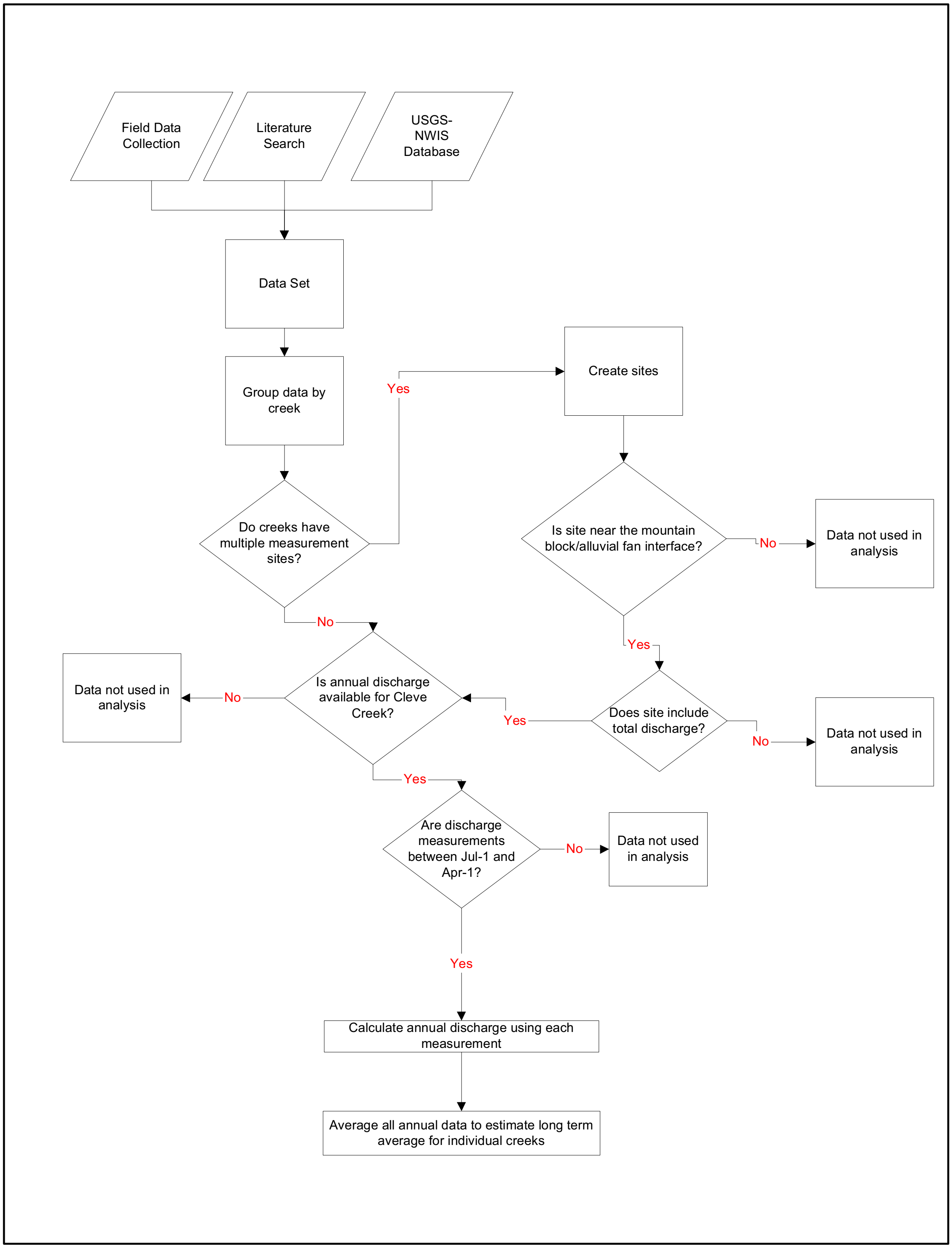

Figure 4-4
Process and Criteria Used to Evaluate Miscellaneous Discharge Measurements

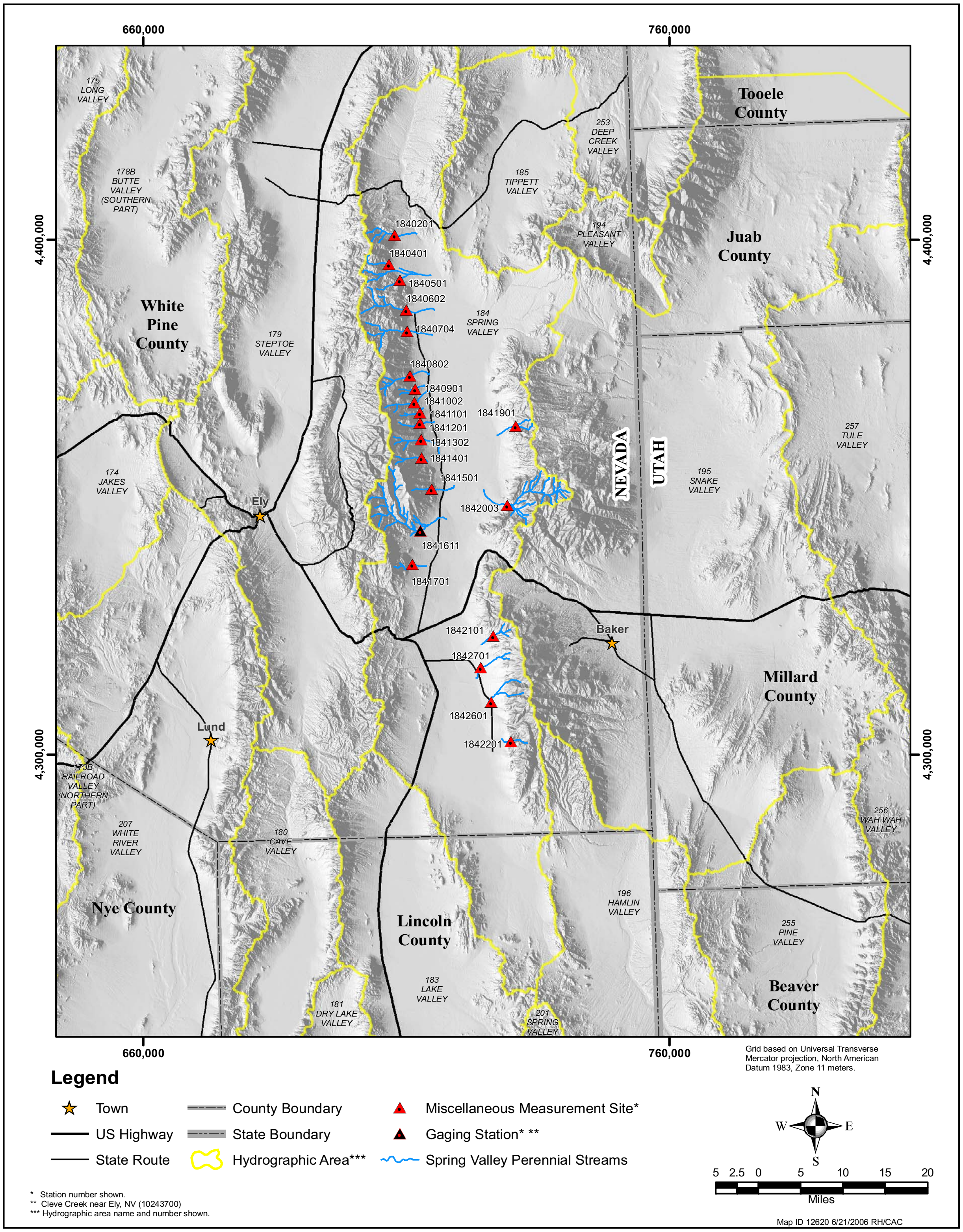

Figure 4-5
Location of Sites for Measurements Used to Calculate Annual Flows

by stream name and station number. Included in Appendix C are the values assigned to Q_M, Q_a, and Q_b to calculate the annual flows. The average of all measurements for a given site were calculated to determine the average annual flow for the corresponding stream.

4.6 Results and Discussion

The objectives of the analysis were achieved; all of the available stream flow data for Spring Valley were compiled and evaluated then subsequently used to estimate the "long-term" average annual flow of the perennial streams within Spring Valley.

The estimated long-term average annual perennial streamflow for Spring Valley is approximately 65 cfs, or 47,000 afy based on analysis of all of the available streamflow data compiled through 2005. Table 4-3 lists the results, including the mean annual flow for Cleve Creek. These values are slightly higher than those reported by Rush and Kazmi (1965, Table 4, p. 15), who reported an annual flow of 50 cfs, or approximately 36,000 afy. However, the analysis in this report included an additional eight perennial streams that were not considered in Rush and Kazmi (1965). These streams are Frenchman Creek, Piermont Creek, Garden Creek, Little Negro Creek, Odgers Creek, Stephens Creek, Bastian Creek, and Swallow Canyon. Based on this analysis, the perennial streamflow from these eight streams is approximately 18 cfs. When added to the 50 cfs reported by Rush and Kazmi (1965), an estimate of 68 cfs is computed, very close to the 65 cfs derived by this analysis. The perennial streamflow estimated by Rush and Kazmi (1965) represented a portion of the total runoff from the mountain front, which was estimated at 90,000 afy.

Perennial streamflow during 2005 was above normal. The mean streamflow at the Cleve Creek gage for the 2005 water year was reported to be 21.6 cfs, approximately 208 percent of mean annual flow of 10.4 cfs (USGS, 2005). Miscellaneous measurements conducted by SNWA for ungaged perennial streams were also observed to be much higher than in previous years (Appendix C). However, not all of the perennial streams were measured in 2005; therefore, an estimate of the total perennial streamflow for Spring Valley during 2005 was not derived using the methods described in Section 4.4.

4.7 Uncertainty

Uncertainty in the results is principally derived from the accuracy and number of the concurrent measurements, the accuracy of stream gage records, and consistency between the respective surface-runoff characteristics of the gaged and ungaged streams. Conducting additional miscellaneous measurements on the ungaged streams will provide a larger sample set, thereby providing more certainty in the results. Increasing the measurement accuracy will also provide more certainty; however, it is typically the conditions under which the measurements are made that influence the accuracy of their results, and these conditions are not likely to change on the ungaged streams. Therefore, the only viable opportunity to reduce this component of the uncertainty is to increase the frequency of measurements.

Table 4-3
Estimated Average Annual Streamflow for Ungaged Perennial Streams Within Spring Valley and Cleve Creek

Station Number	Stream Name		Q_m (cfs)
1840201	Siegel Creek		0.98
1840401	North Creek		1.21
1840501	Frenchman Creek		0.54
1840602	Muncy Creek		2.01
1840704	Kalamazoo Creek		5.90
1840802	Piermont Creek		1.67
1840901	Garden Creek		0.42
1841002	Bassett Creek		4.95
1841101	Little Negro Creek		0.85
1841201	Odgers Creek		2.40
1841302	McCoy Creek		7.03
1841401	Taft Creek		2.66
1841501	Stephens Creek		1.07
1841701	Bastian Creek		2.57
1841901	Eight Mile Creek		0.97
1842003	Negro Creek		2.59
1842101	Willard Creek		0.68
1842201	Swallow Creek		8.31
1842601	Dry Canyon and Williams Canyon		3.71
1842701	Pine and Ridge Creeks		3.71
1841611	Cleve Creek (USGS, 2006)		10.40
Totals		**cfs**	**65**
		afy	**47,000**

Differences in the surface-water runoff characteristics between the gaged and ungaged streams also contribute to the uncertainty of the results. The greater these differences, the greater the difference between the ratios Q_b/Q_M and Q_a/Q_m. The influence that these differences have on the computed values would be reduced if the data used for the concurrent measurements (Q_a and Q_b) were collected during baseflow conditions. Uncertainty can also be reduced by using a gaged stream that has similar surface-runoff characteristics to the ungaged streams. In this analysis, the ungaged stream characteristics were found to have good correlation with the gaged record for Cleve Creek.

To assess the surface-runoff characteristics between the Cleve Creek and the ungaged streams, a simple linear regression was performed using the miscellaneous measurements (Q_a) and the mean daily flows for Cleve Creek (Q_b) for streams with greater than five measurements. The results of this analysis are listed in Table 4-4. The correlation was highest for McCoy and Bastian Creeks which have corresponding R^2 values of 0.91, and 0.92, respectively, and lowest for Willard Creek which has

Table 4-4
Results of Simple Linear Regression Between
Q_a and Q_b for Gaged and Ungaged Streams

Station Number	Station Name	Years of Record	Number of Measurements	Equation	R^2
1840201	Siegel Creek at Mountain Block	9	10	y = 0.1774 x -0.6414	0.88
1840401	North Creek at Sunkist, NV	10	16	y = 0.1639 x -0.3655	0.83
1840501	Frenchman Creek at Mountain Block	5	6	y = 0.0555 x -0.1085	0.67
1840704	Kalamazoo Creek (Site 1)	19	34	y = 0.5997 x -0.2465	0.86
1840802	Piermont Creek at Mountain Block at Piermont, NV	17	50	y = 0.3167 x -1.3685	0.89
1841002	Bassett Creek at Mountain Block	25	80	y = 0.3980 x +0.5922	0.85
1841101	Little Negro Creek abv Diversion nr Bassett Ranch	7	9	y = 0.1180 x -0.2911	0.84
1841201	Odgers Creek at Mountain Block	17	46	y = 0.1373 x +0.9089	0.48
1841302	McCoy Creek at Mountain Block	13	26	y = 1.0152 x -3.4256	0.91
1841401	Taft Creek at Diversion	7	12	y = 0.5456 x -2.1538	0.83
1841701	Bastian Creek at Mountain Block	8	10	y = 0.6155 x -3.1230	0.92
1841901	Eight Mile Creek at Mountain Block	7	9	y = 0.1688 x -0.7049	0.64
1842003	Negro Creek	6	12	y = 0.3184 x -0.5198	0.83
1842101	Willard Creek (USGS)	3	5	y = 0.0234 x +0.2497	0.054
1842201	Swallow Canyon above Diversion nr Minerva, NV	9	14	y = 1.6586 x -7.7785	0.71

a corresponding R^2 of 0.054. The low value for Willard Creek is due to the variability of the miscellaneous discharge measurements and the limited dataset. The average R^2 value for all creeks was 0.75, indicating the stream-runoff characteristics for Cleve Creek and the ungaged creeks are similar. Based on the results of this analysis and the manner by which the method was applied, the uncertainty due to differences between surface-runoff characteristics was minimized.

4.8 Summary and Conclusions

Through an evaluation and analysis of miscellaneous discharge measurements for ungaged perennial streams, the perennial streamflow for Spring Valley was estimated using the continuous gage records for Cleve Creek and the concurrent measurement method described in Moore (1968). Using this method, the long-term average annual perennial streamflow for Spring Valley was estimated at 65 cfs, or 47,000 afy.

The perennial streamflow estimates derived by this analysis are within the range of previous estimates by Rush and Kazmi (1965), in which an estimate of 50 cfs (36,000 afy) was reported for the total average annual streamflow. The estimate derived by this analysis is larger than the estimate reported by Rush and Kazmi (1965) because an additional eight perennial streams were included in the analysis. Based on this analysis, the perennial streamflow from these eight streams is approximately 18 cfs. When added to the 50 cfs reported by Rush and Kazmi (1965), an estimate of 68 cfs is computed, which is very close to the 65 cfs derived by the analysis in this report. Based on the available data for perennial streams within Spring Valley, the perennial streamflow derived by this analysis is consistent with that reported by Rush and Kazmi (1965).

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5.0 EVAPOTRANSPIRATION

Evapotranspiration is an important and large component of the water budget for Spring Valley. This section of the report describes previous studies related to ET within Spring Valley, including those studies by Rush and Kazmi (1965), Nichols (2000), and Devitt et al. (2006). Each of these studies provides an estimate of ET for groundwater discharge areas within Spring Valley based on different data and assumptions, but very similar mapping. Subsequent sections describe, in general terms, the data, technical approach, results, and conclusions of each of these studies for the purpose of establishing the range of estimates for Spring Valley.

5.1 Previous Studies

The following sections describe the technical approach, data, methodology, and results of previous ET studies conducted by Rush and Kazmi (1965), Nichols (2000), and Devitt et al. (2006). Rush and Kazmi (1965) and Nichols (2000) reported estimates of groundwater ET for groundwater discharge areas within Spring Valley, while Devitt et al. (2006) reported estimates of total ET.

5.1.1 Rush and Kazmi (1965)

As part of the USGS Water Resources - Reconnaissance Series studies, Rush and Kazmi (1965, p. 23) conducted a water-resources appraisal of Spring Valley in which they provided a preliminary estimate of groundwater discharge by phreatophytes and bare soil. In their report, Rush and Kazmi (1965, Plate 1) provided a map depicting groundwater discharge areas in Spring Valley, including a delineation of phreatophyte areas based on field mapping of salt grass, meadow grass, rabbitbrush, greasewood, and “swamp” cedars. Playa areas were also delineated on the map. The total area delineated for the phreatophyte areas was estimated at 173,900 acres, while the area delineated for the playas was estimated to be 11,600 acres. Seventy-five percent of the discharge area was reported to be covered by greasewood and rabbitbrush. Groundwater ET was estimated for each of the areas by applying consumptive-use rates based on lysimeter experiments conducted by Lee (1912), White (1932), Young and Blaney (1942), and Houston (1950) in which water-use rates for phreatophytic species, such as salt grass were measured (Rush and Kazmi, 1965). Based on these data and field reconnaissance of Spring Valley Rush and Kazmi (1965, Table 7, p. 23) provided a preliminary estimate of average annual groundwater discharge for phreatophytes and bare soil (playas) of 70,000 afy.

5.1.2 Nichols (2000)

As part of a cooperative study with NDWR and LVVWD, Nichols (2000) derived regional estimates of groundwater ET and basin groundwater budgets for selected basins within the Great Basin. One of these basins was Spring Valley, for which Nichols (2000) provided estimates of groundwater ET for 1985 and 1989.

Nichols (2000) used ET-station data collected during previous investigations from five sites in Nevada (Smoke Creek Desert, Smith Creek Valley, Railroad Valley and two sites in the Ash Meadows area) and nine sites in Owens Valley, California. These investigations were completed by Duell (1990), Nichols (1994), and Nichols et al. (1997). Additional data were collected at the study sites, including data related to the percent vegetative cover and depth-to-groundwater. These data were used in a regression analysis to determine the relationship between each parameter and groundwater ET. As a result, two equations were developed for estimating groundwater ET the first as a function of the depth-to-groundwater, and the second as a function of plant cover. The second equation was used to estimate groundwater ET in 16 basins, including Spring Valley, using satellite imagery and remotely sensed vegetation index data, such as the Modified Soil Adjusted Vegetation Index (MSAVI).

Nichols (2000) then used point estimates of ET that were scaled to the basin level. Nichols (2000) also used remote sensing techniques and LANDSAT imagery to derive plant cover values from which values of ET could be calculated using the equation describing the relationship between ET and plant cover. First, plant cover data were collected in June 1995 at locations in Railroad Valley and Little Fish Lake Valley and used to derive a relationship between plant cover and MSAVI values extracted from June 1985 LANDSAT imagery. LANDSAT imagery for June 1985 was used because imagery for June 1995 was unavailable at the time of analysis. From this analysis, Nichols (2000) derived a linear and logarithmic relationship between MSAVI values and plant cover. The equations describing these relationships were then used to derive values of plant cover for entire LANDSAT scenes. Using these values, estimates of groundwater ET were calculated by applying the equation describing the relationship between groundwater ET and plant cover.

To derive the groundwater ET estimates for the 16 basins, Nichols (2000) used LANDSAT scenes for 1985 and 1989. Nichols (2000, p. C-13) reports that both 1985 and 1989 were years in which the precipitation was below normal and that 1985 followed three years of above normal precipitation, while 1989 followed three years of below-normal precipitation. For these years and the phreatophytic areas, MSAVI values were extracted from the LANDSAT scenes. Using the MSAVI values for each pixel in the LANDSAT scenes, values for plant cover were derived and used to estimate groundwater ET at each pixel using the equation describing the relationship between groundwater ET and plant cover. For Spring Valley, Nichols (2000, Table C-17, p. C-44) reports a phreatophytic area of 168,236 acres and groundwater ET estimates of 102,000 afy and 77,500 afy for 1985 and 1989, respectively. The average of these two estimates is approximately 90,000 afy.

5.1.3 Devitt et al. (2006)

In 2004, the SNWA initiated a study with the University of Nevada, Las Vegas (UNLV) and DRI to estimate total ET on a basin-wide scale in Spring and White River Valleys. Dr. Dale Devitt, a Professor in the UNLV Biology Department, is the lead investigator and is assisted in the study by Dr. Mike Young and Dr. Lynn Fenstermaker of DRI. The results of the first year of study (August, 2004 through August, 2005) are presented in Devitt et al. (2006). The following sections provide a summary of the technical approach, data collection and processing, and the methods used in the study to estimate ET.

Three sites were established in Spring Valley, each having a different plant species composition and plant cover (Figure 5-1). A weather station was placed at the central site (Site 2) for the entire period of data collection for the purposes of collecting precipitation, wind speed, temperature, relative humidity, and solar radiation data. At the plant level, several parameters were measured during site visits, including stomatal conductance, leaf-water potential, leaf-area index and canopy temperature differential. At the canopy level, an eddy-flux tower was rotated between the three sites approximately every two to three weeks to measure net radiation, latent heat, sensible heat and soil heat fluxes to close energy balances at each site. Additionally, a scintillometer was used to further assess the sensible heat above the soil and plant canopies.

Devitt et al. (2006) scaled point estimates of ET to the basin level then used remote sensing techniques to estimate total ET for the basin. This was accomplished by first extracting normalized difference vegetation index (NDVI) values from LANDSAT TM satellite imagery at the study sites. Using these values and the ET estimates for each site, a relationship between the two parameters was derived and is described by a linear equation. The total ET within the phreatophyte areas of Spring Valley was then estimated by extracting NDVI values for each pixel of the LANDSAT TM imagery and applying the equation describing the relationship between ET and NDVI.

The phreatophytic zone, wetland meadows, agricultural areas, playas, and open-water surfaces within the groundwater discharge area were delineated and are depicted in Figure 5-2. Devitt et al. (2006) used an area of 150,030 acres for the phreatophytic zone, excluding open-water surfaces, agricultural areas, and playas, and 22,600 acres for the wetland meadows (referred to as “high NDVI areas”). For the first year of the study (August, 2004 through August, 2005), the total ET within the phreatophytic zone for the growing season (145 days) was estimated at 213,948 af. A 14-day transition period was added to the beginning and end of the assumed growing period to account for uncertainty associated with determining when the actual growing season had started and ended. In doing so, the total growing season ET for the phreatophytic zone was adjusted to 228,251 af. Devitt et al. (2006) also reported that the non-growing season ET for the phreatophytic zone ranges from 6 to 18 centimeters, or 0.20 to 0.60 ft. Using the lower value as a conservative estimate, the non-growing season ET for the phreatophytic zone was estimated to be 25,638 af. Adding this to the growing-season estimate yields an annual ET estimate for the phreatophytic zone of 253,889 af. This volume could obviously be larger if a higher value for non-growing season ET was used. Accounting for the wetland meadows, Devitt et al. (2006) estimated an annual ET of 53,336 af based on a consumptive-use rate of 2.36 feet per year (ft/yr) (Berger et al., 2001). Adding this to the annual estimate for the phreatophytic zone yields a total annual ET estimate of 307,225 af for 2005, excluding ET from

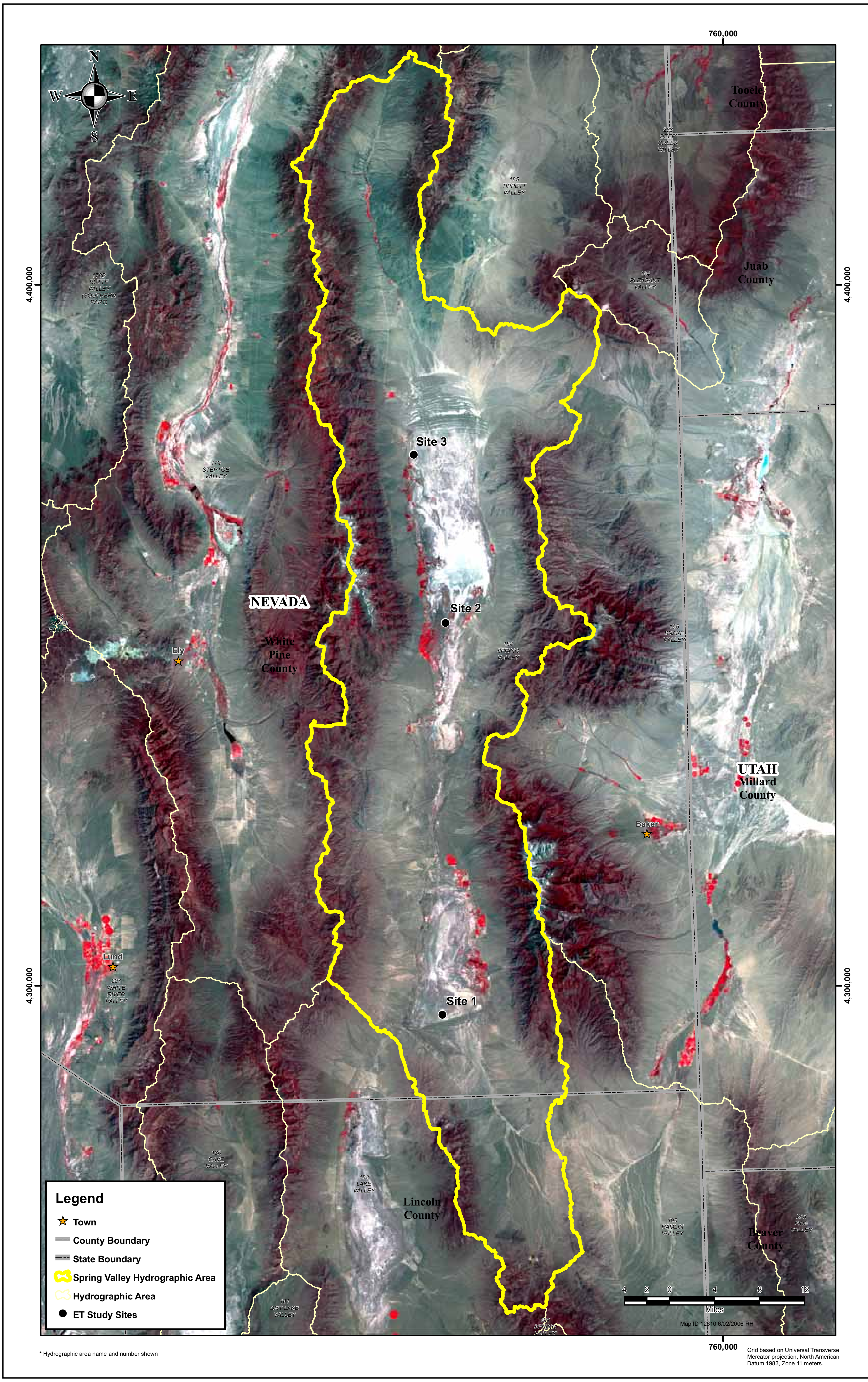

Figure 5-1
Location of Evapotranspiration Stations in Spring Valley

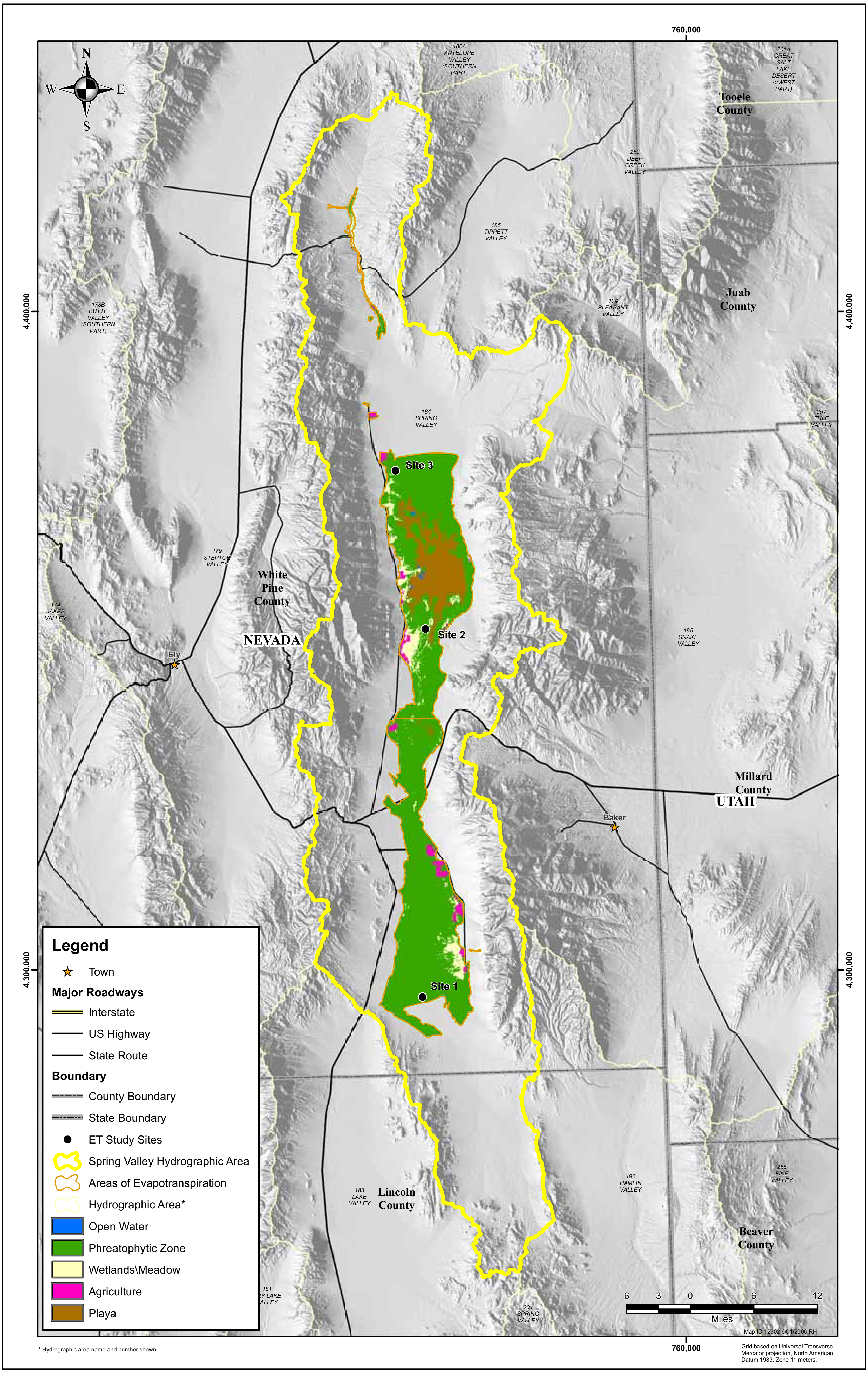

Figure 5-2
Spatial Distribution of Groundwater Discharge Areas in Spring Valley

agricultural areas and evaporation from playas and open-water surfaces. The derivation of this estimate is summarized in Table 5-1 and represents the ET from precipitation, groundwater, and surface-water sources combined.

Table 5-1
Summary ET Estimates for Devitt et al. (2006)

ET Feature	Area (acres)	Total ET (af)	Consumptive Use Rates (ft/yr)
Phreatophytic Zone[a]	127,430	253,889	2.0
Wetland Meadows[b]	22,600	53,336	2.36[c]
Total	150,030	307,225	N/A

[a]Phreatophytic Zone includes greasewood, rabbitbrush, and salt grass.
[b]Wetland Meadows include irrigated pastures, meadowland, and saltgrass.
[c]Source: Berger et al. (2001)

At Site 2, Devitt et al. (2006) reported a measured depth of precipitation of 1.07 ft for the first year of the study, and concluded that rainfall rather than groundwater was the largest component of the water balance for the native plant communities. This conclusion was based largely on the observation that at all sites, except Site 2, the plants decoupled from the groundwater source at the same time the soil moisture was depleted. This suggests that the available groundwater was not enough to meet demand. At Site 2, however, groundwater appeared to be a significant component of the water balance.

5.2 Estimation of Evapotranspiration for Agricultural Areas and Evaporation From Open-Water Surfaces and Playas

The ET estimates for agricultural areas (i.e., irrigated crops), open-water surfaces, and playas within Spring Valley were also estimated for 2005. For the estimated 4,100 acres of irrigated crops (Figure 5-1) within Spring Valley, the crop consumptive use was assumed to be 62.5 percent of the 4 ft/acre annual duty applied to the acreage, which yielded a consumptive-use estimate of 10,250 afy. A detailed discussion of this assumption is presented in Section 3.0 of the “Summary of Groundwater Water-Rights and Current Water Uses in Spring Valley” (SNWA, 2006b). For open-water surfaces, a potential ET value of 3.82 ft/yr (Devitt et al., 2006) was applied to an estimated acreage of 280 acres and multiplied by a coefficient of 1.2 (Devitt, 2006). This yielded an estimate of open-water evaporation of approximately 1,280 afy. For the Yelland Dry Lake and playa area (referred to as “playa” hereafter), it was assumed that all perennial streamflow, other surface waters, and precipitation that reaches the playa evaporates during the course of the year. Given this assumption and the fact that the surface-water and precipitation volumes are unknown, estimates of evaporation were not derived. However, a small amount of groundwater evaporates from the playa, and using an estimated playa acreage of 15,200 acres and an average annual groundwater evaporation rate, the volume of groundwater evaporation from the playa was derived. The groundwater evaporation rate was derived as the average of the range reported by Deverel et al. (2005) for the Yelland Dry Lake. Deverel et al. (2005, p. 9) reported a range of 11 to 42 millimeters per year, or 0.04 to 0.14 ft/yr based on an analysis of chloride and deuterium data from shallow groundwater samples and soil cores collected at two sites located on the playa. Applying the average of this range, 0.09 ft/yr, to the estimated playa acreage, the groundwater evaporation from the playa was estimated at 1,370 afy.

5.3 Precipitation Adjusted ET Estimates for 2005

For 2005, Devitt et al. (2006) reported an annual Spring Valley ET estimate for the phreatophytic zone and wetland meadows of 307,225 af. This estimate represents ET from all water sources, including precipitation, groundwater, and surface-water sources. These components are generally depicted in the diagram in Figure 5-3. The precipitation and surface-water components of the ET estimates are significant due to the volume of perennial streamflow and precipitation that reaches the phreatophytic zone and wetland meadow areas. Because the Devitt et al. (2006) estimates represent the total ET within these areas and not just the groundwater component, it is not directly comparable to the groundwater ET estimates of previous investigators. However, the precipitation component can be accounted for by subtracting it from the total ET estimate, making the comparison similar. The following paragraphs describe the method and assumptions used to exclude the precipitation component of the ET estimates reported by Devitt et al. (2006) for the phreatophytic zone and wetland meadows, and the estimates of open-water evaporation.

The ET estimates were adjusted to exclude precipitation using the depth of precipitation measured at Site 2 and as reported by Devitt et al. (2006). As stated previously, precipitation at this location was measured at 1.07 ft during the period of data collection. To calculate the volume of precipitation for each corresponding area, it was assumed that this depth occurred uniformly over the entire area. The volume of precipitation for each area was calculated by multiplying the area by 1.07 ft. The volume of precipitation was then subtracted from the corresponding ET estimate. Using the 150,030 acres that represent the phreatophytic zone and wetland meadows area, the volume of precipitation was calculated to be approximately 160,500 af. The Devitt et al. (2006) ET estimate for this area was reduced by this amount to account for precipitation and yielded a value of approximately 147,000 af, or nearly 50 percent of the total ET estimate. Open-water evaporation was adjusted to account for precipitation in the same manner. The consumptive-use estimate for the agricultural areas was not adjusted because the precipitation component is already accounted for in the derivation of the annual duty. These values are summarized in Table 5-2 and include the estimate of groundwater evaporation from the playa. For 2005, the total ET from groundwater and surface-water sources is estimated to be approximately 159,000 af.

Simplifying assumptions were made in deriving the ET estimates listed in Table 5-2. First, it was assumed that the depth-of-precipitation occurred uniformly over the entire discharge area. This assumption is probably not an accurate reflection of the actual precipitation, which varies spatially. However, given the central location of the precipitation gage (Site 2) and the fact that the topographic relief within the discharge area is minimal, this is a reasonable assumption. Second, it was assumed that the precipitation that reached the valley floor within the discharge area was fully consumed by ET by the end of the year. This is a conservative assumption as it is plausible that some of the precipitation could have recharged the groundwater system during this period, particularly since the precipitation was at least 20 percent above normal near the discharge area ("Shoshone 5 N" gage).

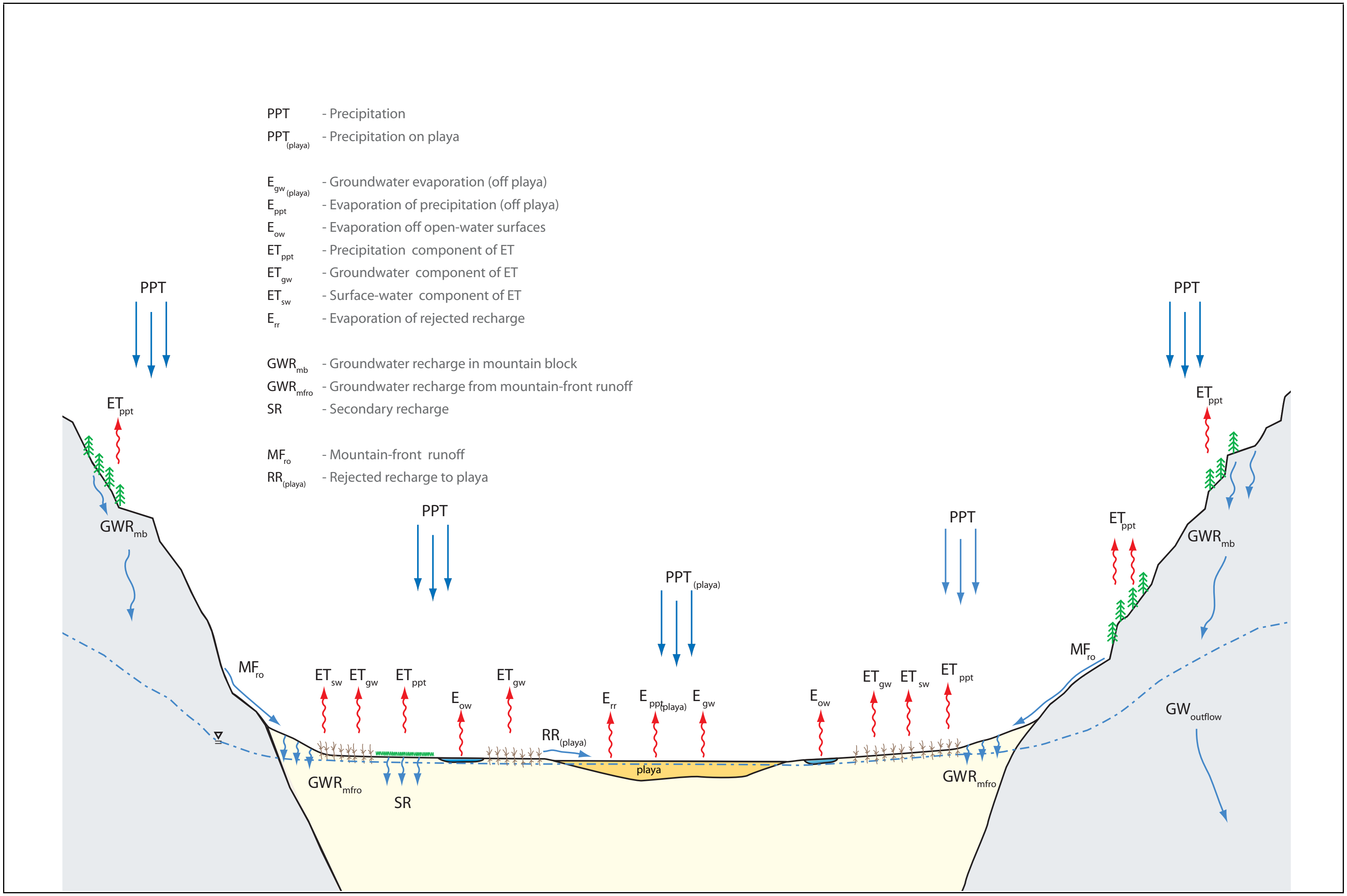

Figure 5-3
Conceptual Representation of Evapotranspiration Components in Spring Valley

Table 5-2
Estimates of 2005 ET Components

ET Feature	Area (acres)	Estimated Precipitation[a] (af)	Total ET (ET_{gw} + ET_{sw} + ET_{ppt}) (af)	ET_{sw} + ET_{gw} (af)
Phreatophytic Zone	127,430	136,350	253,889	117,539
Wetland Meadows	22,600	24,182	53,336	29,154
Agricultural Area	4,100	N/A	N/A	10,250
Open-Water Surfaces	280	300	1,280	980
Playa (groundwater)	15,200	N/A	N/A	1,370[b]
Total	169,610	160,832	308,505	159,293

[a]Values derived by multiplying 1.07 ft by the corresponding area.
[b]Estimate does not include surface water sources (i.e., precipitation, perennial streamflow).

Ultimately, however, this water would discharge by ET during subsequent years. Limitations related to these estimates are described in Devitt et al. (2006).

5.4 Results and Discussion

Rush and Kazmi (1965) estimated groundwater ET in Spring Valley to be 70,000 afy. Nichols (2000) reported estimates for 1985 and 1989 of 102,000 af and 77,500 af, respectively, for an average of 90,000 afy. Devitt et. al. (2006) estimated total annual ET within the groundwater discharge area to be 307,225 af for 2005, noting that the volume could be larger if a higher rate was used for the non-growing season ET. The precipitation component of the ET estimate for Devitt et al. (2006) was accounted for by subtracting it from the total ET estimate based on the measured precipitation at Site 2 and the acreage of the phreatophytic zone and wetland meadows area. This was added to consumptive-use estimates for agricultural areas, open-water evaporation of surface water and groundwater, and playa groundwater evaporation, which yielded a value of 159,000 af. This value represents ET from groundwater and surface-water sources for 2005. There are complications when considering these estimates for the purposes of estimating the long-term average ET as discussed below.

The preliminary estimate of Rush and Kazmi (1965) is based on field reconnaissance conducted during July and August of 1964. Based on the cumulative departure from the average annual precipitation for the “Ely”, “McGill”, “Shoshone 5 N”, “Schellbourne Pass”, “Connors Pass”, and “Berry Creek” precipitation gages that is depicted in Figure 5-4, their estimate may have been influenced by drought conditions. As Figure 5-4 illustrates, precipitation was below average for an extended period preceding the Rush and Kazmi (1965) field reconnaissance. This drought period lasted approximately 19 years based on the “Schellbourne Pass” and “Connors Pass” gages located in Spring Valley. However, there is uncertainty as to exactly when the drought ended because of apparent inconsistencies between the cumulative departures between the precipitation gages in Steptoe Valley (“Ely” and “McGill”) and those in Spring Valley (“Schellbourne Pass” and “Connors

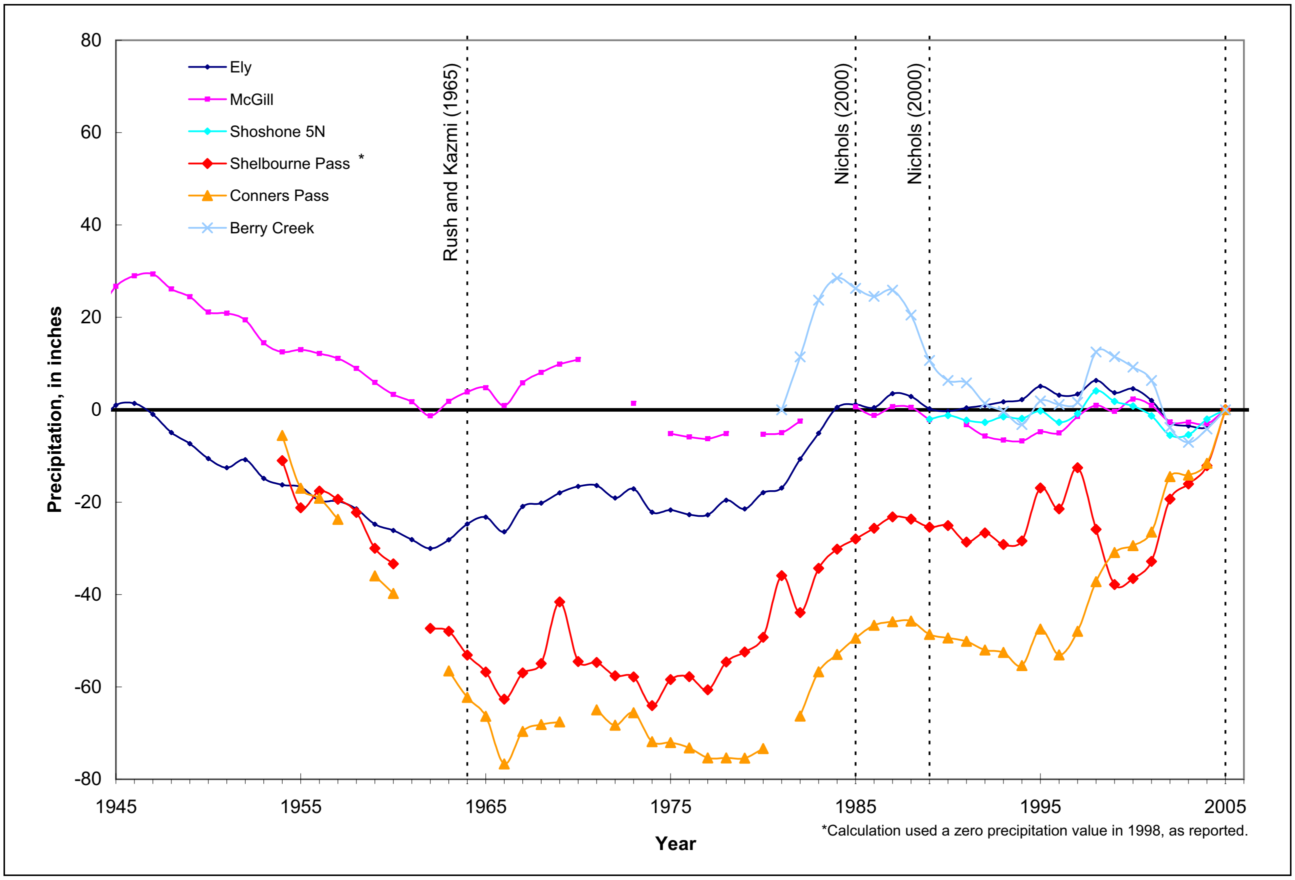

Figure 5-4
Graph of Cumulative Departure From Average Annual Precipitation for the Period 1945 to 2005

Pass"). The Steptoe Valley gages indicate the drought ended two years before the field reconnaissance, while the Spring Valley gages indicate the drought ended two years after. The streamflow record for Cleve Creek near Ely, NV gaging station is consistent with the two Spring Valley precipitation gages in that the annual mean streamflow for water year 1964 was 8.69 cfs (USGS, 1964), approximately 16 percent below the period of record average of 10.4 cfs (USGS, 2005). These observations are important, because it is likely that the depth-to-water (DTW) increased during the drought period due to the dryer than normal conditions and reduced mountain-front runoff. For an extended period, these conditions would effectively reduce the ET from both the groundwater and surface water components, principally within the wetland meadows areas where the extinction depths are small. The extent to which these conditions affected the groundwater discharge areas are not known because there are no long-term water-level records that illustrate depth-to-water trends during this period. The groundwater ET estimate of Rush and Kazmi (1965), while probably representative of the conditions at the time of their field reconnaissance, represents the lower bound rather than the long-term average.

As stated previously, Nichols (2000) estimated groundwater ET for 1985 and 1989 and reported that (1) for both years the precipitation was below normal, (2) 1985 followed three years of above normal precipitation, and (3) 1989 followed three years of below normal precipitation (Figure 5-4). It is noteworthy that the 1985 estimate was much larger than the 1989 estimate, which could be a result of the hydrologic conditions experienced during the preceding years. The Nichols (2000) estimate for 1985 was approximately 25 percent higher than the estimate for 1989. This suggests that ET is much higher during years following above-normal precipitation and years in which the precipitation is above normal (i.e., higher water levels and increased soil moisture).

Hydrologic conditions observed during the period of data collection for the Devitt et al. (2006) study can be characterized as above normal based on the pertinent gage records for 2005 ("Shoshone 5 N" precipitation gage and Cleve Creek near Ely, NV stream gage). Based on these conditions and the results of the Nichols (2000) study, one would expect to observe larger than normal ET. For Spring Valley, the "normal" or average condition is not known; however, the ET estimate of Devitt et al. (2006) is relatively high compared to the groundwater ET estimates reported by the previous studies. This is due, in large part, to the fact that the Devitt et al. (2006) ET estimate includes a surface-water component. The Devitt et al. (2006) estimate is comparable to the 1985 estimate by Nichols (2000) based on the hydrologic conditions preceding and during the year for which the ET was estimated. For the two water-years preceding the Nichols (2000) estimate for 1985, the average annual flow from Cleve Creek was approximately 18 cfs. For the two years preceding the Devitt et al. (2006) estimate for 2005, the average annual flow was 14 cfs, while the average precipitation for the "Shoshone 5 N" gage was approximately 11.40 in/yr, as compared to the period-of-record average of 9.73 in/yr. The ET estimates were 102,000 af (groundwater) and approximately 159,000 af (groundwater and surface water) for Nichols (2000) and Devitt et al. (2006), respectively.

5.5 Summary and Conclusions

Rush and Kazmi (1965) provided a preliminary estimate of 70,000 afy for the average annual groundwater ET for Spring Valley. For 1985 and 1989, Nichols (2000) estimated the groundwater ET to be 77,500 af and 102,000 af, respectively, for an average of 90,000 afy. For 2005, Devitt et al. (2006) estimated total ET for the phreatophytic zone and wetland meadows area to be 307,225 af. This value and the consumptive-use estimates for irrigated crops, open-water evaporation, and playa groundwater evaporation were adjusted to exclude the precipitation component and, when combined, resulted in an ET estimate of approximately 159,000 af from groundwater and surface-water sources.

The range of groundwater ET estimates for Spring valley varies depending on the hydrologic conditions. The value reported by Rush and Kazmi (1965) and the 1989 estimate of Nichols (2000) likely represent the lower bound, while the estimate of Devitt et al. (2006) and the 1985 estimate of Nichols (2000) represent the upper bound. The average annual ET for Spring Valley is more likely the average of the two estimates reported by Nichols (2000) (90,000 afy) rather than the 70,000 afy estimated by Rush and Kazmi (1965). This conclusion is based on the fact that each of the 1985 and 1989 estimates of Nichols (2000) represents a range of hydrologic conditions rather than the hydrologic conditions for a single year. This average annual value of 90,000 afy is corroborated by the independent recharge estimate described previously in Section 3.0.

6.0 GROUNDWATER OCCURRENCE AND MOVEMENT

Understanding the groundwater occurrence and movement within Spring Valley is an important consideration when developing a conceptualization of the hydrologic system and water budget components, particularly the interbasin inflow/outflow component. This section discusses groundwater occurrence, source, and movement for Spring Valley and provides an assessment of the current and recent water-level conditions based on an inventory of groundwater sites.

6.1 Groundwater-Site Data

Groundwater sites within Spring Valley include wells and springs which can provide indications of groundwater occurrence and gradients and a conceptualization of the potentiometric surface and flow directions. For this assessment, well data were compiled for Spring Valley and vicinity from the NDWR Well Log database, USGS NWIS/GWSI database, and published and unpublished reports. The compiled data include coordinate information, reference elevation, well type, construction data, lithologic descriptions, and depth-to-water data. Based on this compilation there are 158 wells within Spring Valley that are, or were, used for stock watering, irrigation, domestic use, mining and milling, and monitoring purposes. Of these, 155 are completed in the basin-fill sediments, while three are completed in bedrock. Nearly two-thirds of the wells are completed to relatively shallow depths of less than 100 ft. Two wells are completed to depths greater than 900 ft. Most lithologic descriptions reported on the driller's logs contain references to interbedded sands, gravels, and clays and support the characterization of the basin-fill sediments described by previous investigators. Selected spring data were also compiled for this assessment, including coordinate data and reference elevations.

6.2 Groundwater Occurrence

Representative groundwater sites containing depth-to-water data were selected for the purpose of evaluating the spatial distribution of water levels within Spring valley. These sites and corresponding data are listed in Appendix D, Table D.1-1. The most recent water-level elevation for each site is depicted in Figure 6-1.

Groundwater occurs at shallow depths throughout most of Spring Valley. Groundwater within the valley and the basin-fill sediments occurs above the ground surface (i.e., flowing wells) and to depths of approximately 400 ft below ground surface (bgs). Depths-to-water are greatest on the alluvial fans and least in the groundwater discharge areas. In the northern portion of Spring Valley at well 184 N24 E66 31CB 1, the depth-to-water is approximately 140 ft-bgs. In the central and south-central portion of the valley the depth-to-water is shallow, particularly within the phreatophytic zone (Figure 5-2) and where there are springs and significant perennial streamflow (Figure 4-1). Within the phreatophytic zone and to the south, in Baking Powder Flat, there are flowing wells

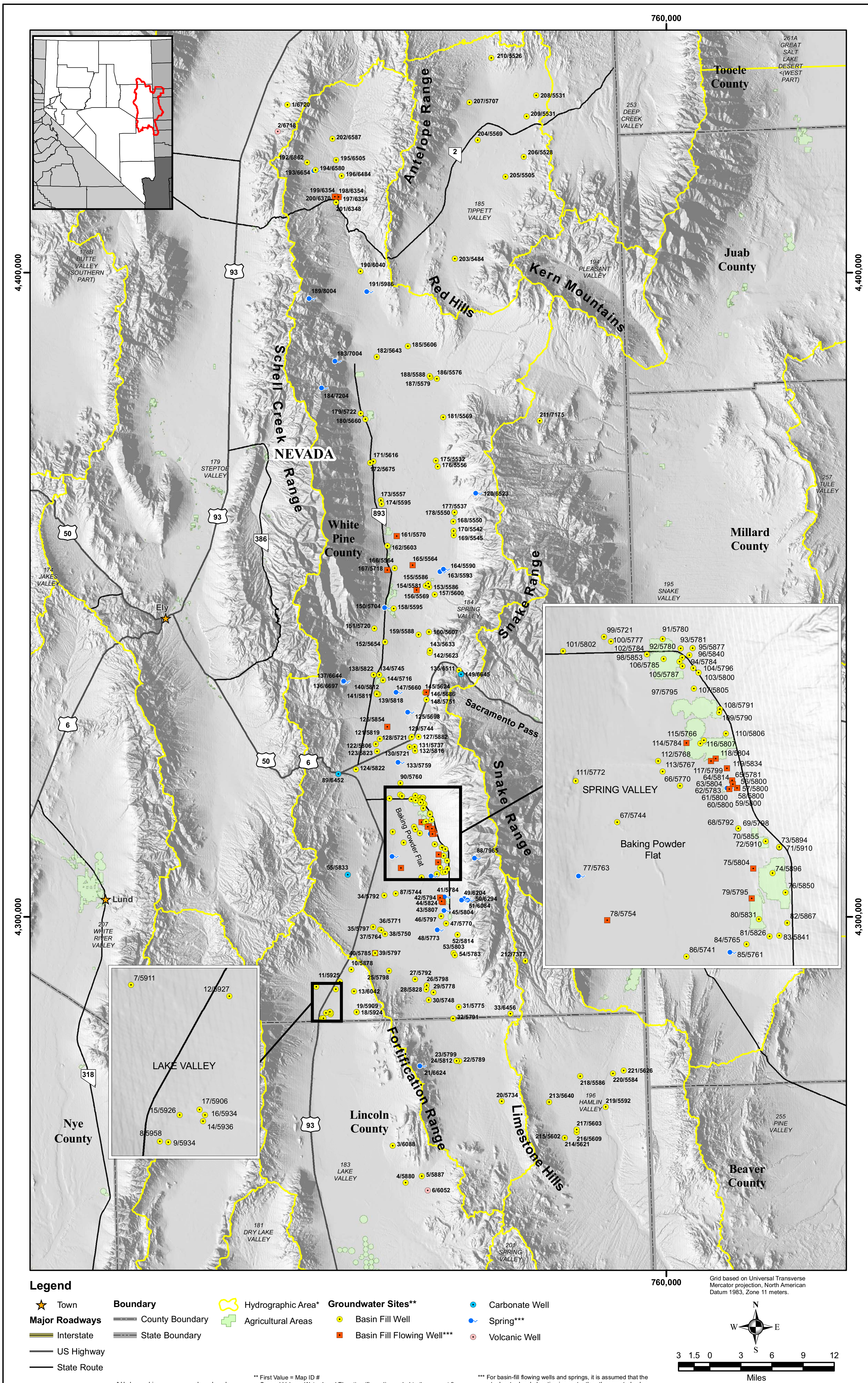

Figure 6-1
Most Recent Water-Level Elevations for Spring Valley and Vicinity

indicative of an upward gradient. This gradient is created by the significant recharge areas within the Schell Creek and Snake Ranges, as depicted by Figure 3-7 in Section 3.0, and the confining nature of some of the fine-grained surficial deposits (e.g., playa and lake deposits).

Water-level elevations derived from the well data provide an indication of the direction of groundwater flow within Spring Valley and the potential for groundwater outflow to adjacent basins. Because most of the wells are completed within the basin-fill sediments, nearly all of the water-level data are reflective of the basin-fill hydraulic heads. Hydraulic heads within the basin fill range from approximately 6,600 ft-amsl in the northernmost portion of the valley to approximately 5,530 ft-amsl east and southeast of Yelland Dry Lake. In the southern part of the valley, the lowest water levels are approximately 5,730 ft-amsl near the topographic divide with Hamlin Valley. As the data indicate and Figure 6-1 illustrates, there is a water-level gradient from north to south in the northern portion of the valley, and a gradient from south to north in most of the southern portion of the valley, with an apparent groundwater divide west and north of the Limestone Hills. These observations are consistent with those reported by Rush and Kazmi (1965) and Brothers et al. (1994).

There are few water-level data available for the underlying carbonate-rock aquifer. Three wells within Spring Valley are completed in the carbonate-rock aquifer based on driller's logs and their location relative to carbonate-rock outcroppings. All three wells are located south of US 50 along the range fronts as depicted in Figure 6-1. Well 184 N15 E68 17DD 1, located on the east side of the valley near Sacramento Pass, has an elevation of 6,645 ft-amsl and may be influenced by the underlying clastic rocks, which act as a lower confining unit. Well 184 N13 E66 05ACAB 1, located near the intersection of US 50 and US 93, has a water-level elevation of 6,452 ft-amsl. This well is assumed to be completed in the carbonate-rocks based on the driller's log that indicates a borehole penetration of "hard lime" from 20 to 40 ft-bgs. The third carbonate-rock well, 184 N12 E66 21CD 1, is located in the southern portion of the valley and has a water-level elevation of 5,833 ft-amsl.

6.3 Groundwater Source

Sources of groundwater within Spring Valley are the significant groundwater recharge areas within the Schell Creek and Snake Ranges. Additional sources include groundwater recharge from areas within the Fortification Range to the south, Antelope Range to the north, subsurface inflow from Tippett Valley, and perennial streamflow. Scott et al. (1971), Harrill et al. (1988), and Brothers et al. (1994) estimated a small amount of subsurface inflow through the carbonate rocks into Spring Valley. Scott et al. (1971, Table 3, p. 8) and Harrill et al. (1988, Plate 4) estimated 2,000 afy, while Brothers et al. (1994, p. 28) estimated 1,700 afy based on the results of a steady-state groundwater flow model. Because Spring Valley is a topographically closed basin, perennial streamflow originating in the valley is also considered a groundwater source as some of it infiltrates and recharges the groundwater system.

6.4 Groundwater Movement

Groundwater moves from the recharge areas within the surrounding mountain ranges, principally the Schell Creek and Snake Ranges, to discharge areas located on the valley floor. The hydraulic-head potential derived from the recharge areas is evident by the numerous springs and seeps located on the valley floor. Nearly all of these springs and seeps are coincident with the range-front faults, and are immediately downgradient from the recharge areas. Flowing wells within the valley are another indication of the hydraulic-head potential derived from the recharge areas and suggest that the potentiometric surface of the underlying carbonate-rock aquifer is greater than or equal to that of the basin-fill (i.e., upward vertical gradient).

Within the basin-fill, the water-level gradients described in Section 6.2 indicate groundwater flow from north to south in the northern portion of the valley and toward groundwater discharge areas in the central portion of the valley. The water-level data also indicate groundwater flow from the southern portion of the valley to the north, to discharge areas in the central portion of the valley. Water-level elevations also indicate an apparent groundwater divide within the southern portion of the valley, north and west of the Limestone Hills near the boundary of Lincoln and White Pine counties. This divide is defined by an approximate water-level elevation of 5,800 ft-amsl and water-level data to the north and south ranging from 5,741 ft-amsl (184 N12 E67 27B 1) and 5,734 ft-amsl (184 N08 E68 14A 1 USBLM), respectively. The boundary is coincident with a gravity high in this area (SNWA, 2006a, Figure 13-5, p. 13-7).

To the southeast of the groundwater divide, Rush and Kazmi (1965), Scott et al. (1971), Harrill et al. (1988), Brothers et al. (1994), and Nichols (2000) interpret groundwater outflow from Spring Valley to Hamlin Valley through the carbonate-rocks of the Limestone Hills. This is supported by the available water-level data from wells 184 N08 E68 14A 1 USBLM and 196 N08 E69 15B 1, which indicate an approximate gradient across the Limestone Hills of 20 feet per mile, or 0.4 percent. Estimates of groundwater outflow to Hamlin Valley range from 4,000 afy (Rush and Kazmi, 1965; Scott et al., 1971, Harrill et al., 1988; Brothers et al., 1994) to 10,000 afy (Nichols, 2000).

Nichols (2000) and Katzer and Donovan (2003) interpreted groundwater outflow to Snake Valley between the Snake Range and the Kern Mountains, and estimated 4,000 afy and 6,000 afy, respectively. There are no water-level data available within this area except for a single stock well completed in 1953 (i.e., well 195 N19 E69 15C 1). This well was completed in the alluvium to a depth of 28 ft-bgs and a corresponding elevation of approximately 7,175 ft-amsl; this well is most likely representative of local conditions. The available water-level data are insufficient to substantiate estimates of groundwater flow from Spring Valley to Snake Valley through this divide.

Katzer and Donovan (2003) postulated a small amount of groundwater outflow (2,000 afy) from northern Spring Valley to Steptoe Valley based on a contour map presented in Brothers et al. (1994). This concept is not supported by the available data. The water-level elevation data for wells located in the far northern portion of the valley clearly indicate a gradient to the south coincident with Spring Valley Creek. The northernmost well, 184 N24 E66 31CB 1, has an elevation of 6,587 ft-amsl. Along Spring Valley Creek water-level elevations range from 6,505 to 6,040 ft-amsl in the north-south direction at wells 184 N23 E66 07C 1 and 184 N21 E66 04B 2, respectively.

6.5 Temporal Variation of Water Levels

There are few wells within Spring Valley that have sufficient water-level records from which an analysis of the temporal variation in water levels can be performed. For those that do, the water-level data are limited in their period of record and frequency of measurements. These limitations, coupled with the fact that groundwater production data is unavailable, make it difficult to characterize the temporal variation due to changes in hydrologic conditions and/or anthropogenic effects.

To evaluate the temporal variation in water-level data, hydrographs for wells with significant periods of water-level record were constructed from data collected by SNWA since 1993 and data obtained from the USGS through May 2006. These are presented in Appendix D and were selected because of their relatively long period of record. All of the wells are located in the southern portion of the valley (i.e., south of US 50) and are completed in the basin-fill based upon the lithologic description of their respective driller's logs. Many of the wells were constructed in the early 1980s in support of the USAFs MX Missile Siting Program, and since their construction, there has been intermittent data collection. In 1990, the USGS began quarterly monitoring as part of a joint funding agreement with the LVVWD and NDWR. This joint funding arrangement continues and was expanded in 2005 to include additional wells. As the hydrographs illustrate, the periods of record are essentially the same, ranging from 1981 to present.

Temporal variation in water levels ranges from 2 to 8 ft for these wells and is most likely related to changes in the hydrologic conditions and measurement accuracy rather than anthropogenic effects. Based on comparisons between the water-level hydrographs and the cumulative departure from the annual mean precipitation for selected precipitation gages ("Ely," "McGill," "Shoshone 5 N," "Schellbourne Pass," "Connors Pass," and "Berry Creek") presented in Figure 5-4, the water-levels in most of the wells appear to have responded to recent drought conditions from 1999 through 2004 and above-normal precipitation in 2005. Groundwater production data for the limited pumping that occurs within Spring Valley are unavailable, so the effects of pumping were not evaluated. However, it is probable that the magnitude and expanse of the pumping effects is small and localized near the production wells.

6.6 Summary and Conclusions

Data from groundwater sites within Spring Valley and vicinity were compiled and analyzed so that the occurrence, source, and movement of groundwater within Spring Valley could be assessed. Groundwater within the valley occurs above the ground surface (i.e., flowing wells) and to depths of approximately 400 ft-bgs. Shallow depths-to-water are observed within the discharge areas and near springs and flowing wells. Water-level elevations in Spring Valley range from approximately 6,900 to 5,500 ft-amsl, with higher elevations occurring to the north and south, and near the margins of the valley. Based on the water-level elevation data, an apparent groundwater divide exists within the valley, north and west of the Limestone Hills. This divide is coincident with a gravity high that extends across the valley in the east-west direction. Groundwater movement on the southern side of this divide is interpreted to flow eastward through the Limestone Hills and into Hamlin Valley. Groundwater to the north of this divide is interpreted to flow to the north, to discharge areas located in the central portion of the valley. In the northern portion of the valley, groundwater is interpreted to flow to the south, to discharge areas in the central portion of the valley. The movement of groundwater within Spring Valley is driven by the hydraulic-head potential created by the significant recharge sources located within the Schell Creek and Snake Ranges, and by other smaller recharge areas located in the Fortification and Antelope Ranges to the south and north, respectively.

Groundwater inflow to Spring Valley is limited to inflow from Tippett Valley to the north, which has been estimated to be 2,000 afy (Scott et al., 1971; Harrill et al., 1988) and 1,700 afy (Brothers et al., 1994). Groundwater outflow from Spring Valley to Hamlin Valley has been estimated to be 4,000 afy (Rush and Kazmi, 1965; Scott et al., 1971, Harrill et al., 1988; Brothers et al., 1994) and 10,000 afy (Nichols, 2000). Nichols (2000) and Katzer and Donovan (2003) interpreted groundwater outflow to Snake Valley between the Snake Range and the Kern Mountains, and estimated 4,000 afy and 6,000 afy, respectively. Katzer and Donovan (2003) also interpreted groundwater outflow to Steptoe Valley from northern Spring Valley, and estimated 2,000 afy.

Temporal variations in water-level data for Spring Valley were evaluated to the extent that the limited data would allow. Very few wells have any significant periods of record, and all are located in the southern half of the valley. Given the limited amount of data, most of the hydrographs indicate a response to the recent drought conditions experienced from 1999 through 2004, although one well seemed unaffected and another indicated a water-level rise. Groundwater production data are unavailable for the purpose of ascertaining the effects of the limited pumping that occurs in the valley.

Given this evaluation, the following conclusions are made:

- Groundwater flows to discharge areas located in the central portion of the valley, except south of an apparent groundwater divide in the southern portion of the valley where it flows through carbonate rocks of the Limestone Hills, eastward to Hamlin Valley.

- Groundwater outflow from Spring Valley is estimated to be 4,000 afy based on the previous investigations by Rush and Kazmi (1965), Scott et al. (1971), Harrill et al. (1988), and Brothers et al. (1994), although the estimate could be adjusted higher or lower depending upon assumptions related to the transmissibility of the Limestone Hills.

- Groundwater outflow to Steptoe Valley from northern Spring Valley is not supported by the available water-level data.

- Groundwater outflow to Snake Valley between the Snake Range and Kern Mountains cannot be substantiated due to the lack of sufficient water-level data within the area.

- Groundwater inflow to Spring Valley from Tippett Valley is most likely no more than 2,000 afy (Scott et al., 1971; Harrill et al., 1988) based on the available water-level data, which suggest that there is a groundwater divide between the two valleys.

- Insufficient data exists to assess the temporal variation of groundwater conditions within Spring Valley. There are too few monitor wells with requisite periods of water-level records, groundwater production data is unavailable, and data for other hydrologic indices are limited.

7.0 WATER RESOURCES AND GROUNDWATER BUDGET

The water resources and groundwater budgets for Spring Valley were developed using the results of analyses presented in this report, a water rights survey conducted for Spring Valley (SNWA, 2006b), and the results of previous studies. The derivation of each budget and the data sources and simplifying assumptions related to each budget component are presented in the following sections.

7.1 Objectives

The objectives of this analysis were to (1) construct a water resources and groundwater budget for Spring Valley using estimates for each budget component that represent annual average values and reflect the most current data and information available, and (2) compare the groundwater budget derived by this analysis with the budget described in Rush and Kazmi (1965).

7.2 Water Resources Budget

The water resources budget is presented in Table 7-1. The estimate for each budget component represents an annual average value. The inflow components include perennial streamflow at the mountain block-alluvial interface, groundwater recharge from precipitation within the mountain block, and groundwater inflow from Tippett Valley. The outflow components include groundwater ET by phreatophytes, surface-water ET and evaporation, subsurface outflow to Hamlin Valley, groundwater ET by irrigated crops, and other consumptive uses of groundwater (mining and milling, stock watering, quasi-municipal uses, wildlife). The budget excludes the portion of precipitation that does not contribute to the water resources of the valley. This portion of the precipitation is assumed to be lost through ET and bare-soil evaporation. The budget only considers perennial streamflow, and does not quantify or include any of the ephemeral streamflow below 6,000 ft that contributes to the water resources of the valley as either available surface water or as groundwater recharge. The following sections describe the data sources and simplifying assumptions related to the derivation of each budget component.

7.2.1 Water Resources Budget Inflows

The inflow components of the water resources budget include perennial streamflow at the mountain block-alluvial interface, groundwater recharge from precipitation within the mountain block, and groundwater inflow from Tippet Valley. The perennial streamflow estimate of 47,000 afy is based on the application of Moore's (1968) concurrent measurement method using continuous data reported for the Cleve Creek near Ely, NV gage, and miscellaneous measurements conducted by SNWA and USGS, and other measurements compiled from published and unpublished reports (Section 4.0). The

Table 7-1
Water Resources Budget for Spring Valley

Flow Component	Volume (afy)	Source
Inflow Components		
Perennial Streamflow (at mountain block/alluvial interface)	47,000	Section 4.0
Groundwater Recharge (within mountain block)	87,000	Section 3.0
Subsurface Inflow (from Tippett Valley)	2,000	Scott et al. (1971), Harrill et al. (1988), and Brothers et al. (1994)
TOTAL IN	**136,000**	
Outflow Components		
Groundwater ET	90,000	Nichols (2000)
Surface Water ET and Evaporation (meadows/grasslands, crops, riparian, open water)	35,250	75% of perennial streamflow
Subsurface Outflow (to Hamlin Valley)	4,000	Rush and Kazmi (1965), Scott et al. (1971), Harrill et al. (1988), and Brothers et al. (1994)
Groundwater ET by Crops	5,780	(SNWA, 2006b, Table 4-1, p. 4-1)
Other Groundwater Consumptive Uses (milling and mining, stock water, quasi-municipal, wildlife)	346	(SNWA, 2006b, Table 4-1, p. 4-1)
TOTAL OUT	**135,376**	
TOTAL INFLOW MINUS TOTAL OUTFLOW (residual)	**624**	
DIFFERENTIAL (%)	**0%**	

groundwater recharge from precipitation within the mountain block was estimated to be 87,000 afy by applying the standard Maxey-Eakin recharge efficiencies to a precipitation distribution developed from an altitude-precipitation relationship. The altitude-precipitation relationship was derived from altitude and precipitation data compiled for 39 precipitation stations within Spring Valley and vicinity (Section 3.0). Subsurface inflow from Tippett Valley was estimated at 2,000 afy based on estimates by Scott et al. (1971), Harrill et al. (1988), and Brothers et al. (1994) who reported estimates of groundwater inflow from Tippett Valley ranging from 1,700 afy to 2,000 afy. Based on these estimates, the total inflow for Spring Valley is 136,000 afy.

7.2.2 Water Resources Budget Outflows

The outflow components of the water resources budget include groundwater ET by phreatophytes, surface-water ET and evaporation, subsurface outflow to Hamlin Valley, consumptive uses of groundwater by irrigated crops, and other consumptive uses of groundwater. Groundwater ET by phreatophytes was estimated at 90,000 afy based on Nichols (2000). Surface-water ET and evaporation was assumed to be 75 percent of the perennial streamflow, or 35,250 afy. This assumption is discussed in greater detail in the following paragraph. Subsurface outflow to Hamlin

Valley was estimated at 4,000 afy based on the estimates of Rush and Kazmi (1965), Scott et al. (1971), Harrill et al. (1988), and Brothers et al. (1994), each of which estimated total groundwater outflow from Spring Valley at 4,000 afy. Groundwater consumptive use by irrigated crops and other uses were estimated at 5,780 afy and 346 afy, respectively (SNWA, 2006b, Table 4-1, p. 4-1).

In estimating the budget component for the surface-water ET and evaporation, it was assumed that 75 percent of the annual average perennial streamflow is consumptively used by ET from irrigated crops, pastures and meadowlands, open-water evaporation, livestock, and natural vegetation transpiration. The remaining 25 percent of the perennial streamflow is assumed to infiltrate and recharge the groundwater system. SNWA field reconnaissance indicates that much of the water is diverted to small storage reservoirs for the controlled application of surface water to irrigate crops, or is used to flood irrigate pastures and meadowlands. Diverted water that is not consumed by ET or evaporation, or does not infiltrate and recharge the groundwater system, returns to the stream via irrigation drains and/or the natural drainage network. This return flow and any undiverted water ultimately flows to lowland areas, most notably the Yelland Dry Lake, where it pools and evaporates.

The 75:25 ratio has been applied in other studies to estimate irrigation consumptive use (Harrill, 1986, p. 19; Brothers et al., 1993, p. 39). A similar ratio was used in Rush and Kazmi (1965) to estimate the contribution of mountain-front runoff to the perennial yield estimate. In this case, Rush and Kazmi (1965, p. 26) estimated that the contribution might be on the order of one-third of the mountain-front runoff, or 33 percent. Ultimately, however, all of the perennial streamflow is consumed by ET and evaporation, including the amount that recharges the groundwater system.

Based on these estimates and simplifying assumptions, the total outflow for Spring Valley is estimated to be approximately 135,376 afy. Compared to the total inflow amount of 136,000 afy, there is an imbalance of 624 afy, or effectively zero percent of the total budget.

7.3 Groundwater Budget

The groundwater budget is presented in Table 7-2. Like the water resources budget, the estimate for each budget component represents the annual average value. The inflow components include groundwater recharge from perennial streamflow, groundwater recharge from precipitation within the mountain block, and groundwater inflow from Tippet Valley. The outflow components include groundwater ET by phreatophytes, subsurface outflow to Hamlin Valley, groundwater ET by irrigated crops, and other consumptive uses of groundwater (mining and milling, stock watering, quasi-municipal uses, wildlife). The groundwater budget excludes the portion of precipitation that does not contribute to the groundwater resources of the valley. This portion of the precipitation is assumed to be lost through ET and bare-soil evaporation. The groundwater budget only considers recharge from perennial streamflow, and does not quantify or include any of the ephemeral streamflow below 6,000 ft that contributes to the groundwater resources of the valley.

The surface-water components of the water resources budget were excluded in the development of the groundwater budget. In doing so, the perennial streamflow component of the groundwater budget was reduced to include only the water assumed to recharge the groundwater system, or 25 percent of

Table 7-2
Groundwater Budget for Spring Valley

Flow Component	Volume (afy)	Source
Inflow Components		
Recharge from Perennial Streamflow (below mountain block/alluvial interface)	11,750	25% of perennial streamflow; Section 4.0
Groundwater Recharge (within mountain block)	87,000	Section 3.0
Subsurface Inflow (from Tippett Valley)	2,000	Scott et al. (1971), Harrill et al. (1988), and Brothers et al. (1994)
TOTAL IN	**100,750**	
Outflow Components		
Groundwater ET	90,000	Nichols (2000)
Subsurface Outflow (to Hamlin Valley)	4,000	Rush and Kazmi (1965), Scott et al. (1971), Harrill et al. (1988), and Brothers et al. (1994)
Groundwater ET by Crops	5,780	(SNWA, 2006b, Table 4-1, p. 4-1)
Other Groundwater Consumptive Uses (mining and milling, stock water, quasi-municipal, wildlife)	346	(SNWA, 2006b, Table 4-1, p. 4-1)
TOTAL OUT	**100,126**	
TOTAL INFLOW MINUS TOTAL OUTFLOW (residual)	**624**	
DIFFERENTIAL (%)	**<1%**	

the estimated perennial streamflow. For the outflow portion of the groundwater budget, the surface-water ET and evaporation component was excluded.

Based on these estimates and simplifying assumptions, the groundwater inflow and outflow for Spring Valley is estimated to be 100,750 and 100,126 afy, respectively. This equates to an imbalance of 624 afy, or less than one percent of the total budget.

7.4 Budget Assumptions

The assumptions related to the derivation of the water-resources and groundwater budgets include those that are explicit in deriving estimates for particular budget components, and those that are inherently made when constructing the budget. The explicit assumptions have been described in the preceding sections of this report. One of the assumptions that is not explicitly represented in the budgets is the assumption that the conditions that can influence the estimates for individual budget components did not change during the timeframe in which each component was estimated. This assumption principally relates to the estimates of groundwater ET by phreatophytes and irrigated crops. For this budget, it is assumed that land developed for agricultural purposes replaced areas of native phreatophytes. This assumption is valid because the irrigated lands fall within the phreatophytic zone (Figure 5-2). It is also assumed that all surface water that reaches the playa (i.e., Yelland Dry Lake) pools and eventually evaporates.

7.5 Results and Discussion

All of the developed and undeveloped water resources were accounted for in each budget to achieve the objectives of the analysis. The estimates for each budget component were derived independently from each other, and represent an annual average value. In some cases simplifying assumptions were made to derive estimates for selected budget components. These assumptions are described in the preceding sections of this report and mostly relate to the derivation of (1) consumptive use and secondary recharge of perennial streamflow and (2) the groundwater consumptive use of irrigated crops. Because these budget components represent only a small fraction of the total budget, a change in their estimated value does not appreciably affect the budget outcome.

A comparison of the water resources budget derived by this analysis with that of Rush and Kazmi (1965) is complicated because the budget terms are different in some cases. Rush and Kazmi (1965) did not provide estimates for some of the budget components used in this analysis, and in other instances the budget components were added or partitioned. For example, in Figure 6 of the Rush and Kazmi (1965) report one could interpret the mountain-block recharge that occurs above an altitude of 7,000 to be mostly within the "Underflow from mountains" component or mostly within the "Runoff from mountains" component. Depending upon which interpretation is used, the "rejected recharge" component could be very different. A more meaningful comparison is between the groundwater budgets, which is provided in Table 7-3.

One of the fundamental differences between the Rush and Kazmi (1965) water budget and the groundwater budget derived by this analysis is that the Rush and Kazmi (1965) budget did not explicitly consider secondary recharge or seepage losses from the application of surface waters. However, Rush and Kazmi (1965) did estimate the runoff from the mountain front at 90,000 afy, and concluded that although some of the runoff flows to the playa and evaporates, a "large part seeps into the ground and recharges the ground-water reservoir" (Rush and Kazmi, 1965, p.18). For the groundwater budget estimated by this analysis, it was assumed the 25 percent of the perennial streamflow recharges the groundwater system through the diversion and application of the water to irrigated crops, pastures and meadowlands, or through seepage losses from stream channels and irrigation ditches as the water flows to lowland areas such as the playa. The volume of inflow from this budget component is balanced, in part, by the groundwater ET.

The percentage of the secondary recharge and seepage losses can be greater as Rush and Kazmi (1965) suggest by their assumption that one-third of the runoff volume of 90,000 afy could be salvaged by "extensive and well-distributed" pumping. The incremental increase from the 25 percent assumed by this study to the 33 percent assumed by Rush and Kazmi (1965) would occur through the creation of additional storage capacity by lowering the water table in the locations where the surface water is applied. If a sufficient lowering of the water table occurred in the areas where perennial streamflow is applied, secondary recharge could become as high as 37.5 percent of the perennial streamflow based on the assumptions related to the Alpine Decree. These assumptions are described in detail in Section 3.0 of the "Summary of Groundwater Water-Rights and Current Water Uses in Spring Valley" (SNWA, 2006b).

Table 7-3
Comparison of Groundwater Budgets for Spring Valley

Flow Component	Rush and Kazmi (1965)	SNWA (2006)
Inflow Components		
Recharge from Perennial Streamflow (below mountain block/alluvial interface)	N/S[a]	11,750
Groundwater Recharge (within mountain block)	65,000	87,000
Groundwater Recharge (on alluvial apron)	10,000	
Subsurface Inflow (from Tippett Valley)	0	2,000
TOTAL IN	75,000	***100,750***
Outflow Components		
Groundwater ET	70,000	90,000
Subsurface Outflow	4,000	4,000
Groundwater ET by Crops	1,000	5,780
Other Groundwater Consumptive Uses (milling and mining, stock water, quasi-municipal, wildlife)		346
TOTAL OUT	75,000	***100,126***
TOTAL INFLOW MINUS TOTAL OUTFLOW (residual)	**0**	**624**
DIFFERENTIAL (%)	**0%**	**<1%**

[a]N/S - Not Specified; Rush and Kazmi (1965, p. 26) indicate that up to one-third of the estimated 90,000 afy of mountain-front runoff could be salvaged by "extensive and well-distributed pumping"

The remaining components of the groundwater budgets are similar or the same. For those that are different, the differences are discussed in the preceding sections of this report.

7.6 Summary and Conclusions

Water resources and groundwater budgets were developed for Spring Valley based on the available data and the results of analyses presented in this report and other studies related to specific budget components. The estimates for each budget component were derived independently from each other, and represent an annual average value. In some cases simplifying assumptions were made to derive estimates for selected budget components. All budget components have related uncertainty, and is discussed in the corresponding sections of this report.

The water resources budget for Spring Valley is approximately 136,000 afy of inflow and outflow. This budget includes a significant component of perennial streamflow (47,000 afy) and groundwater recharge within the mountain block (87,000 afy), and a small amount of subsurface inflow from Tippett Valley (2,000 afy). The inflow is balanced by outflow from groundwater ET by natural vegetation (90,000 afy) and irrigated crops (5,780 afy), surface water ET and evaporation

(35,250 afy), groundwater outflow to Hamlin Valley (4,000 afy), and other groundwater uses (346 afy).

The groundwater budget for Spring Valley is approximately 101,000 afy of inflow and outflow, and includes significant components of groundwater recharge within the mountain block (87,000 afy) and from secondary recharge and seepage losses from the perennial streams and irrigation ditches (11,750 afy), and a small amount of subsurface inflow from Tippett Valley (2,000 afy). The inflow is balanced by outflow from groundwater ET by natural vegetation (90,000 afy) and irrigated crops (5,780 afy), groundwater outflow to Hamlin Valley (4,000 afy), and other groundwater uses (346 afy).

A comparison of the groundwater budget derived by this analysis with the groundwater budget developed by Rush and Kazmi (1965) is complicated because the budget terms are different in some cases. Rush and Kazmi (1965) did not provide estimates for secondary recharge or seepage losses from the perennial streams and irrigation ditches. The estimates derived by this analysis for the groundwater recharge within the mountain block and groundwater ET components are larger than those of Rush and Kazmi (1965). The difference between the groundwater recharge components is 12,000 afy, while the difference between the groundwater ET components is 20,000 afy. Despite these differences, the groundwater budget derived by this analysis supports the perennial yield estimate of Rush and Kazmi (1965) and Scott et al. (1971).

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8.0 UNAPPROPRIATED GROUNDWATER

8.1 Perennial Yield

The established perennial yield of Spring Valley is 100,000 afy (Scott et al., 1971) based on the USGS Water Resources-Reconnaissance Series Report completed by Rush and Kazmi (1965). The results of the analyses presented in this report and those of previous investigators generally support the reconnaissance-level estimates of groundwater recharge and discharge, mountain-front runoff, and associated perennial yield.

In Rush and Kazmi (1965), the perennial yield of the groundwater reservoir is defined as:

> *". . . the maximum amount of water of usable chemical quality that can be withdrawn and consumed economically each year for an indefinite period of time..." "Perennial yield cannot exceed the natural recharge to an area indefinitely, and ultimately it is limited to the amount of natural discharge that can be salvaged for beneficial use."* (p. 26)

This definition is consistent with NDWR perennial yield definitions (NDWR, 1972; 1996). Rush and Kazmi (1965, pp. 14 and 22) describe the basis for the perennial yield estimate as the groundwater discharge from ET and the salvageable portion of mountain-front runoff. Rush and Kazmi (1965) provided preliminary estimates for groundwater ET and mountain-front runoff of 70,000 afy and 90,000 afy, respectively.

The range of groundwater ET estimates for Spring valley varies depending on the hydrologic conditions. The preliminary estimate of Rush and Kazmi (1965), while probably representative of the conditions at the time of their field reconnaissance, represents the lower bound rather than the long-term average. This is substantiated by the more recent work of Nichols (2000), which indicated that the groundwater ET in Spring Valley could range from 77,500 afy to 102,000 afy, and that the average is 90,000 afy. These values are based on the 1985 and 1989 estimates which represent a range of hydrologic conditions rather than the hydrologic conditions for a single year. The average annual value of 90,000 afy is corroborated by the independent recharge estimate described previously in Section 3.0 of this report. The work conducted by Devitt et al. (2006) during 2005 support the estimate of the upper bound of the range, although this estimate of 307,225 afy, when adjusted to exclude precipitation, represents ET from both groundwater and surface-water sources. This adjusted estimate is approximately 147,000 afy for the phreatophytic zone and wetland meadows area.

The other component of the perennial yield identified by Rush and Kazmi (1965) is the portion of the runoff from the mountain front that could be salvaged by "extensive and well-distributed" pumping.

Rush and Kazmi (1965) estimate the runoff from the mountain-front to be approximately 90,000 afy, and assume that one-third of this volume could be salvaged. Rush and Kazmi (1965) also state that although some of the runoff flows to the playa and evaporates, a “large part seeps into the ground and recharges the ground-water reservoir”, however, an estimate for this groundwater recharge component was not provided and is not accounted for in their water budget. Currently, nearly all of the surface water is diverted and applied to irrigated crops, pastures and meadowlands, providing a significant opportunity for secondary recharge and seepage losses from irrigation ditches. The secondary recharge component is a significant groundwater resource that was not explicitly accounted for in the Rush and Kazmi (1965) water budget, and could be 25 - 37 percent of the volume of water applied to the irrigated areas.

The available data, recent studies, and the analyses presented in this report support the Rush and Kazmi (1965) and Scott et al. (1971) perennial yield estimates of 100,000 afy for Spring Valley. Although these data, studies, and analyses indicate that selected components of the Rush and Kazmi (1965) water budget were underestimated, the perennial yield estimate is valid. Perennial yield estimates for Spring Valley are compared in Section 8-1.

Table 8-1
Estimates of Perennial Yield for Spring Valley

	Rush and Kazmi (1965)	Scott et al. (1971)	SNWA (2006)
Perennial Yield Estimate	100,000	100,000	101,000[a]

[a] Estimate based on groundwater budget presented in Section 7.0 of this report

8.2 Unappropriated Groundwater Resources

The unappropriated groundwater resources can be determined from the difference between the perennial yield and the committed groundwater rights. The committed groundwater rights used in the determination of unappropriated groundwater resources are based on the water-rights survey summarized in the “Summary of Groundwater Water-Rights and Current Water Uses in Spring Valley” report (SNWA, 2006b). Based on the water rights survey, there are 9,610 afy of non-supplemental committed groundwater rights within Spring Valley. Assuming that 62.5 percent of the annual duty applied to irrigated crops and quasi-municipal uses is consumptively used, the consumptive use portion of these committed rights is 6,125 afy. A detailed discussion of this assumption is presented in Section 3.0 of the “Summary of Groundwater Water-Rights and Current Water Uses in Spring Valley” report (SNWA, 2006b). **Based on the perennial yield estimate of Scott et al. (1971) and the consumptive-use estimate of the non-supplemental committed groundwater rights, the unappropriated groundwater resources within Spring Valley is 93,875 afy.**

The volume of unappropriated groundwater within Spring Valley is greater than the total combined duty of the pending SNWA applications (54003-54021), which amount to approximately 91,224 afy based on the maximum diversion rates for each application. Therefore, sufficient unappropriated groundwater resources are available for allocation up to the requested diversion rate of these applications.

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9.0 REFERENCES

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Appendix A

Precipitation Station Data

Table A.1-1
Precipitation Data Listed By Data Source
(Page 1 of 3)

Station Name	Data Source	UTM Northing (m)	UTM Easting (m)	Altitude (ft)	Altitude 30m DEM (ft)	Start	End	Duration (years)	Years of Non-zero Precipitation	NCDC Normals	Annual Precipitation (in.)			
											Average[a]	Minimum[b]	Maximum[b]	Standard Deviation[b]
Connors Pass	NDWR	4,323,835	703,315	7,732	7,783	1954	2005	52	46	No	14.72	2.90	26.30	5.31
Current Creek	NDWR	4,298,199	649,245	5,999	6,913	1954	2005	52	48	No	13.71	6.00	24.49	4.15
Overland Pass 2	NDWR	4,430,934	621,103	6,790	6,848	1966	2005	40	39	No	14.43	0.00	26.40	4.93
Robinson Summit	NDWR	4,365,136	665,201	7,800	7,708	1954	2005	52	47	No	14.05	0.55	27.30	5.41
Schellbourne Pass	NDWR	4,409,348	702,800	7,100	7,277	1954	2005	52	45	No	13.67	0.00	26.80	6.21
White Horse Pass	NDWR	4,470,279	735,178	6,000	5,881	1954	2005	52	43	No	9.41	2.30	19.00	4.04
Wilson Creek Summit	NDWR	4,254,601	730,436	7,200	7,413	1954	2005	52	48	No	17.51	6.50	33.00	5.85
Berry Creek	NRCS (Snotel)	4,354,622	705,390	9,100	9,681	1981	2005	25	25	No	27.35	19.00	40.80	6.86
Ward Mountain	NRCS (Snotel)	4,333,562	677,114	9,200	9,437	1981	2005	25	25	No	24.22	13.30	38.80	7.39
Cave Mountain	USGS	4,337,547	706,108	10,650	10,621	1984	2005	22	22	No	20.41	12.00	32.16	5.09
Cherry Creek Range	USGS	4,443,655	680,594	9,700	9,106	1984	2005	22	22	No	15.67	9.00	26.25	4.06
Mt. Hamilton	USGS	4,344,777	625,555	10,600	10,448	1984	2005	22	20	No	19.51	0.00	43.75	11.12
Mt. Washington	USGS	4,309,377	732,764	10,440	10,508	1984	2005	22	22	No	26.13	12.00	46.00	7.53
Mt. Wilson	USGS	4,236,086	728,118	9,200	9,088	1984	2005	22	21	No	19.68	0.00	47.00	11.79
Unnamed Peak NW of Mt. Moriah	USGS	4,355,941	737,695	9,300	8,836	1984	2005	22	20	No	16.72	0.00	28.50	7.65
Callao	WRCC	4,421,801	780,345	4,330	4,349	1948	2005	58	58	Yes	5.84	0.94	10.59	2.00
Currant Hwy Stn	WRCC	4,295,867	643,208	6,240	7,266	1963	1977	15	15	No	10.59	6.46	11.79	2.15
Currie Highway Stn	WRCC	4,460,144	691,236	5,820	5,796	1961	1991	31	21	No	7.16	2.43	9.78	2.35
Desert Exp Range	WRCC	4,277,393	782,964	5,250	5,239	1950	1984	35	35	No	6.22	2.40	10.68	2.12
Ely WBO	WRCC	4,350,044	685,372	6,250	6,280	1897	2005	109	80	Yes	9.57	4.22	16.16	2.83
Eskdale	WRCC	4,334,515	763,613	4,980	4,979	1966	2005	40	40	Yes	6.44	3.18	12.57	2.30
Ferguson Springs Hms	WRCC	4,478,184	739,177	5,840	5,922	1972	1982	11	11	No	8.22	4.07	9.00	2.02
Fish Springs Refuge	WRCC	4,415,084	808,023	4,340	4,471	1960	2005	46	46	Yes	7.94	3.89	12.64	2.31
Garrison	WRCC	4,313,196	757,384	5,260	5,276	1951	1990	40	40	Yes	7.61	4.59	14.69	2.40
Geyser Ranch	WRCC	4,282,815	706,113	6,020	5,972	1948	2002	55	28	No	8.67	1.65	15.49	3.71
Gold Hill	WRCC	4,451,436	769,871	5,250	5,257	1966	1990	25	25	No	11.11	5.29	22.08	4.56
Great Basin Natl Park	WRCC	4,320,446	740,673	6,830	6,949	1948	2005	58	58	Yes	13.24	7.37	21.20	3.12
Ibapah	WRCC	4,435,448	757,623	5,280	5,302	1948	2005	58	58	Yes	9.77	3.20	16.41	2.91
Kimberly	WRCC	4,348,581	669,869	7,230	7,359	1948	1958	11	11	No	12.03	7.82	18.59	3.21
Lages	WRCC	4,436,011	702,945	5,960	6,091	1984	2005	22	22	Yes	8.35	4.83	13.20	2.20
Lake Valley Steward	WRCC	4,243,927	705,365	6,350	6,481	1971	1998	28	28	No	15.69	9.39	28.29	5.15
Lund - NV	WRCC	4,302,024	673,483	5,570	5,721	1957	2005	49	49	Yes	10.26	4.99	18.83	2.94
McGill	WRCC	4,363,530	691,944	6,300	6,490	1914	2005	92	92	Yes	8.82	3.76	16.21	2.48
Modena	WRCC	4,188,089	771,110	5,460	5,473	1901	2004	104	103	Yes	10.26	4.17	19.07	3.14
Old Ruth	WRCC	4,348,676	674,182	7,030	7,014	1978	1985	8	8	No	14.15	10.39	17.01	2.86

Table A.1-1
Precipitation Data Listed By Data Source
(Page 2 of 3)

Station Name	Data Source	UTM Northing (m)	UTM Easting (m)	Altitude (ft)	Altitude 30m DEM (ft)	Start	End	Duration (years)	Years of Non-zero Precipitation	NCDC Normals	Annual Precipitation (in.)			
											Average[a]	Minimum[b]	Maximum[b]	Standard Deviation[b]
Partoun	WRCC	4,391,336	767,708	4,780	4,768	1950	2005	56	56	Yes	6.74	2.03	12.21	2.25
Pioche	WRCC	4,201,109	724,042	6,180	6,068	1948	2005	58	58	Yes	13.25	3.81	27.29	4.57
Ruby Lake	WRCC	4,451,025	627,593	6,010	6,412	1948	2005	58	58	Yes	13.19	5.94	23.86	3.66
Ruth	WRCC	4,350,154	673,938	6,840	6,845	1958	2005	48	41	Yes	12.05	6.68	19.46	3.17
Shoshone 5 N	WRCC	4,311,105	725,336	5,930	5,942	1988	2005	18	18	Yes	9.73	5.48	14.56	2.38
Spring Valley St Pk	WRCC	4,212,891	747,440	5,950	5,850	1974	2005	32	32	Yes	12.16	5.05	23.48	4.75
Sunnyside	WRCC	4,254,266	672,777	5,300	5,368	1948	2005	58	44	Yes	9.44	5.73	17.11	3.10
Ursine	WRCC	4,207,236	744,095	5,830	5,569	1964	1972	9	9	No	11.38	9.67	16.85	3.06
Wah Wah Ranch	WRCC	4,265,142	812,231	4,880	4,889	1955	2005	51	51	Yes	6.77	3.12	11.26	2.03
Alligator Ridge Nevada	RAWS-BLM	4,399,939	626,738	6,560	6,611	1989	2005	17	7	No	2.42	0.00	7.19	3.83
Baker Creek Nevada	RAWS-?	4,318,173	739,008	7,900	8,262	2002	2003	2	0	No	b	b	b	b
Baker Flat Nevada	RAWS-NPS	4,320,446	740,673	6,840	6,949	2000	2005	6	4	No	4.67	0.26	14.89	10.34
Brimstone Res. - Milford 20Wsw	RAWS-BLM	4,246,408	816,463	5,620	5,749	1987	2005	19	18	No	5.77	2.55	11.00	3.54
Buckhorn Ranch Nevada	RAWS-BLM	4,233,691	737,167	7,050	7,027	1991	1997	7	0	No	f	d	d	d
Cattle Camp Nevada	RAWS-BLM	4,307,951	689,839	7,300	7,002	1994	2005	13	11	No	9.49	6.34	13.12	2.49
Cedar Pass Nevada	RAWS-BLM	4,404,942	742,358	7,185	7,274	1989	2005	17	6	No	3.52	0.00	12.18	6.05
Clifton Flat Utah	RAWS-BLM	4,444,624	765,846	6,384	6,286	2004	2005	2	1	No	d	d	d	d
Coyote Wash Nevada	RAWS-BLM	4,239,249	695,855	5,720	5,724	1986	2005	20	19	No	9.07	5.82	16.81	4.66
Currant Creek Nevada	RAWS-BLM	4,291,336	638,074	5,580	5,729	1989	2005	17	15	No	5.12	4.10	9.18	1.96
Dale Nevada	RAWS-?	4,309,452	705,422	6,420	9,543	2004	2004	1	0	No	d	d	d	d
Ely Nevada	RAWS-BLM	4,351,175	686,208	6,590	6,264	2000	2005	6	6	No	6.21	d	d	d
Immigration Wash Nevada	RAWS-BLM	4,200,737	749,569	6,230	6,230	1990	2005	16	6	No	4.43	0.00	15.26	7.53
Mather Nevada	RAWS-NPS	4,322,534	736,276	9,268	8,876	1998	2005	9	0	No	f	d	d	d
McGill Junction Nevada	RAWS-BLM	4,359,398	704,117	6,270	9,822	1986	1997	12	0	No	f	d	d	d
Paris Nevada	RAWS-BLM	4,434,162	673,112	6,341	6,359	1994	1997	4	0	No	d	d	d	d
Ruby Lake NWR Nevada	RAWS-FWS	4,447,710	628,501	5,970	5,979	2002	2005	4	2	No	11.17	e	e	d
Spring Gulch Nevada	RAWS-BLM	4,497,004	736,881	5,470	5,472	1990	2005	16	14	No	5.65	3.41	9.19	2.70
Spruce Mountain Nevada	RAWS-BLM	4,478,888	685,667	6,100	6,342	1986	2005	20	18	No	4.88	3.22	9.84	2.44
Tule Valley - Delta 49W	RAWS-BLM	4,361,862	811,884	5,200	5,205	1987	2005	19	15	No	5.14	3.43	8.79	2.19
Atlanta Mine	NCDC-other	4,259,116	732,927	6,801	6,832	1981	1985	5	5	No	15.05	15.95	16.75	0.57
Cathedral Gorge State Park	NCDC-other	4,186,804	728,839	4,830	4,738	2003	2005	3	3	No	13.85	9.86	14.93	3.59
Cherry Creek	NCDC-other	4,418,800	681,160	6,165	6,064	1967	2005	39	6	No	9.11	6.41	12.93	4.61
Currant	NCDC-other	4,290,137	632,879	5,184	5,309	1941	1949	9	9	No	6.48	3.01	12.52	3.48
Dolly Varden	NCDC-other	4,467,327	710,608	6,612	6,683	1981	1984	4	4	No	14.88	12.64	16.75	2.91
Eagle Valley State Park	NCDC-other	4,212,891	747,440	5,955	5,850	1973	1974	2	2	No	d	d	d	d
Ely 6 NE	NCDC-other	4,352,305	687,044	6,263	6,239	1999	2005	7	7	No	8.14	4.42	10.46	2.21
Lake Valley	NCDC-other	4,249,543	707,845	5,984	5,986	1966	1972	7	5	No	13.22	10.68	15.11	2.22

Table A.1-1
Precipitation Data Listed By Data Source
(Page 3 of 3)

Station Name	Data Source	UTM Northing (m)	UTM Easting (m)	Altitude (ft)	Altitude 30m DEM (ft)	Start	End	Duration (years)	Years of Non-zero Precipitation	NCDC Normals	Annual Precipitation (in.) Average[a]	Minimum[b]	Maximum[b]	Standard Deviation[b]
Major's Place	NCDC-other	4,321,683	705,970	6,500	7,329	1988	1988	1	1	No	d	d	d	d
Moorman Ranch	NCDC-other	4,354,735	644,726	6,539	6,716	2002	2005	4	4	No	8.88	7.95	8.40	0.32
Parker Ranch	NCDC-other	4,439,342	702,856	5,906	5,907	1970	1971	2	1	No	d	d	d	d
Robin Ranch	NCDC-other	4,426,996	698,058	6,243	6,085	1968	1968	1	1	No	d	d	d	d
Schellbourne	NCDC-other	4,408,015	694,267	6,125	6,157	1948	1951	4	5c	No	d	d	d	d
Ursine Spring Valley	NCDC-other	4,215,138	748,251	5,804	5,859	1954	1955	2	2	No	d	d	d	d

[a]Average calculated from monthly values for period of record at WRCC, RAWS, and NCDC-other sites.
[b]Values calculated from complete years to be consistent with WRCC reported values.
[c]Two 1949s reported.
[d]These values cannot be calculated because no years are complete.
[e]These values cannot be calculated because only one year (2005) is complete.
[f]All values are reported as 0.

Table A.1-2
Summary of Selected Stations Altitude-Precipitation Relationship Regression

Regression Statistics	
Multiple R	0.91
R^2	0.82
Adjusted R^2	0.82
Standard Error	0.19
Observations	39

ANOVA

	df	SS	MS	F	Significance F
Regression	1	6.537118	6.537118	172.708301	0.000000
Residual	37	1.400473	0.037851		
Total	38	7.937591			

	Coefficients	Standard Error	t Stat	P-Value	Lower 95%	Upper 95%
Intercept	-0.537863	0.125732	-4.277866	0.000128	-0.792619	-0.283107
Altitude	0.000237	0.000018	13.141853	0.000000	0.000200	0.000273

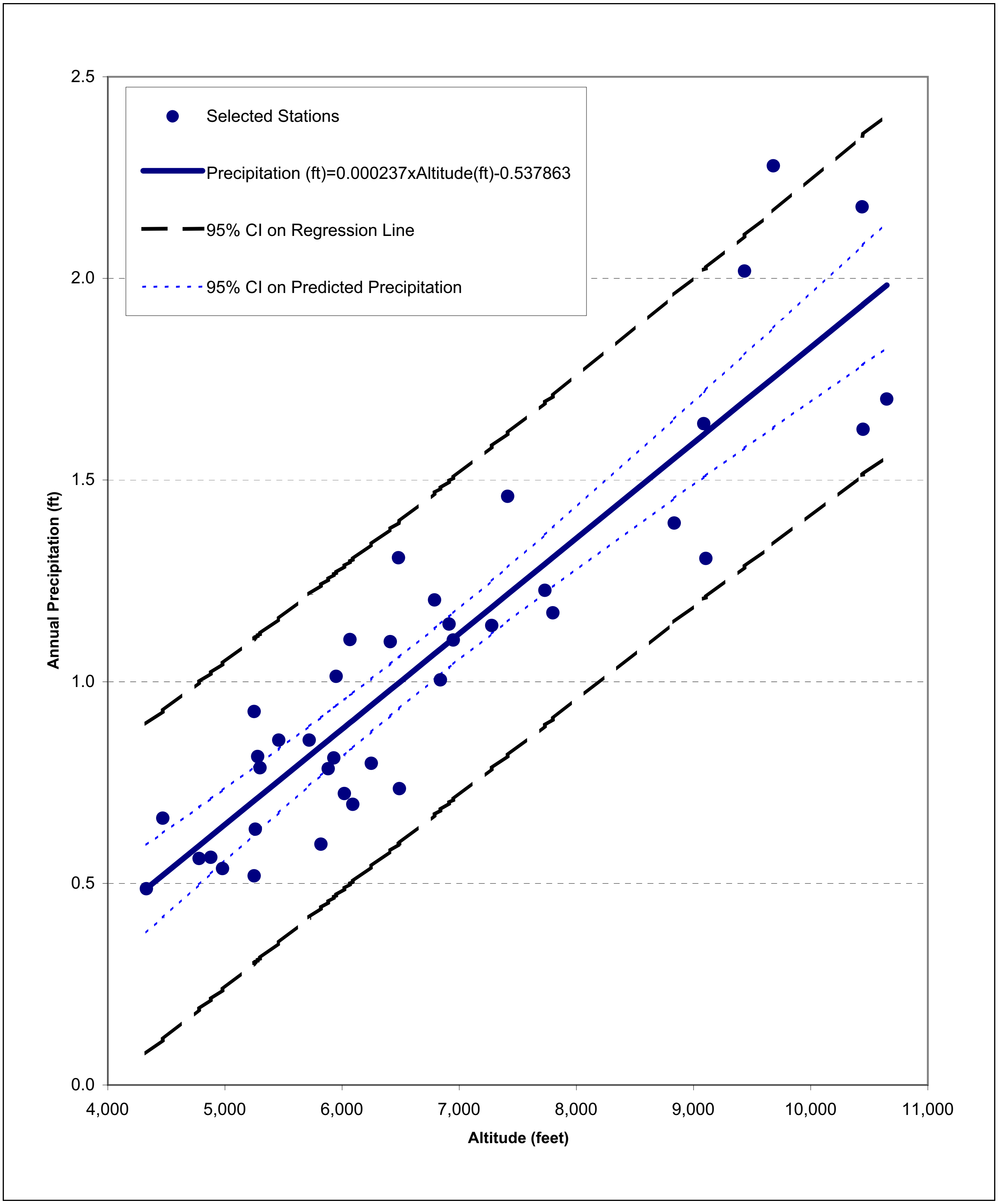
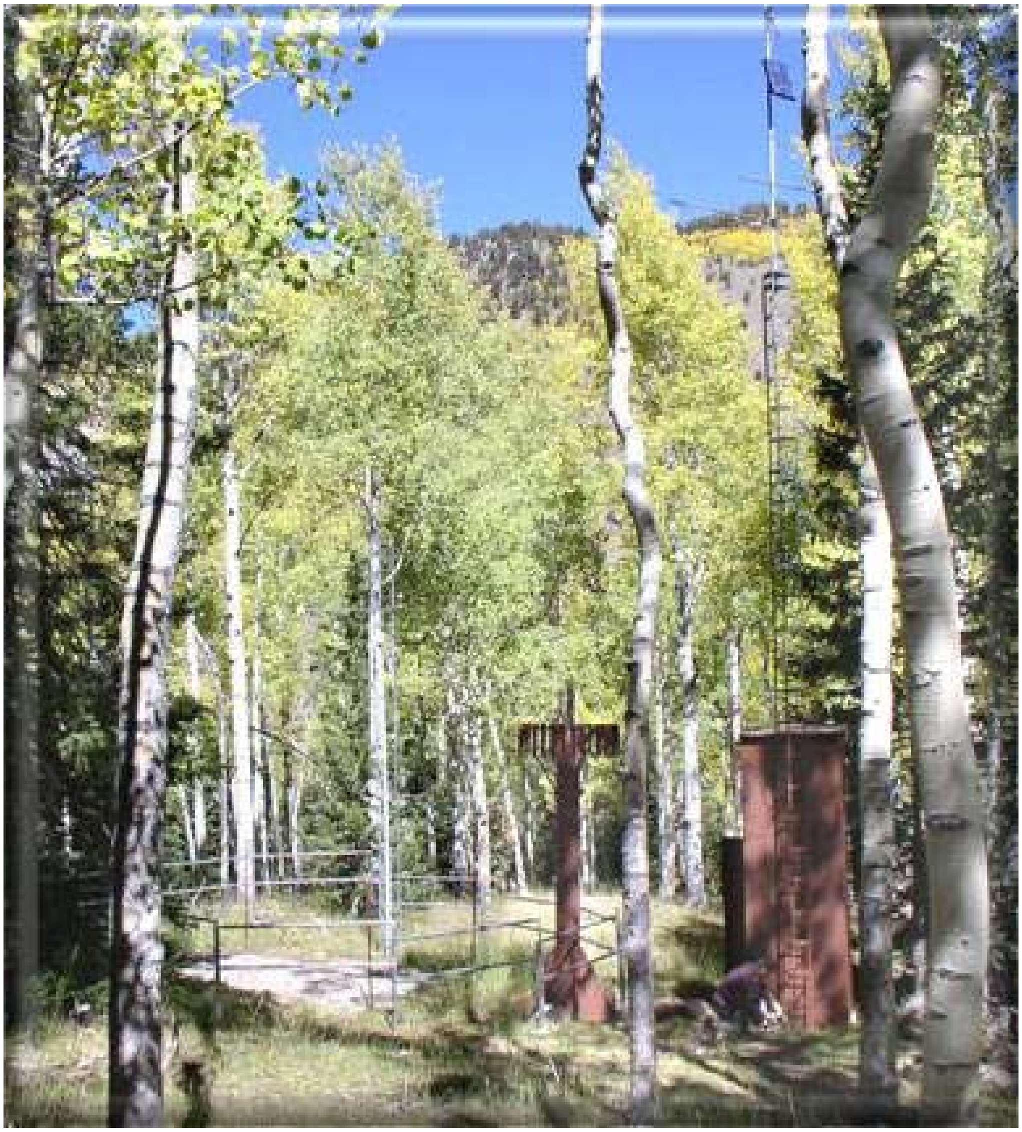


Figure A.1-1
95 Percent Confidence Interval (CI) Plot for Predicted Precipitation With the Derived Precipitation-Altitude Equation



NRCS Snotel Precipitation Site:	Berry Creek
Station ID:	334 14k02s
Latitude (DM-Datum Unkown)*:	39^{o} 19’
Longitude (DM-Datum Unkown)*:	-114^{o} 37’
Altitude (Datum Unknown):	9,100 ft-amsl

Data and Photo Source: NRCS (Snotel)
*Decimal degree coordinates available at NRCS (Snotel) website.

Figure A.1-2
Photo of Berry Creek

USGS Precipitation Site:	Cave Mountain
SiteID:	390946114364901
Latitude (DMS-NAD27):	39° 09’ 46”
Longitude (DMS-NAD27):	114° 36’ 49”
Altitude (NGVD29):	10,650 ft-amsl

Data and Photo Source: USGS

Figure A.1-3
Photo of Cave Mountain

References

NCDC, see National Climate Data Center.

NDWR, see Nevada Division of Water Resources.

NRCS, see Natural Resources Conservation Service.

National Climate Data Center, 2006, (NCDC-other) was purchased from http://www.ncdc.noaa.gov/oa/ncdc.html for Nevada on March 17 and for Utah April 24.

Natural Resources Conservation Service, SNOwpack TELemetry (SNOTEL) 2006, Data as accessed at http://www.wcc.nrcs.usda.gov/snow/ on April 10, and April 21.

Nevada Division of Water Resources, 2006, Precipitation data was transmitted electronically, by request, to the Southern Nevada Water Authority on April 21.

RAWSD, see Remote Automated Weather Station Data.

Remote Automated Weather Station Data, 2006, Precipitation data as accessed at http://www.wrcc.dri.edu/wraws/nvutF.html) between April 10 and April 24. Cooperating federal agencies (BLM, NPS, FWS and unknown[" "]) was indicated in the metadata.

USGS, see U.S. Geological Survey.

U.S. Geological Survey, 2006, Data was transmitted electronically, by request, to the Southern Nevada Water Authority and the Nevada Division of Water Resources on March 13.

WRCC, see Western Regional Climate Center.

Western Regional Climate Center, 2006, Data as accessed at http://www.wrcc.dri.edu/Climsum.html. on April 20, and April 21, with an additional site (Ruth, Nevada) on May 4.

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Appendix B

Perennial Streamflow Data

Table B.1-1
Perennial Streamflow Data Listed by Station Number and by Date
(Page 1 of 26)

Station No.	Station Name	UTM Northing (m)	UTM Easting (m)	Date of Measurement	Time of Measurement	Date Accuracy	Discharge (cfs)	Measurement Rated	Data Source
1840101	Stage Canyon near Ely	4,409,809	704,607	7/13/1998	17:01	Day	0.15	Fair	SNWA[a]
1840101	Stage Canyon near Ely	4,409,809	704,607	7/12/1999	16:40	Day	0.09	Fair	SNWA[a]
1840101	Stage Canyon near Ely	4,409,809	704,607	7/24/2000	13:50	Day	0	Fair	SNWA[a]
1840101	Stage Canyon near Ely	4,409,809	704,607	8/6/2001		Day	0	Fair	SNWA[a]
1840201	Siegel Creek at Mountain Block	4,400,822	707,782	7/16/1996	9:50	Day	1.3	Fair	SNWA[a]
1840201	Siegel Creek at Mountain Block	4,400,822	707,782	7/13/1998		Day	2.65	Fair	SNWA[a]
1840201	Siegel Creek at Mountain Block	4,400,822	707,782	7/12/1999	15:30	Day	2.66	Good	SNWA[a]
1840201	Siegel Creek at Mountain Block	4,400,822	707,782	7/24/2000	15:00	Day	0.25	Fair	SNWA[a]
1840201	Siegel Creek at Mountain Block	4,400,822	707,782	7/26/2000	9:00	Day	0.474	Fair	SNWA[a]
1840201	Siegel Creek at Mountain Block	4,400,822	707,782	8/6/2001	15:50	Day	0.12	Fair	SNWA[a]
1840201	Siegel Creek at Mountain Block	4,400,822	707,782	7/16/2002	17:15	Day	0.21	Fair	SNWA[a]
1840201	Siegel Creek at Mountain Block	4,400,822	707,782	8/6/2003	11:00	Day	0.67	Fair	SNWA[a]
1840201	Siegel Creek at Mountain Block	4,400,822	707,782	7/28/2004	10:26	Day	0.29	Fair	SNWA[a]
1840201	Siegel Creek at Mountain Block	4,400,822	707,782	7/28/2005	17:40	Day	2.95	Fair	SNWA[a]
1840203	Seigel Creek at Doutre Ranch	4,400,481	712,308	7/16/1964		Day	2	--	Rush and Kazmi 1965
1840301	Silver Creek at Mountain Block	4,397,579	707,030	7/17/1998	9:00	Day	0	Excellent	SNWA[a]
1840401	North Creek at Sunkist, NV	4,395,129	706,672	7/14/1964		Day	2.23	--	USGS 1964
1840401	North Creek at Sunkist, NV	4,395,129	706,672	7/17/1996	8:04	Day	1.13	Fair	SNWA[a]
1840401	North Creek at Sunkist, NV	4,395,129	706,672	7/14/1998	9:25	Day	3.11	Fair	SNWA[a]
1840401	North Creek at Sunkist, NV	4,395,129	706,672	7/17/1998	8:55	Day	2.74	Fair	SNWA[a]
1840401	North Creek at Sunkist, NV	4,395,129	706,672	7/12/1999	14:08	Day	2.47	Fair	SNWA[a]
1840401	North Creek at Sunkist, NV	4,395,129	706,672	7/24/2000	17:10	Day	0.6	Fair	SNWA[a]
1840401	North Creek at Sunkist, NV	4,395,129	706,672	7/25/2000	13:36	Day	0.572	Fair	SNWA[a]
1840401	North Creek at Sunkist, NV	4,395,129	706,672	7/25/2000	13:05	Day	0.64	Fair	SNWA[a]
1840401	North Creek at Sunkist, NV	4,395,129	706,672	7/25/2000	11:31	Day	0.656	Fair	SNWA[a]
1840401	North Creek at Sunkist, NV	4,395,129	706,672	7/25/2000	12:25	Day	0.554	Fair	SNWA[a]
1840401	North Creek at Sunkist, NV	4,395,129	706,672	8/6/2001	17:10	Day	0.37	Good	SNWA[a]
1840401	North Creek at Sunkist, NV	4,395,129	706,672	8/9/2001	10:15	Day	0.42	Fair	SNWA[a]
1840401	North Creek at Sunkist, NV	4,395,129	706,672	7/16/2002	14:00	Day	0.68	Fair	SNWA[a]
1840401	North Creek at Sunkist, NV	4,395,129	706,672	8/6/2003	12:47	Day	0.67	Good	SNWA[a]
1840401	North Creek at Sunkist, NV	4,395,129	706,672	7/28/2004	11:55	Day	0.564	Fair	SNWA[a]
1840401	North Creek at Sunkist, NV	4,395,129	706,672	7/28/2005	16:46	Day	2.05	Fair	SNWA[a]
1840501	Frenchman Creek at Mountain Block	4,392,107	708,758	7/17/1996		Day	0.66	Good	SNWA[a]

Table B.1-1
Perennial Streamflow Data Listed by Station Number and by Date
(Page 2 of 26)

Station No.	Station Name	UTM Northing (m)	UTM Easting (m)	Date of Measurement	Time of Measurement	Date Accuracy	Discharge (cfs)	Measurement Rated	Data Source
1840501	Frenchman Creek at Mountain Block	4,392,107	708,758	7/14/1998	11:30	Day	0.898	Fair	SNWA[a]
1840501	Frenchman Creek at Mountain Block	4,392,107	708,758	7/17/1998		Day	0.86	Fair	SNWA[a]
1840501	Frenchman Creek at Mountain Block	4,392,107	708,758	7/12/1999	12:55	Day	1.04	Good	SNWA[a]
1840501	Frenchman Creek at Mountain Block	4,392,107	708,758	8/7/2001	10:20	Day	0.1	Fair	SNWA[a]
1840601	Muncy Creek (USGS)	4,386,426	708,705	7/14/1964		Day	4.23	--	USGS 1964
1840601	Muncy Creek (USGS)	4,386,426	708,705	8/15/1964		Day	1.98	--	USGS 1964
1840602	Muncy Creek near Muncy Ranch	4,386,314	709,979	7/16/1998	8:30	Day	5.17	Good	SNWA[a]
1840602	Muncy Creek near Muncy Ranch	4,386,314	709,979	7/17/1998	12:35	Day	5.14	Fair	SNWA[a]
1840602	Muncy Creek near Muncy Ranch	4,386,314	709,979	7/13/1999	13:35	Day	5.04	Good	SNWA[a]
1840602	Muncy Creek near Muncy Ranch	4,386,314	709,979	7/24/2000	15:02	Day	1.06	Poor	SNWA[a]
1840602	Muncy Creek near Muncy Ranch	4,386,314	709,979	7/24/2000	14:13	Day	0.81	Poor	SNWA[a]
1840602	Muncy Creek near Muncy Ranch	4,386,314	709,979	7/27/2000	13:39	Day	0.75	Fair	SNWA[a]
1840602	Muncy Creek near Muncy Ranch	4,386,314	709,979	8/7/2001	9:25	Day	0.8	Fair	SNWA[a]
1840701	Kalamazoo Creek (Site 4)	4,382,348	706,082	7/16/1997	16:33	Day	0.89	Fair	SNWA[a]
1840701	Kalamazoo Creek (Site 4)	4,382,348	706,082	7/17/1997	16:10	Day	0.937	Good	SNWA[a]
1840701	Kalamazoo Creek (Site 4)	4,382,348	706,082	7/17/1997	11:40	Day	1.02	Good	SNWA[a]
1840701	Kalamazoo Creek (Site 4)	4,382,348	706,082	7/17/1997	10:00	Day	0.999	Good	SNWA[a]
1840701	Kalamazoo Creek (Site 4)	4,382,348	706,082	7/17/1997	7:57	Day	1.09	Good	SNWA[a]
1840701	Kalamazoo Creek (Site 4)	4,382,348	706,082	7/18/1997	9:22	Day	1.02	Good	SNWA[a]
1840701	Kalamazoo Creek (Site 4)	4,382,348	706,082	7/18/1997	12:40	Day	1.05	Good	SNWA[a]
1840701	Kalamazoo Creek (Site 4)	4,382,348	706,082	7/27/2000	13:40	Day	0.36	Fair	SNWA[a]
1840701	Kalamazoo Creek (Site 4)	4,382,348	706,082	8/9/2001	9:11	Day	0.309	Fair	SNWA[a]
1840701	Kalamazoo Creek (Site 4)	4,382,348	706,082	7/28/2005	13:44	Day	0.971	Fair	SNWA[a]
1840702	Kalamazoo Creek (Site 3)	4,382,324	706,408	7/16/1997	17:30	Day	0.803	Fair	SNWA[a]
1840702	Kalamazoo Creek (Site 3)	4,382,324	706,408	7/17/1997	12:25	Day	0.837	Good	SNWA[a]
1840702	Kalamazoo Creek (Site 3)	4,382,324	706,408	7/17/1997	8:28	Day	0.88	Good	SNWA[a]
1840702	Kalamazoo Creek (Site 3)	4,382,324	706,408	7/17/1997	10:52	Day	0.815	Good	SNWA[a]
1840702	Kalamazoo Creek (Site 3)	4,382,324	706,408	7/18/1997	9:57	Day	0.88	Good	SNWA[a]
1840702	Kalamazoo Creek (Site 3)	4,382,324	706,408	7/12/1998	13:35	Day	2.63	Fair	SNWA[a]
1840702	Kalamazoo Creek (Site 3)	4,382,324	706,408	7/27/2000	14:53	Day	2.9	Fair	SNWA[a]
1840702	Kalamazoo Creek (Site 3)	4,382,324	706,408	8/9/2001	10:15	Day	0.164	Fair	SNWA[a]
1840703	Kalamazoo Creek (Site 2)	4,382,468	706,940	7/16/1997	16:40	Day	4.66	Fair	SNWA[a]
1840703	Kalamazoo Creek (Site 2)	4,382,468	706,940	7/17/1997	13:03	Day	4.76	Fair	SNWA[a]
1840703	Kalamazoo Creek (Site 2)	4,382,468	706,940	7/17/1997	12:10	Day	3.74	Fair	SNWA[a]

Table B.1-1
Perennial Streamflow Data Listed by Station Number and by Date
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Station No.	Station Name	UTM Northing (m)	UTM Easting (m)	Date of Measurement	Time of Measurement	Date Accuracy	Discharge (cfs)	Measurement Rated	Data Source
1840703	Kalamazoo Creek (Site 2)	4,382,468	706,940	7/17/1997	9:06	Day	4.59	Fair	SNWA[a]
1840703	Kalamazoo Creek (Site 2)	4,382,468	706,940	7/18/1997	13:00	Day	4.86	Fair	SNWA[a]
1840703	Kalamazoo Creek (Site 2)	4,382,468	706,940	7/18/1997	10:25	Day	4.63	Fair	SNWA[a]
1840703	Kalamazoo Creek (Site 2)	4,382,468	706,940	7/12/1998	15:05	Day	9.72	Fair	SNWA[a]
1840703	Kalamazoo Creek (Site 2)	4,382,468	706,940	8/7/2003	10:58	Day	3	Fair	SNWA[a]
1840703	Kalamazoo Creek (Site 2)	4,382,468	706,940	7/28/2005	15:13	Day	6.57	Fair	SNWA[a]
1840704	Kalamazoo Creek (Site 1)	4,382,169	710,123	7/14/1964		Day	6.87	--	USGS 1964
1840704	Kalamazoo Creek (Site 1)	4,382,169	710,123	8/15/1964		Day	4.56	--	USGS 1964
1840704	Kalamazoo Creek (Site 1)	4,382,169	710,123	6/1/1980		Month	4.01	--	ERTEC 1981
1840704	Kalamazoo Creek (Site 1)	4,382,169	710,123	12/8/1982		Day	5.29	--	USGS 1983
1840704	Kalamazoo Creek (Site 1)	4,382,169	710,123	6/30/1983		Day	28.2	--	USGS 1983
1840704	Kalamazoo Creek (Site 1)	4,382,169	710,123	10/26/1983		Day	6.68	--	USGS 1985
1840704	Kalamazoo Creek (Site 1)	4,382,169	710,123	6/13/1984		Day	27.2	--	USGS 1985
1840704	Kalamazoo Creek (Site 1)	4,382,169	710,123	11/7/1984		Day	7.52	--	USGS 1985
1840704	Kalamazoo Creek (Site 1)	4,382,169	710,123	2/5/1985		Day	5.75	--	USGS 1985
1840704	Kalamazoo Creek (Site 1)	4,382,169	710,123	5/24/1985		Day	12.1	--	USGS 1985
1840704	Kalamazoo Creek (Site 1)	4,382,169	710,123	7/12/1991		Day	4.42	--	USGS 1991
1840704	Kalamazoo Creek (Site 1)	4,382,169	710,123	10/22/1991		Day	3.18	--	USGS 1992
1840704	Kalamazoo Creek (Site 1)	4,382,169	710,123	12/3/1991		Day	3.02	--	USGS 1992
1840704	Kalamazoo Creek (Site 1)	4,382,169	710,123	3/16/1992		Day	3.42	--	USGS 1992
1840704	Kalamazoo Creek (Site 1)	4,382,169	710,123	6/24/1992		Day	3.03	--	USGS 1992
1840704	Kalamazoo Creek (Site 1)	4,382,169	710,123	6/23/1993		Day	9.64	Fair	Katzer and Donovan 2003
1840704	Kalamazoo Creek (Site 1)	4,382,169	710,123	7/15/1996	15:00	Day	4.75	Good	SNWA[a]
1840704	Kalamazoo Creek (Site 1)	4,382,169	710,123	7/16/1996	8:02	Day	5.05	Good	SNWA[a]
1840704	Kalamazoo Creek (Site 1)	4,382,169	710,123	7/16/1997	15:38	Day	5.62	Good	SNWA[a]
1840704	Kalamazoo Creek (Site 1)	4,382,169	710,123	7/17/1997	10:11	Day	5.98	Good	SNWA[a]
1840704	Kalamazoo Creek (Site 1)	4,382,169	710,123	7/17/1997	13:10	Day	5.83	Good	SNWA[a]
1840704	Kalamazoo Creek (Site 1)	4,382,169	710,123	7/17/1997	8:10	Day	5.75	Good	SNWA[a]
1840704	Kalamazoo Creek (Site 1)	4,382,169	710,123	7/17/1997	12:05	Day	5.79	Good	SNWA[a]
1840704	Kalamazoo Creek (Site 1)	4,382,169	710,123	7/17/1997	16:09	Day	5.74	Fair	SNWA[a]
1840704	Kalamazoo Creek (Site 1)	4,382,169	710,123	7/18/1997	8:22	Day	6.04	Good	SNWA[a]
1840704	Kalamazoo Creek (Site 1)	4,382,169	710,123	7/12/1998	14:15	Day	9.31	Good	SNWA[a]
1840704	Kalamazoo Creek (Site 1)	4,382,169	710,123	7/14/1998	9:45	Day	9.96	Fair	SNWA[a]
1840704	Kalamazoo Creek (Site 1)	4,382,169	710,123	7/13/1999	14:25	Day	7.26	Good	SNWA[a]

Table B.1-1
Perennial Streamflow Data Listed by Station Number and by Date
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Station No.	Station Name	UTM Northing (m)	UTM Easting (m)	Date of Measurement	Time of Measurement	Date Accuracy	Discharge (cfs)	Measurement Rated	Data Source
1840704	Kalamazoo Creek (Site 1)	4,382,169	710,123	7/24/2000	16:00	Day	3.27	Fair	SNWA[a]
1840704	Kalamazoo Creek (Site 1)	4,382,169	710,123	7/27/2000	8:49	Day	3.51	Fair	SNWA[a]
1840704	Kalamazoo Creek (Site 1)	4,382,169	710,123	8/9/2001	11:40	Day	3.77	Poor	SNWA[a]
1840704	Kalamazoo Creek (Site 1)	4,382,169	710,123	7/16/2002	14:50	Day	3.1	Fair	SNWA[a]
1840704	Kalamazoo Creek (Site 1)	4,382,169	710,123	8/7/2003	12:00	Day	3.35	Fair	SNWA[a]
1840704	Kalamazoo Creek (Site 1)	4,382,169	710,123	7/28/2004	13:10	Day	2.73	Fair	SNWA[a]
1840704	Kalamazoo Creek (Site 1)	4,382,169	710,123	7/27/2005	10:20	Day	10.1	Fair	SNWA[a]
1840705	Dos Tetones Spring Creek abv Kalamazoo Creek	4,382,371	706,665	8/9/2001	10:39	Day	2.62	Fair	SNWA[a]
1840705	Dos Tetones Spring Creek abv Kalamazoo Creek	4,382,371	706,665	8/7/2003	10:20	Day	2.48	Fair	SNWA[a]
1840705	Dos Tetones Spring Creek abv Kalamazoo Creek	4,382,371	706,665	7/28/2005	14:25	Day	0.897	Fair	SNWA[a]
1840801	Piermont Creek above Piermont, NV (Site 2)	4,372,851	707,968	7/14/1999	10:05	Day	3.45	Fair	SNWA[a]
1840801	Piermont Creek above Piermont, NV (Site 2)	4,372,851	707,968	7/14/1999	11:00	Day	3.54	Fair	SNWA[a]
1840801	Piermont Creek above Piermont, NV (Site 2)	4,372,851	707,968	7/14/1999	12:00	Day	3.59	Fair	SNWA[a]
1840801	Piermont Creek above Piermont, NV (Site 2)	4,372,851	707,968	7/14/1999	13:00	Day	3.46	Fair	SNWA[a]
1840801	Piermont Creek above Piermont, NV (Site 2)	4,372,851	707,968	7/14/1999	14:00	Day	3.45	Fair	SNWA[a]
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	7/18/1972		Day	0.91	--	USGS 1972
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	11/1/1972		Day	1.39	--	USGS 1973
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	1/24/1973		Day	1.08	--	USGS 1973
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	4/26/1973		Day	5.69	--	USGS 1973
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	5/21/1973		Day	26	--	USGS 1973
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	7/25/1973		Day	1.5	--	USGS 1973
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	9/18/1973		Day	1.14	--	USGS 1973
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	5/14/1974		Day	6.32	--	USGS 1974
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	6/12/1974		Day	4.23	--	USGS 1974
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	8/20/1974		Day	0.52	--	USGS 1974
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	10/1/1974		Day	0.49	--	USGS 1975
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	1/14/1975		Day	1.78	--	USGS 1975
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	5/19/1975		Day	30.4	--	USGS 1975
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	6/12/1975		Day	22.8	--	USGS 1975
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	9/18/1975		Day	1.48	--	USGS 1975
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	4/21/1976		Day	2.17	--	USGS 1976
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	6/23/1976		Day	2.38	--	USGS 1976
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	8/19/1976		Day	0.79	--	USGS 1976
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	10/13/1976		Day	1.14	--	USGS 1977

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Station No.	Station Name	UTM Northing (m)	UTM Easting (m)	Date of Measurement	Time of Measurement	Date Accuracy	Discharge (cfs)	Measurement Rated	Data Source
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	2/23/1977		Day	1.06	--	USGS 1977
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	4/21/1977		Day	1.95	--	USGS 1977
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	8/24/1977		Day	1.04	--	USGS 1977
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	4/19/1978		Day	4.95	--	USGS 1978
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	5/18/1978		Day	11.2	--	USGS 1978
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	7/24/1978		Day	1.53	--	USGS 1978
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	10/2/1978		Day	1.08	--	USGS 1979
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	2/21/1979		Day	1.06	--	USGS 1979
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	5/22/1979		Day	14.1	--	USGS 1979
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	9/18/1979		Day	0.74	--	USGS 1979
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	1/23/1980		Day	1.05	--	USGS 1980
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	12/8/1982		Day	2.6	--	USGS 1983
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	7/16/1996	15:24	Day	1.09	Fair	SNWA[a]
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	7/14/1998	14:30	Day	5.94	Fair	SNWA[a]
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	7/15/1998	9:25	Day	6.47	Fair	SNWA[a]
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	7/17/1998	14:05	Day	4.96	Fair	SNWA[a]
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	7/14/1999	10:30	Day	2.9	Good	SNWA[a]
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	7/14/1999	9:35	Day	2.91	Good	SNWA[a]
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	7/14/1999	11:28	Day	2.87	Good	SNWA[a]
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	7/14/1999	12:29	Day	2.74	Good	SNWA[a]
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	7/14/1999	13:30	Day	2.83	Good	SNWA[a]
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	7/14/1999	13:55	Day	2.74	Good	SNWA[a]
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	7/14/1999	14:50	Day	2.82	Good	SNWA[a]
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	7/24/2000	12:15	Day	0.92	Good	SNWA[a]
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	7/27/2000	12:00	Day	0.68	Fair	SNWA[a]
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	7/27/2000	12:17	Day	0.73	Fair	SNWA[a]
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	8/8/2001	14:57	Day	0.51	Fair	SNWA[a]
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	8/9/2001	9:20	Day	0.7	Good	SNWA[a]
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	7/16/2002	13:13	Day	1.11	Fair	SNWA[a]
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	8/7/2003	13:42	Day	0.562	Fair	SNWA[a]
1840802	Piermont Creek at Mountain Block at Piermont, NV	4,373,529	710,688	7/28/2004	14:37	Day	0.558	Fair	SNWA[a]
1840901	Garden Creek at Mountain Block	4,370,891	711,705	7/14/1998	12:31	Day	1.12	Fair	SNWA[a]
1840901	Garden Creek at Mountain Block	4,370,891	711,705	7/13/1999	10:10	Day	0.926	Fair	SNWA[a]
1840901	Garden Creek at Mountain Block	4,370,891	711,705	8/7/2001	9:40	Day	0.098	Fair	SNWA[a]

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Station No.	Station Name	UTM Northing (m)	UTM Easting (m)	Date of Measurement	Time of Measurement	Date Accuracy	Discharge (cfs)	Measurement Rated	Data Source
1841001	Bassett Creek (Site 2)	4,367,945	708,774	7/26/2000	12:29	Day	4.38	Fair	SNWA[a]
1841001	Bassett Creek (Site 2)	4,367,945	708,774	7/26/2000	13:30	Day	3.68	Fair	SNWA[a]
1841001	Bassett Creek (Site 2)	4,367,945	708,774	7/26/2000	15:00	Day	3.89	Fair	SNWA[a]
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	7/16/1964		Day	5	--	Rush and Kazmi 1965
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	8/15/1964		Day	3.13	--	USGS 1964
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	9/24/1964		Day	2.48	--	USGS 1968
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	3/21/1968		Day	2.66	--	USGS 1968
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	5/1/1968		Month	8.53	--	USGS 1968
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	6/18/1968		Day	18.8	--	USGS 1968
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	12/4/1968		Day	2.37	--	USGS 1969
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	2/11/1969		Day	2.15	--	USGS 1969
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	4/21/1969		Day	4.08	--	USGS 1969
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	5/21/1969		Day	15.7	--	USGS 1969
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	6/23/1969		Day	13.3	--	USGS 1969
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	7/23/1969		Day	4.53	--	USGS 1969
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	9/23/1969		Day	2.61	--	USGS 1969
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	11/23/1969		Day	2.48	--	USGS 1970
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	3/10/1970		Day	2.14	--	USGS 1970
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	5/26/1970		Day	18.6	--	USGS 1970
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	6/24/1970		Day	16.3	--	USGS 1970
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	9/22/1970		Day	2.75	--	USGS 1971
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	11/19/1970		Day	2.62	--	USGS 1971
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	1/27/1971		Day	2.32	--	USGS 1971
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	4/21/1971		Day	6.11	--	USGS 1971
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	5/21/1971		Day	12.2	--	USGS 1971
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	6/22/1971		Day	22	--	USGS 1971
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	7/27/1971		Day	5.62	--	USGS 1971
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	9/26/1971		Day	2.66	--	USGS 1971
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	11/16/1971		Day	3.54	--	USGS 1972
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	2/22/1972		Day	2.15	--	USGS 1972
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	3/21/1972		Day	3.5	--	USGS 1972
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	5/2/1972		Day	4.47	--	USGS 1972
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	7/18/1972		Day	3.1	--	USGS 1972
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	10/31/1972		Day	2.48	--	USGS 1973

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Station No.	Station Name	UTM Northing (m)	UTM Easting (m)	Date of Measurement	Time of Measurement	Date Accuracy	Discharge (cfs)	Measurement Rated	Data Source
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	1/24/1973		Day	1.95	--	USGS 1973
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	4/26/1973		Day	4.09	--	USGS 1973
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	9/18/1973		Day	4.27	--	USGS 1973
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	10/30/1973		Day	4.51	--	USGS 1974
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	1/30/1974		Day	2.19	--	USGS 1974
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	3/18/1974		Day	2.83	--	USGS 1974
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	5/14/1974		Day	10.9	--	USGS 1974
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	6/12/1974		Day	9.83	--	USGS 1974
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	8/20/1974		Day	2.94	--	USGS 1974
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	10/1/1974		Day	2.24	--	USGS 1975
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	1/14/1975		Day	1.68	--	USGS 1975
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	5/19/1975		Day	20.2	--	USGS 1975
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	6/12/1975		Day	26.5	--	USGS 1975
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	9/18/1975		Day	2.69	--	USGS 1975
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	4/21/1976		Day	2.61	--	USGS 1976
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	6/23/1976		Day	6.69	--	USGS 1976
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	8/19/1976		Day	2.56	--	USGS 1976
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	10/13/1976		Day	2.61	--	USGS 1977
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	2/23/1977		Day	2.14	--	USGS 1977
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	4/21/1977		Day	2.86	--	USGS 1977
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	8/24/1977		Day	2.46	--	USGS 1977
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	4/19/1978		Day	4.4	--	USGS 1978
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	5/18/1978		Day	15.7	--	USGS 1978
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	7/24/1978		Day	4.97	--	USGS 1978
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	10/2/1978		Day	3.32	--	USGS 1979
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	2/21/1979		Day	1.88	--	USGS 1979
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	5/22/1979		Day	18.7	--	USGS 1979
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	9/18/1979		Day	3.61	--	USGS 1979
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	1/22/1980		Day	3.1	--	USGS 1980
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	7/16/1991		Day	4.65	--	USGS 1991
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	10/22/1991		Day	2.15	--	USGS 1992
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	12/3/1991		Day	2.54	--	USGS 1992
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	3/16/1992		Day	1.72	--	USGS 1992
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	6/24/1992		Day	1.99	--	USGS 1992

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Station No.	Station Name	UTM Northing (m)	UTM Easting (m)	Date of Measurement	Time of Measurement	Date Accuracy	Discharge (cfs)	Measurement Rated	Data Source
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	6/23/1993		Day	9.31	Fair	Katzer and Donovan 2003
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	7/18/1996	8:20	Day	5.26	Good	SNWA[a]
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	7/17/1998	15:55	Day	11.5	Fair	SNWA[a]
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	7/13/1999	13:20	Day	5.96	Fair	SNWA[a]
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	7/24/2000	9:35	Day	4.13	Fair	SNWA[a]
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	7/26/2000	9:15	Day	4.34	Fair	SNWA[a]
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	7/26/2000	14:00	Day	3.49	Fair	SNWA[a]
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	7/26/2000	12:55	Day	3.58	Fair	SNWA[a]
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	7/26/2000	12:00	Day	3.28	Fair	SNWA[a]
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	7/26/2000	10:00	Day	3.54	Fair	SNWA[a]
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	7/26/2000	11:00	Day	4.51	Fair	SNWA[a]
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	8/8/2001	13:40	Day	1.93	Fair	SNWA[a]
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	8/9/2001	10:20	Day	2.09	Fair	SNWA[a]
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	7/16/2002	12:06	Day	2.6	Good	SNWA[a]
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	8/7/2003	15:21	Day	2.76	Fair	SNWA[a]
1841002	Bassett Creek at Mountain Block	4,368,358	711,490	7/28/2004	14:29	Day	3.07	Good	SNWA[a]
1841101	Little Negro Creek abv Diversion nr Bassett Ranch	4,366,360	712,626	7/17/1996	13:10	Day	0.94	Fair	SNWA[a]
1841101	Little Negro Creek abv Diversion nr Bassett Ranch	4,366,360	712,626	7/15/1998	15:40	Day	2.48	Fair	SNWA[a]
1841101	Little Negro Creek abv Diversion nr Bassett Ranch	4,366,360	712,626	7/17/1998	14:39	Day	1.8	Fair	SNWA[a]
1841101	Little Negro Creek abv Diversion nr Bassett Ranch	4,366,360	712,626	7/13/1999	12:25	Day	1.26	Good	SNWA[a]
1841101	Little Negro Creek abv Diversion nr Bassett Ranch	4,366,360	712,626	7/24/2000	14:28	Day	0.45	Fair	SNWA[a]
1841101	Little Negro Creek abv Diversion nr Bassett Ranch	4,366,360	712,626	7/27/2000	10:52	Day	0.48	Fair	SNWA[a]
1841101	Little Negro Creek abv Diversion nr Bassett Ranch	4,366,360	712,626	8/8/2001	12:15	Day	0.44	Fair	SNWA[a]
1841101	Little Negro Creek abv Diversion nr Bassett Ranch	4,366,360	712,626	8/7/2003	16:03	Day	0.28	Fair	SNWA[a]
1841101	Little Negro Creek abv Diversion nr Bassett Ranch	4,366,360	712,626	7/29/2004	15:28	Day	0.315	Fair	SNWA[a]
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	11/7/1972		Day	1.4	--	USGS 1973
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	1/24/1973		Day	1.01	--	USGS 1973
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	4/26/1973		Day	2.33	--	USGS 1973
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	5/21/1973		Day	10.9	--	USGS 1973
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	7/25/1973		Day	2.26	--	USGS 1973
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	9/18/1973		Day	2.12	--	USGS 1973
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	10/30/1973		Day	1.7	--	USGS 1974
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	12/11/1973		Day	1.2	--	USGS 1974
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	1/30/1974		Day	1	--	USGS 1974

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Station No.	Station Name	UTM Northing (m)	UTM Easting (m)	Date of Measurement	Time of Measurement	Date Accuracy	Discharge (cfs)	Measurement Rated	Data Source
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	3/18/1974		Day	1.57	--	USGS 1974
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	5/14/1974		Day	2.27	--	USGS 1974
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	6/12/1974		Day	5.48	--	USGS 1974
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	8/20/1974		Day	1.46	--	USGS 1974
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	10/1/1974		Day	0.76	--	USGS 1975
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	1/14/1975		Day	1.19	--	USGS 1975
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	5/19/1975		Day	5.16	--	USGS 1975
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	6/12/1975		Day	16.8	--	USGS 1975
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	9/18/1975		Day	1.75	--	USGS 1975
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	4/21/1976		Day	1.02	--	USGS 1976
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	6/23/1976		Day	2.07	--	USGS 1976
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	8/19/1976		Day	1.94	--	USGS 1976
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	10/13/1976		Day	0.95	--	USGS 1977
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	2/23/1977		Day	1.31	--	USGS 1977
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	4/21/1977		Day	1.03	--	USGS 1977
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	8/24/1977		Day	1.49	--	USGS 1977
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	4/19/1978		Day	1.98	--	USGS 1978
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	5/18/1978		Day	5.35	--	USGS 1978
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	7/24/1978		Day	2.77	--	USGS 1978
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	10/2/1978		Day	1.34	--	USGS 1979
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	2/21/1979		Day	1.24	--	USGS 1979
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	5/22/1979		Day	5.24	--	USGS 1979
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	9/18/1979		Day	0.7	--	USGS 1979
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	1/23/1980		Day	0.67	--	USGS 1980
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	7/16/1991		Day	2.51	--	USGS 1991
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	10/23/1991		Day	1.24	--	USGS 1992
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	12/3/1991		Day	0.98	--	USGS 1992
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	3/17/1992		Day	1.06	--	USGS 1992
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	6/24/1992		Day	1.41	--	USGS 1992
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	6/24/1993		Day	6.93	Fair	Katzer and Donovan 2003
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	7/18/1996	10:17	Day	2.18	Fair	SNWA[a]
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	7/15/1998	13:55	Day	6.39	Fair	SNWA[a]
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	7/17/1998	12:45	Day	6.34	Fair	SNWA[a]
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	7/15/1999	10:42	Day	4.35	Good	SNWA[a]

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Station No.	Station Name	UTM Northing (m)	UTM Easting (m)	Date of Measurement	Time of Measurement	Date Accuracy	Discharge (cfs)	Measurement Rated	Data Source
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	7/24/2000	13:06	Day	2	Fair	SNWA[a]
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	8/7/2001	11:19	Day	1.34	Fair	SNWA[a]
1841201	Odgers Creek at Mountain Block	4,364,327	712,611	7/29/2004		Day	1.25	Fair	SNWA[a]
1841301	Mc Coy Creek (Site 2)	4,360,977	709,945	7/15/1999	11:00	Day	6.62	Fair	SNWA[a]
1841301	Mc Coy Creek (Site 2)	4,360,977	709,945	7/15/1999	13:20	Day	6.4	Fair	SNWA[a]
1841301	Mc Coy Creek (Site 2)	4,360,977	709,945	7/15/1999	10:05	Day	6.85	Fair	SNWA[a]
1841301	Mc Coy Creek (Site 2)	4,360,977	709,945	7/15/1999	14:15	Day	6.46	Fair	SNWA[a]
1841302	Mc Coy Creek at Mountain Block	4,361,152	712,804	7/14/1964		Day	9.52	--	USGS 1964
1841302	Mc Coy Creek at Mountain Block	4,361,152	712,804	8/15/1964		Day	5.95	--	USGS 1964
1841302	Mc Coy Creek at Mountain Block	4,361,152	712,804	6/1/1980		Month	18.9	--	ERTEC 1981
1841302	Mc Coy Creek at Mountain Block	4,361,152	712,804	7/16/1991		Day	7.58	--	USGS 1991
1841302	Mc Coy Creek at Mountain Block	4,361,152	712,804	10/22/1991		Day	3.49	--	USGS 1992
1841302	Mc Coy Creek at Mountain Block	4,361,152	712,804	12/3/1991		Day	2.89	--	USGS 1992
1841302	Mc Coy Creek at Mountain Block	4,361,152	712,804	3/17/1992		Day	2.78	--	USGS 1992
1841302	Mc Coy Creek at Mountain Block	4,361,152	712,804	6/24/1992		Day	3.63	--	USGS 1992
1841302	Mc Coy Creek at Mountain Block	4,361,152	712,804	5/18/1993	10:40	Day	40.5	Fair	SNWA[a]
1841302	Mc Coy Creek at Mountain Block	4,361,152	712,804	7/17/1996	14:34	Day	5.82	Fair	SNWA[a]
1841302	Mc Coy Creek at Mountain Block	4,361,152	712,804	7/15/1998	12:25	Day	15.45	Fair	SNWA[a]
1841302	Mc Coy Creek at Mountain Block	4,361,152	712,804	7/15/1998	15:20	Day	14.9	Fair	SNWA[a]
1841302	Mc Coy Creek at Mountain Block	4,361,152	712,804	7/17/1998	10:55	Day	10.8	Good	SNWA[a]
1841302	Mc Coy Creek at Mountain Block	4,361,152	712,804	7/15/1999	12:31	Day	8.46	Good	SNWA[a]
1841302	Mc Coy Creek at Mountain Block	4,361,152	712,804	7/15/1999	13:30	Day	7.98	Good	SNWA[a]
1841302	Mc Coy Creek at Mountain Block	4,361,152	712,804	7/15/1999	9:05	Day	8.61	Good	SNWA[a]
1841302	Mc Coy Creek at Mountain Block	4,361,152	712,804	7/15/1999	10:35	Day	8.51	Good	SNWA[a]
1841302	Mc Coy Creek at Mountain Block	4,361,152	712,804	7/15/1999	11:30	Day	8.7	Good	SNWA[a]
1841302	Mc Coy Creek at Mountain Block	4,361,152	712,804	7/15/1999	9:46	Day	8.33	Good	SNWA[a]
1841302	Mc Coy Creek at Mountain Block	4,361,152	712,804	7/24/2000	10:35	Day	4.31	Fair	SNWA[a]
1841302	Mc Coy Creek at Mountain Block	4,361,152	712,804	7/27/2000	9:42	Day	3.54	Fair	SNWA[a]
1841302	Mc Coy Creek at Mountain Block	4,361,152	712,804	8/8/2001	11:08	Day	4.38	Fair	SNWA[a]
1841302	Mc Coy Creek at Mountain Block	4,361,152	712,804	8/9/2001	11:31	Day	3.88	Fair	SNWA[a]
1841302	Mc Coy Creek at Mountain Block	4,361,152	712,804	7/16/2002	10:33	Day	4.55	Fair	SNWA[a]
1841302	Mc Coy Creek at Mountain Block	4,361,152	712,804	8/7/2003	13:53	Day	3.38	Fair	SNWA[a]
1841302	Mc Coy Creek at Mountain Block	4,361,152	712,804	7/28/2004	12:20	Day	3.77	Fair	SNWA[a]
1841302	Mc Coy Creek at Mountain Block	4,361,152	712,804	7/27/2005	16:35	Day	13.3	Fair	SNWA[a]

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Station No.	Station Name	UTM Northing (m)	UTM Easting (m)	Date of Measurement	Time of Measurement	Date Accuracy	Discharge (cfs)	Measurement Rated	Data Source
1841401	Taft Creek at Diversion	4,357,514	712,906	6/1/1980		Month	12.9	--	ERTEC 1981
1841401	Taft Creek at Diversion	4,357,514	712,906	7/16/1991		Day	2.51	--	USGS 1991
1841401	Taft Creek at Diversion	4,357,514	712,906	10/23/1991		Day	0.71	--	USGS 1992
1841401	Taft Creek at Diversion	4,357,514	712,906	12/4/1991		Day	0.77	--	USGS 1992
1841401	Taft Creek at Diversion	4,357,514	712,906	3/17/1992		Day	0.37	--	USGS 1992
1841401	Taft Creek at Diversion	4,357,514	712,906	6/24/1992		Day	1.22	--	USGS 1992
1841401	Taft Creek at Diversion	4,357,514	712,906	7/18/1996	12:30	Day	2.08	Fair	SNWA[a]
1841401	Taft Creek at Diversion	4,357,514	712,906	7/15/1998		Day	10.7	Fair	SNWA[a]
1841401	Taft Creek at Diversion	4,357,514	712,906	7/16/1998	16:17	Day	8.43	Fair	SNWA[a]
1841401	Taft Creek at Diversion	4,357,514	712,906	7/13/1999	14:32	Day	4.32	Good	SNWA[a]
1841401	Taft Creek at Diversion	4,357,514	712,906	7/24/2000	8:45	Day	1.24	Fair	SNWA[a]
1841401	Taft Creek at Diversion	4,357,514	712,906	7/27/2000	10:12	Day	1.27	Fair	SNWA[a]
1841401	Taft Creek at Diversion	4,357,514	712,906	8/7/2001		Day	1.21	Fair	SNWA[a]
1841402	Taft Creek below South Taft Creek	4,356,856	714,714	7/14/1964		Day	3	--	Rush and Kazmi 1965
1841402	Taft Creek below South Taft Creek	4,356,856	714,714	9/18/1964		Day	2	--	Rush and Kazmi 1965
1841501	Stephens Creek at Mountain Block	4,351,483	714,780	7/25/2000	13:13	Day	0.69	Fair	SNWA[a]
1841501	Stephens Creek at Mountain Block	4,351,483	714,780	7/27/2000	11:30	Day	0.76	Good	SNWA[a]
1841601	Cleve Creek below Pete Spring	4,348,685	706,197	8/24/1982		Day	1.33	--	USGS 1987
1841602	Cleve Creek 3,000 ft below Pete Spring	4,347,828	706,460	8/24/1982		Day	1.13	--	USGS 1987
1841603	Cleve Creek 4,500 ft below Pete Spring	4,347,398	706,543	8/24/1982		Day	1.33	--	USGS 1987
1841604	Cleve Creek above Kolcheck basin tributary	4,347,016	706,788	8/24/1982		Day	0.96	--	USGS 1987
1841605	Cleve Creek below Kolcheck basin tributary	4,346,670	707,186	8/24/1982		Day	0.17	--	USGS 1987
1841606	Cleve Creek North Fork at mouth (USGS)	4,344,771	709,852	8/24/1982		Day	8.89	--	USGS 1987
1841606	Cleve Creek North Fork at mouth (USGS)	4,344,771	709,852	10/6/1987		Day	5.97	--	USGS 1987
1841607	Cleve Creek (Site 4)	4,344,757	709,808	5/17/1993		Day	38.1	Fair	SNWA[a]
1841607	Cleve Creek (Site 4)	4,344,757	709,808	5/17/1993		Day	37.9	Fair	SNWA[a]
1841607	Cleve Creek (Site 4)	4,344,757	709,808	7/14/1997	14:35	Day	8.55	Fair	SNWA[a]
1841607	Cleve Creek (Site 4)	4,344,757	709,808	7/14/1997	15:25	Day	8.64	Fair	SNWA[a]
1841607	Cleve Creek (Site 4)	4,344,757	709,808	7/14/1997	13:42	Day	8.81	Fair	SNWA[a]
1841607	Cleve Creek (Site 4)	4,344,757	709,808	7/14/1997	12:50	Day	8.79	Fair	SNWA[a]
1841607	Cleve Creek (Site 4)	4,344,757	709,808	7/14/1997	11:25	Day	9.09	Fair	SNWA[a]
1841607	Cleve Creek (Site 4)	4,344,757	709,808	7/14/1997	10:32	Day	9.28	Fair	SNWA[a]
1841607	Cleve Creek (Site 4)	4,344,757	709,808	7/15/1997	15:02	Day	8.48	Good	SNWA[a]
1841607	Cleve Creek (Site 4)	4,344,757	709,808	7/15/1997	10:52	Day	8.35	Fair	SNWA[a]

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Station No.	Station Name	UTM Northing (m)	UTM Easting (m)	Date of Measurement	Time of Measurement	Date Accuracy	Discharge (cfs)	Measurement Rated	Data Source
1841607	Cleve Creek (Site 4)	4,344,757	709,808	7/15/1997	8:36	Day	8.35	Fair	SNWA[a]
1841607	Cleve Creek (Site 4)	4,344,757	709,808	7/16/1997	6:15	Day	8.26	Fair	SNWA[a]
1841607	Cleve Creek (Site 4)	4,344,757	709,808	7/12/1998	12:20	Day	21.4	Fair	SNWA[a]
1841607	Cleve Creek (Site 4)	4,344,757	709,808	7/27/2000	11:20	Day	7.74	Fair	SNWA[a]
1841608	Cleve Creek (Site 3)	4,344,375	710,248	5/17/1993		Day	34.8	Fair	SNWA[a]
1841608	Cleve Creek (Site 3)	4,344,375	710,248	7/15/1997	10:40	Day	6.41	Good	SNWA[a]
1841608	Cleve Creek (Site 3)	4,344,375	710,248	7/15/1997	13:54	Day	8	Fair	SNWA[a]
1841608	Cleve Creek (Site 3)	4,344,375	710,248	7/15/1997	15:49	Day	6.79	Fair	SNWA[a]
1841608	Cleve Creek (Site 3)	4,344,375	710,248	7/16/1997	6:52	Day	8.16	Fair	SNWA[a]
1841609	Cleve Creek (Site 2)	4,344,036	710,613	5/17/1993		Day	40.4	Fair	SNWA[a]
1841609	Cleve Creek (Site 2)	4,344,036	710,613	7/15/1997	8:58	Day	9.06	Good	SNWA[a]
1841609	Cleve Creek (Site 2)	4,344,036	710,613	7/15/1997	13:11	Day	8.52	Good	SNWA[a]
1841609	Cleve Creek (Site 2)	4,344,036	710,613	7/15/1997	15:00	Day	7.97	Fair	SNWA[a]
1841609	Cleve Creek (Site 2)	4,344,036	710,613	7/16/1997	7:27	Day	8.62	Fair	SNWA[a]
1841610	Cleve Creek at Campground	4,343,870	710,765	8/24/1982		Day	8.97	--	USGS 1987
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	10/20/1959		Day	4.74	--	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	11/10/1959		Day	4.6	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	12/8/1959		Day	1.85	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	1/15/1960		Day	4.49	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	2/17/1960		Day	9.17	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	3/15/1960		Day	4.96	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	3/30/1960		Day	6.06	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	4/7/1960		Day	5.94	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	4/26/1960		Day	6.79	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	5/12/1960		Day	10	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	5/19/1960		Day	11.2	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	6/2/1960		Day	6.91	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	6/15/1960		Day	6.21	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/7/1960		Day	5.55	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	8/1/1960		Day	4.74	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	8/29/1960		Day	3.52	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	9/29/1960		Day	3.64	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	10/13/1960		Day	5.12	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	11/9/1960		Day	5.25	Good	NWIS Feb 2006

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Station No.	Station Name	UTM Northing (m)	UTM Easting (m)	Date of Measurement	Time of Measurement	Date Accuracy	Discharge (cfs)	Measurement Rated	Data Source
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	12/14/1960		Day	5.34	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	1/11/1961		Day	5.46	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	2/10/1961		Day	4.42	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	3/8/1961		Day	5.38	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	4/5/1961		Day	6.98	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	5/3/1961		Day	8.96	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	5/24/1961		Day	11.7	--	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	5/30/1961		Day	15.1	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	6/9/1961		Day	9.58	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	6/27/1961		Day	6.22	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/20/1961		Day	4.44	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	8/8/1961		Day	5.74	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	8/24/1961		Day	59.4	--	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	8/31/1961		Day	4.47	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	8/31/1961		Day	4.05	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	9/26/1961		Day	4.78	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	10/25/1961		Day	4.7	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	11/27/1961		Day	4.61	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	12/19/1961		Day	4.96	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	1/24/1962		Day	5.16	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	2/26/1962		Day	3.41	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	3/26/1962		Day	6.54	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	4/23/1962		Day	26.7	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	5/9/1962		Day	26.3	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	5/28/1962		Day	12.6	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	6/20/1962		Day	14.7	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/13/1962		Day	8.88	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	8/28/1962		Day	5.55	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	9/21/1962		Day	5.23	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	10/10/1962		Day	5.41	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	11/14/1962		Day	6.26	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	12/11/1962		Day	5.27	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	1/7/1963		Day	5.35	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	2/18/1963		Day	6.34	Good	NWIS Feb 2006

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Perennial Streamflow Data Listed by Station Number and by Date
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Station No.	Station Name	UTM Northing (m)	UTM Easting (m)	Date of Measurement	Time of Measurement	Date Accuracy	Discharge (cfs)	Measurement Rated	Data Source
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	3/11/1963		Day	7.42	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	4/8/1963		Day	5.97	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	5/6/1963		Day	14.2	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	6/10/1963		Day	51.5	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/9/1963		Day	10.4	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	8/13/1963		Day	6.57	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	9/9/1963		Day	6.09	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	10/7/1963		Day	6.2	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	11/13/1963		Day	6.26	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	12/17/1963		Day	6.25	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	1/17/1964		Day	7.59	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	2/13/1964		Day	6.84	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	3/17/1964		Day	6.42	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	4/16/1964		Day	8.25	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	5/14/1964		Day	21.5	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	5/14/1964		Day	21	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	6/8/1964		Day	19.1	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/10/1964		Day	8.88	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	8/20/1964		Day	7.26	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	9/9/1964		Day	6.64	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	10/20/1964		Day	5.54	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	11/13/1964		Day	6.33	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	12/7/1964		Day	6.49	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	1/26/1965		Day	7.39	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	2/23/1965		Day	6.94	--	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	3/22/1965		Day	6.06	--	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	4/26/1965		Day	14.2	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	5/20/1965		Day	29.3	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	6/21/1965		Day	14.9	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/20/1965		Day	9.33	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	8/24/1965		Day	7.36	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	9/28/1965		Day	8.39	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	10/21/1965		Day	7	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	11/23/1965		Day	8.06	Good	NWIS Feb 2006

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Perennial Streamflow Data Listed by Station Number and by Date
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Station No.	Station Name	UTM Northing (m)	UTM Easting (m)	Date of Measurement	Time of Measurement	Date Accuracy	Discharge (cfs)	Measurement Rated	Data Source
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	12/21/1965		Day	7.57	--	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	1/20/1966		Day	5.03	--	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	2/23/1966		Day	7.15	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	3/23/1966		Day	6.77	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	4/27/1966		Day	11.4	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	5/26/1966		Day	10	--	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	6/21/1966		Day	6.92	--	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/19/1966		Day	5.44	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	8/23/1966		Day	5.07	--	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	9/24/1966		Day	5.4	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	10/19/1966		Day	4.93	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	11/16/1966		Day	5.6	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	12/19/1966		Day	5.6	--	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	1/25/1967		Day	7.98	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	2/22/1967		Day	5.6	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	3/21/1967		Day	6.29	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	4/18/1967		Day	6.13	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	5/24/1967		Day	47.4	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	6/21/1967		Day	53.1	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/20/1967		Day	13.2	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	8/22/1967		Day	9.25	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	9/19/1967		Day	8.32	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	6/1/1968		Month	37	--	USGS 1968
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	5/1/1969		Month	90	--	USGS 1969
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	8/1/1970		Month	100	--	USGS 1971
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/17/1971		Day	42	--	USGS 1971
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	1/1/1972		Year	11	--	USGS 1972
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	1/19/1973		Day	80	--	USGS 1973
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	1/30/1974		Day	70	--	USGS 1974
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	6/1/1975		Month	70	--	USGS 1975
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	5/1/1976		Month	30	--	USGS 1976
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	10/14/1976	9:40	Day	7.43	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	12/22/1976	13:10	Day	11.7	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	1/19/1977	9:30	Day	5.2	Good	NWIS Feb 2006

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Station No.	Station Name	UTM Northing (m)	UTM Easting (m)	Date of Measurement	Time of Measurement	Date Accuracy	Discharge (cfs)	Measurement Rated	Data Source
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	2/23/1977	14:15	Day	8.61	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	3/24/1977	7:20	Day	5.33	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	4/21/1977	13:30	Day	6.59	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	5/18/1977	8:30	Day	6.74	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	6/23/1977	11:00	Day	8.94	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/20/1977	13:55	Day	5.8	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	8/24/1977	13:30	Day	7.31	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	9/21/1977	8:35	Day	5.63	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	10/19/1977	10:15	Day	5.94	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	12/19/1977	14:25	Day	8	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	1/19/1978	14:20	Day	5.73	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	2/28/1978	10:40	Day	6.04	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	4/19/1978	14:10	Day	15.4	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	4/19/1978	14:40	Day	15.8	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	5/18/1978	15:05	Day	42.8	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	6/21/1978	16:10	Day	28.1	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/24/1978	15:50	Day	8.94	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	8/23/1978	12:45	Day	8.34	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	10/2/1978		Day	6.37	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	11/20/1978	14:50	Day	8.05	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	12/27/1978	16:15	Day	7.34	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	1/29/1979		Day	9.64	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	3/21/1979	9:35	Day	8.63	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	4/24/1979		Day	21	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	5/22/1979	13:20	Day	40.3	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	6/20/1979	13:55	Day	13.8	--	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/25/1979	9:07	Day	7.6	Poor	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/25/1979		Day	8.59	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	8/21/1979	9:50	Day	7.87	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	9/18/1979	12:35	Day	6.81	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	10/24/1979	10:00	Day	7.53	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	11/28/1979	8:50	Day	6.05	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	12/19/1979	13:10	Day	7.17	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	1/23/1980	12:35	Day	8.49	Fair	NWIS Feb 2006

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Station No.	Station Name	UTM Northing (m)	UTM Easting (m)	Date of Measurement	Time of Measurement	Date Accuracy	Discharge (cfs)	Measurement Rated	Data Source
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	2/21/1980	11:25	Day	9.64	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	3/19/1980	16:15	Day	8.34	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	4/24/1980	14:15	Day	16.5	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	5/21/1980	10:55	Day	46.7	--	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	6/25/1980	12:00	Day	26.6	--	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	6/25/1980	13:50	Day	26.9	--	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/23/1980	11:05	Day	15.1	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	8/18/1980	17:20	Day	8.78	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	9/16/1980	9:45	Day	10.9	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	10/21/1980	11:00	Day	9.4	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	11/20/1980	10:50	Day	9.11	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	12/17/1980	8:00	Day	7.33	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	1/20/1981	15:00	Day	7.06	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	3/18/1981	16:40	Day	6.4	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	4/22/1981	9:00	Day	9.8	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	5/13/1981	9:35	Day	14.3	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	6/17/1981	9:00	Day	11.4	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/22/1981	14:30	Day	6.62	--	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	8/19/1981	14:25	Day	6.79	--	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	9/22/1981	15:15	Day	6.37	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	10/20/1981	9:55	Day	7.39	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	4/7/1982		Day	7.09	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	12/8/1982	9:45	Day	12	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	1/20/1983	12:30	Day	9.97	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	3/22/1983	15:15	Day	13.8	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	4/26/1983	12:15	Day	33.3	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	5/18/1983	16:25	Day	40.8	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	5/30/1983		Day	440	--	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	6/28/1983	16:00	Day	53.3	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/7/1983	16:00	Day	37.2	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	8/4/1983	8:30	Day	23.6	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	9/13/1983	11:04	Day	15.8	Poor	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	10/25/1983	14:25	Day	15.3	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	12/6/1983	14:15	Day	12.9	Fair	NWIS Feb 2006

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Perennial Streamflow Data Listed by Station Number and by Date
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Station No.	Station Name	UTM Northing (m)	UTM Easting (m)	Date of Measurement	Time of Measurement	Date Accuracy	Discharge (cfs)	Measurement Rated	Data Source
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	1/17/1984	14:15	Day	13.6	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	3/6/1984	15:20	Day	13.5	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	4/11/1984	15:00	Day	21.2	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	5/16/1984	15:10	Day	85.8	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	5/22/1984	13:05	Day	89.4	Poor	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	5/30/1984	13:40	Day	61.2	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	6/26/1984	16:00	Day	23.8	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/31/1984	13:30	Day	19.5	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	9/18/1984	15:20	Day	15.8	Poor	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	11/7/1984	9:48	Day	13.9	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	12/13/1984	14:55	Day	13.5	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	2/5/1985	8:35	Day	11	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	3/23/1985	8:02	Day	12.8	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	4/18/1985	15:10	Day	27	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	5/24/1985	11:23	Day	17.7	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/27/1985	12:30	Day	11.3	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	10/4/1985	10:30	Day	8.18	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	12/14/1985	13:25	Day	9.63	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	1/26/1986	12:55	Day	8.79	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	3/19/1986	17:30	Day	13.4	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	5/20/1986	16:33	Day	30.7	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/16/1986	12:39	Day	11.9	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	9/3/1986	16:00	Day	8.83	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	10/21/1986	16:30	Day	11.1	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	11/19/1986	15:20	Day	9.59	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	1/14/1987	11:30	Day	7.06	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	2/12/1987	11:40	Day	7.94	Poor	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	3/24/1987	16:30	Day	9.1	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	5/28/1987	13:20	Day	15.5	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/22/1987	16:35	Day	13.5	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	8/19/1987	15:00	Day	7.74	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	10/6/1987	12:40	Day	6.24	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	12/8/1987		Day	7.3	--	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	1/20/1988	9:30	Day	5.45	Fair	NWIS Feb 2006

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Station No.	Station Name	UTM Northing (m)	UTM Easting (m)	Date of Measurement	Time of Measurement	Date Accuracy	Discharge (cfs)	Measurement Rated	Data Source
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	2/25/1988	11:10	Day	6.92	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	5/18/1988	15:00	Day	28	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	8/18/1988	14:05	Day	6.92	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	4/17/1990	9:24	Day	6.32	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	6/5/1990	13:45	Day	8.47	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/24/1990	14:42	Day	4.82	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	8/29/1990	11:07	Day	4.74	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	10/16/1990	11:36	Day	4.82	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	11/27/1990	12:40	Day	5.97	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	1/8/1991	13:27	Day	5.34	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	2/26/1991	12:33	Day	4.59	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	4/2/1991	15:05	Day	4.72	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	5/3/1991	7:58	Day	5.1	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	6/4/1991	11:30	Day	33.7	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	8/2/1991	15:25	Day	6.08	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	9/18/1991	11:20	Day	5.59	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	10/22/1991	9:48	Day	5.33	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	12/5/1991	12:48	Day	5.52	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	1/14/1992	10:00	Day	5.84	Poor	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	2/25/1992	9:58	Day	5.27	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	4/7/1992	8:35	Day	7.3	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	5/19/1992	9:35	Day	8.06	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	6/30/1992	15:00	Day	4.73	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	8/11/1992	8:56	Day	4.49	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	10/6/1992	10:25	Day	4.68	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	11/18/1992	10:08	Day	4.27	--	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	4/7/1993	11:11	Day	9.52	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	5/17/1993	8:00	Day	37.7	Fair	SNWA[a]
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	5/25/1993	8:17	Day	37.5	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	6/3/1993	12:50	Day	22.5	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	6/22/1993	10:17	Day	14.7	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	8/31/1993	13:08	Day	7.01	Poor	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	9/22/1993	11:22	Day	6.63	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	11/17/1993	14:04	Day	6.13	Fair	NWIS Feb 2006

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Station No.	Station Name	UTM Northing (m)	UTM Easting (m)	Date of Measurement	Time of Measurement	Date Accuracy	Discharge (cfs)	Measurement Rated	Data Source
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	12/22/1993	8:23	Day	3.63	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	2/16/1994	12:25	Day	5.45	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	3/23/1994	15:05	Day	6.55	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	5/3/1994	13:09	Day	8.49	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	6/14/1994	16:45	Day	7.27	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	8/3/1994	13:19	Day	5.32	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	9/9/1994	9:02	Day	5.19	Poor	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	10/18/1994	12:59	Day	5.65	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	11/29/1994	11:36	Day	8.55	Poor	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	1/19/1995	13:38	Day	7.73	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	2/21/1995	14:25	Day	7.6	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	3/28/1995	8:41	Day	7.98	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	5/16/1995	13:40	Day	23.1	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	6/28/1995	12:18	Day	61.3	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/19/1995	8:25	Day	21.5	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	8/30/1995	13:47	Day	10.2	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	10/31/1995	13:55	Day	7.66	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	12/14/1995	13:33	Day	8.03	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	2/14/1996	9:05	Day	7.01	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	3/20/1996	13:47	Day	10.6	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	5/23/1996	13:39	Day	14.5	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	6/29/1996	11:26	Day	8.8	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/18/1996	14:37	Day	8.65	Fair	SNWA[a]
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	8/8/1996	12:58	Day	6.68	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	9/17/1996	14:54	Day	7.45	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	10/22/1996	13:33	Day	6.35	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	12/12/1996	8:21	Day	7.71	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	2/5/1997	11:20	Day	6.91	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	3/11/1997	14:15	Day	7.24	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	4/22/1997	15:10	Day	12.3	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	6/5/1997	11:10	Day	16.2	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/14/1997	13:30	Day	8.27	Good	SNWA[a]
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/14/1997	11:20	Day	7.11	Fair	SNWA[a]
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/14/1997	15:05	Day	7.61	Good	SNWA[a]

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Station No.	Station Name	UTM Northing (m)	UTM Easting (m)	Date of Measurement	Time of Measurement	Date Accuracy	Discharge (cfs)	Measurement Rated	Data Source
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/14/1997	16:30	Day	7.43	Fair	SNWA[a]
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/15/1997	9:48	Day	8.98	Good	SNWA[a]
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/15/1997	13:43	Day	7.41	Fair	SNWA[a]
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/15/1997	16:05	Day	7.74	Good	SNWA[a]
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/15/1997	15:00	Day	8.3	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/16/1997	6:00	Day	6.48	Fair	SNWA[a]
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	8/27/1997	10:05	Day	8.42	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	10/8/1997	13:30	Day	8.42	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	11/18/1997	10:45	Day	7.93	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	1/6/1998	9:32	Day	4.56	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	3/10/1998	13:45	Day	7.6	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	4/15/1998	12:55	Day	10.8	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	5/5/1998	11:05	Day	33.8	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/12/1998	10:35	Day	19.8	Good	SNWA[a]
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/14/1998	14:18	Day	17.5	Fair	SNWA[a]
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/15/1998	13:00	Day	19.9	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/17/1998	10:10	Day	18	Good	SNWA[a]
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	9/3/1998	12:10	Day	11.6	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	10/22/1998	12:00	Day	10.2	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	12/17/1998	13:16	Day	8.41	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	2/9/1999	12:55	Day	9.91	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	3/22/1999	11:35	Day	8.3	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	4/26/1999	11:40	Day	11	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	6/17/1999	10:30	Day	37.7	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/12/1999	15:15	Day	13.67	Fair	SNWA[a]
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/13/1999	12:57	Day	14.2	Good	SNWA[a]
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/14/1999	9:16	Day	12.79	Fair	SNWA[a]
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/15/1999	7:32	Day	13.73	Fair	SNWA[a]
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/16/1999	9:35	Day	13.6	Good	SNWA[a]
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/20/1999	11:00	Day	11.9	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	9/14/1999	13:20	Day	9.49	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	11/2/1999	11:05	Day	8.18	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	12/20/1999	10:04	Day	9.07	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	2/23/2000	10:50	Day	8.55	Fair	NWIS Feb 2006

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Station No.	Station Name	UTM Northing (m)	UTM Easting (m)	Date of Measurement	Time of Measurement	Date Accuracy	Discharge (cfs)	Measurement Rated	Data Source
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	4/3/2000	11:30	Day	8.81	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	5/10/2000	10:30	Day	15.9	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	6/21/2000	10:50	Day	9.04	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/24/2000	10:18	Day	7.33	Good	SNWA[a]
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/25/2000	11:50	Day	7.14	Good	SNWA[a]
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/26/2000	14:19	Day	6.85	Fair	SNWA[a]
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/27/2000	13:25	Day	7.44	Good	SNWA[a]
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/27/2000	12:30	Day	7.48	Good	SNWA[a]
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/27/2000	11:20	Day	7.37	Fair	SNWA[a]
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/27/2000	10:00	Day	8.05	Good	SNWA[a]
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	8/1/2000	8:40	Day	7.09	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	9/13/2000	11:10	Day	6.49	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	11/7/2000	10:50	Day	7.21	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	1/8/2001	10:55	Day	6.31	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	2/27/2001	11:00	Day	6.04	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	4/18/2001	8:18	Day	16.1	Poor	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	6/5/2001	11:15	Day	12.2	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/24/2001	12:07	Day	7.06	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	8/6/2001	10:55	Day	6.09	Good	SNWA[a]
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	8/7/2001	13:38	Day	6.2	Fair	SNWA[a]
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	8/8/2001	9:43	Day	6.26	Fair	SNWA[a]
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	8/9/2001	14:00	Day	6.57	Good	SNWA[a]
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	9/18/2001	12:20	Day	6.36	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	10/17/2001	7:50	Day	5.87	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	12/12/2001	12:25	Day	6.88	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	2/6/2002	12:59	Day	6.67	Poor	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	3/19/2002	12:20	Day	8.41	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	5/9/2002	7:50	Day	10.2	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	6/25/2002	12:32	Day	6.48	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/16/2002	9:15	Day	6.01	Fair	SNWA[a]
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/17/2002	12:45	Day	5.61	Fair	SNWA[a]
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	8/13/2002	15:34	Day	4.81	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	10/8/2002	11:41	Day	4.62	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	11/13/2002	8:06	Day	6.06	Fair	NWIS Feb 2006

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Station No.	Station Name	UTM Northing (m)	UTM Easting (m)	Date of Measurement	Time of Measurement	Date Accuracy	Discharge (cfs)	Measurement Rated	Data Source
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	12/17/2002	14:18	Day	5.32	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	1/27/2003	13:45	Day	4.94	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	3/18/2003	11:01	Day	6.03	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	4/30/2003	8:09	Day	9.2	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	6/12/2003	8:10	Day	16.4	Poor	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/23/2003	8:25	Day	6.83	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	8/7/2003	11:57	Day	5.4	Good	SNWA[a]
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	9/3/2003	8:26	Day	5.05	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	10/28/2003	11:17	Day	5.54	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	12/16/2003	8:15	Day	2.85	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	2/12/2004	11:29	Day	6.41	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	3/31/2004	8:15	Day	8.19	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	5/18/2004	8:14	Day	11.5	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	6/29/2004	11:56	Day	6.19	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/27/2004	10:20	Day	5.22	Fair	SNWA[a]
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/28/2004	9:40	Day	6.06	Fair	SNWA[a]
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	8/25/2004	9:26	Day	5.23	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	10/7/2004	8:22	Day	5.36	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	10/28/2004	8:00	Day	8.78	Good	Squires 2004
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	10/28/2004	8:45	Day	8.13	Good	Squires 2004
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	10/28/2004	9:30	Day	8.43	Good	Squires 2004
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	10/29/2004	8:00	Day	7.87	Good	Squires 2004
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	10/29/2004	8:45	Day	8.22	Good	Squires 2004
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	10/29/2004	9:15	Day	7.87	Good	Squires 2004
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	10/30/2004	8:30	Day	7.95	Good	Squires 2004
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	11/22/2004	15:04	Day	6.44	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	1/11/2005	10:30	Day	7.57	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	3/2/2005	11:13	Day	8.18	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	4/5/2005	16:00	Day	11.5	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	5/9/2005	15:00	Day	41.6	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	5/9/2005	15:30	Day	41.2	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	5/13/2005	12:05	Day	39.1	Fair	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	5/26/2005	18:00	Day	119	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	6/8/2005	14:50	Day	68.9	Good	NWIS Feb 2006

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Station No.	Station Name	UTM Northing (m)	UTM Easting (m)	Date of Measurement	Time of Measurement	Date Accuracy	Discharge (cfs)	Measurement Rated	Data Source
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	6/8/2005	14:00	Day	68.6	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	6/21/2005	8:51	Day	57.6	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/27/2005	14:20	Day	20.1	Fair	SNWA[a]
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	7/28/2005	12:05	Day	11.3	Poor	SNWA[a]
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	8/4/2005	15:25	Day	15.3	Good	NWIS Feb 2006
1841611	Cleve Creek near Ely (Site 1)	4,343,423	712,669	9/15/2005	12:53	Day	11	Fair	NWIS Feb 2006
1841612	Cleve Creek above North Fork Cleve Creek	4,344,739	709,805	8/24/1982		Day	0.19	--	USGS 1987
1841612	Cleve Creek above North Fork Cleve Creek	4,344,739	709,805	10/6/1987		Day	0.03	--	USGS 1987
1841701	Bastian Creek at Mountain Block	4,336,914	711,105	7/15/1998	13:40	Day	10.5	Fair	SNWA[a]
1841701	Bastian Creek at Mountain Block	4,336,914	711,105	7/17/1998	9:27	Day	6.52	Fair	SNWA[a]
1841701	Bastian Creek at Mountain Block	4,336,914	711,105	7/13/1999	14:50	Day	5.95	Fair	SNWA[a]
1841701	Bastian Creek at Mountain Block	4,336,914	711,105	7/25/2000	11:30	Day	0.78	Fair	SNWA[a]
1841701	Bastian Creek at Mountain Block	4,336,914	711,105	7/27/2000	12:56	Day	0.789	Fair	SNWA[a]
1841701	Bastian Creek at Mountain Block	4,336,914	711,105	8/7/2001	15:10	Day	1.27	Fair	SNWA[a]
1841701	Bastian Creek at Mountain Block	4,336,914	711,105	7/16/2002	8:30	Day	0.363	Fair	SNWA[a]
1841701	Bastian Creek at Mountain Block	4,336,914	711,105	8/7/2003	10:58	Day	0.74	Good	SNWA[a]
1841701	Bastian Creek at Mountain Block	4,336,914	711,105	7/28/2004	15:23	Day	0.455	Fair	SNWA[a]
1841701	Bastian Creek at Mountain Block	4,336,914	711,105	7/27/2005	13:15	Day	9.91	Fair	SNWA[a]
1841901	Eight Mile Creek at Mountain Block	4,363,720	730,800	7/14/1964		Day	0.07	--	USGS 1964
1841901	Eight Mile Creek at Mountain Block	4,363,720	730,800	7/14/1998	15:50	Day	2.17	Fair	SNWA[a]
1841901	Eight Mile Creek at Mountain Block	4,363,720	730,800	7/16/1998	13:00	Day	2.02	Poor	SNWA[a]
1841901	Eight Mile Creek at Mountain Block	4,363,720	730,800	7/13/1999	10:15	Day	1.67	Good	SNWA[a]
1841901	Eight Mile Creek at Mountain Block	4,363,720	730,800	7/24/2000	14:52	Day	0.482	Fair	SNWA[a]
1841901	Eight Mile Creek at Mountain Block	4,363,720	730,800	7/26/2000	11:30	Day	0.555	Fair	SNWA[a]
1841901	Eight Mile Creek at Mountain Block	4,363,720	730,800	8/7/2001	15:05	Day	0.52	Fair	SNWA[a]
1841901	Eight Mile Creek at Mountain Block	4,363,720	730,800	7/29/2004	12:10	Day	0.256	Fair	SNWA[a]
1841901	Eight Mile Creek at Mountain Block	4,363,720	730,800	7/28/2005	16:00	Day	4.28	Fair	SNWA[a]
1842001	Negro Creek above Salt Marsh Canyon (Site 4)	4,351,112	733,873	8/8/2001	12:18	Day	1.57	Good	SNWA[a]
1842001	Negro Creek above Salt Marsh Canyon (Site 4)	4,351,112	733,873	8/8/2001	14:49	Day	1.36	Good	SNWA[a]
1842001	Negro Creek above Salt Marsh Canyon (Site 4)	4,351,112	733,873	8/8/2001	13:55	Day	1.39	Good	SNWA[a]
1842001	Negro Creek above Salt Marsh Canyon (Site 4)	4,351,112	733,873	8/8/2001	13:12	Day	1.31	Good	SNWA[a]
1842002	Upper Lower Negro Creek near Ranch House (Site 1)	4,348,340	729,209	8/8/2001	13:27	Day	1.37	Fair	SNWA[a]
1842002	Upper Lower Negro Creek near Ranch House (Site 1)	4,348,340	729,209	8/8/2001	14:35	Day	1.32	Fair	SNWA[a]
1842002	Upper Lower Negro Creek near Ranch House (Site 1)	4,348,340	729,209	8/8/2001	15:30	Day	1.35	Fair	SNWA[a]

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Station No.	Station Name	UTM Northing (m)	UTM Easting (m)	Date of Measurement	Time of Measurement	Date Accuracy	Discharge (cfs)	Measurement Rated	Data Source
1842002	Upper Lower Negro Creek near Ranch House (Site 1)	4,348,340	729,209	8/6/2003	18:00	Day	1.35	Good	SNWA[a]
1842003	Lower Lower Negro Creek near Ranch House (Site 2)	4,348,340	729,209	7/14/1964		Day	3.03	--	Rush and Kazmi 1965
1842003	Lower Lower Negro Creek near Ranch House (Site 2)	4,348,340	729,209	7/14/1998	14:20	Day	4.44	Fair	SNWA[a]
1842003	Lower Lower Negro Creek near Ranch House (Site 2)	4,348,340	729,209	7/16/1998	11:15	Day	6.69	Good	SNWA[a]
1842003	Lower Lower Negro Creek near Ranch House (Site 2)	4,348,340	729,209	7/13/1999	12:10	Day	5.8	Good	SNWA[a]
1842003	Lower Lower Negro Creek near Ranch House (Site 2)	4,348,340	729,209	7/24/2000	13:26	Day	1.17	Fair	SNWA[a]
1842003	Lower Lower Negro Creek near Ranch House (Site 2)	4,348,340	729,209	7/26/2000	12:50	Day	1.08	Fair	SNWA[a]
1842003	Lower Lower Negro Creek near Ranch House (Site 2)	4,348,340	729,209	8/8/2001	14:58	Day	1.62	Fair	SNWA[a]
1842003	Lower Lower Negro Creek near Ranch House (Site 2)	4,348,340	729,209	8/8/2001	13:55	Day	1.67	Fair	SNWA[a]
1842003	Lower Lower Negro Creek near Ranch House (Site 2)	4,348,340	729,209	8/8/2001	12:57	Day	1.67	Fair	SNWA[a]
1842003	Lower Lower Negro Creek near Ranch House (Site 2)	4,348,340	729,209	8/8/2001	12:00	Day	1.61	Fair	SNWA[a]
1842003	Lower Lower Negro Creek near Ranch House (Site 2)	4,348,340	729,209	8/8/2001	11:09	Day	1.51	Fair	SNWA[a]
1842003	Lower Lower Negro Creek near Ranch House (Site 2)	4,348,340	729,209	8/6/2003	17:10	Day	0.69	Good	SNWA[a]
1842004	Negro Creek Below Ranch (Site 3)	4,348,593	727,948	7/17/2002	11:00	Day	0.537	Good	SNWA[a]
1842004	Negro Creek Below Ranch (Site 3)	4,348,593	727,948	7/29/2004		Day	0.766	Fair	SNWA[a]
1842004	Negro Creek Below Ranch (Site 3)	4,348,593	727,948	7/28/2005	13:10	Day	7.4	Fair	SNWA[a]
1842101	Willard Creek (USGS)	4,323,020	726,537	7/12/1964		Day	0.35	--	USGS 1964
1842101	Willard Creek (USGS)	4,323,020	726,537	7/18/1991		Day	0.46	--	USGS 1991
1842101	Willard Creek (USGS)	4,323,020	726,537	10/24/1991		Day	0.29	--	USGS 1992
1842101	Willard Creek (USGS)	4,323,020	726,537	3/17/1992		Day	0.62	--	USGS 1992
1842101	Willard Creek (USGS)	4,323,020	726,537	6/25/1992		Day	0.28	--	USGS 1992
1842201	Swallow Canyon above Diversion nr Minerva, NV	4,302,523	729,884	5/19/1993		Day	44.3	Fair	SNWA[a]
1842201	Swallow Canyon above Diversion nr Minerva, NV	4,302,523	729,884	7/13/1998	13:30	Day	52.41	Fair	SNWA[a]
1842201	Swallow Canyon above Diversion nr Minerva, NV	4,302,523	729,884	7/14/1998	10:12	Day	21.5	Fair	SNWA[a]
1842201	Swallow Canyon above Diversion nr Minerva, NV	4,302,523	729,884	7/16/1998	12:27	Day	35.4	Fair	SNWA[a]
1842201	Swallow Canyon above Diversion nr Minerva, NV	4,302,523	729,884	7/18/1998	10:58	Day	32.3	Fair	SNWA[a]
1842201	Swallow Canyon above Diversion nr Minerva, NV	4,302,523	729,884	7/14/1999	11:40	Day	7.75	Fair	SNWA[a]
1842201	Swallow Canyon above Diversion nr Minerva, NV	4,302,523	729,884	7/16/1999	10:12	Day	6.87	Fair	SNWA[a]
1842201	Swallow Canyon above Diversion nr Minerva, NV	4,302,523	729,884	7/23/2000	15:07	Day	0.969	Fair	SNWA[a]
1842201	Swallow Canyon above Diversion nr Minerva, NV	4,302,523	729,884	7/25/2000	15:25	Day	0.75	Fair	SNWA[a]
1842201	Swallow Canyon above Diversion nr Minerva, NV	4,302,523	729,884	8/7/2001	11:33	Day	1.13	Fair	SNWA[a]
1842201	Swallow Canyon above Diversion nr Minerva, NV	4,302,523	729,884	7/17/2002	15:30	Day	2.31	Fair	SNWA[a]
1842201	Swallow Canyon above Diversion nr Minerva, NV	4,302,523	729,884	8/7/2003	13:50	Day	0.953	Good	SNWA[a]
1842201	Swallow Canyon above Diversion nr Minerva, NV	4,302,523	729,884	7/28/2004	11:43	Day	0.658	Good	SNWA[a]

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Station No.	Station Name	UTM Northing (m)	UTM Easting (m)	Date of Measurement	Time of Measurement	Date Accuracy	Discharge (cfs)	Measurement Rated	Data Source
1842201	Swallow Canyon above Diversion nr Minerva, NV	4,302,523	729,884	7/28/2005	10:00	Day	21	Fair	SNWA[a]
1842301	Connors Pass Creek near Shoshone, NV.	4,324,212	704,749	1/1/1962		Year	2	--	USGS 1962
1842301	Connors Pass Creek near Shoshone, NV.	4,324,212	704,749	1/1/1963		Year	0	--	USGS 1963
1842301	Connors Pass Creek near Shoshone, NV.	4,324,212	704,749	6/17/1964		Day		--	USGS 1964
1842301	Connors Pass Creek near Shoshone, NV.	4,324,212	704,749	8/17/1965		Day	0.4	--	USGS 1965
1842301	Connors Pass Creek near Shoshone, NV.	4,324,212	704,749	4/1/1966		Month		--	USGS 1966
1842301	Connors Pass Creek near Shoshone, NV.	4,324,212	704,749	1/1/1967		Year	0	--	USGS 1967
1842301	Connors Pass Creek near Shoshone, NV.	4,324,212	704,749	1/1/1968		Year	0	--	USGS 1968
1842301	Connors Pass Creek near Shoshone, NV.	4,324,212	704,749	3/1/1969		Month	0.2	--	USGS 1969
1842301	Connors Pass Creek near Shoshone, NV.	4,324,212	704,749	1/1/1970		Year	0	--	USGS 1970
1842301	Connors Pass Creek near Shoshone, NV.	4,324,212	704,749	1/1/1971		Year	0	--	USGS 1971
1842301	Connors Pass Creek near Shoshone, NV.	4,324,212	704,749	1/1/1972		Year	0	--	USGS 1972
1842301	Connors Pass Creek near Shoshone, NV.	4,324,212	704,749	1/1/1973		Year	0	--	USGS 1973
1842301	Connors Pass Creek near Shoshone, NV.	4,324,212	704,749	1/1/1974		Year	0	--	USGS 1974
1842301	Connors Pass Creek near Shoshone, NV.	4,324,212	704,749	9/18/1975		Day	0.2	--	USGS 1975
1842301	Connors Pass Creek near Shoshone, NV.	4,324,212	704,749	4/1/1976		Month	0.4	--	USGS 1976
1842301	Connors Pass Creek near Shoshone, NV.	4,324,212	704,749	1/1/1977		Year	0	--	USGS 1977
1842301	Connors Pass Creek near Shoshone, NV.	4,324,212	704,749	1/1/1978		Year	0	--	USGS 1978
1842301	Connors Pass Creek near Shoshone, NV.	4,324,212	704,749	1/1/1979		Year	0	--	USGS 1979
1842301	Connors Pass Creek near Shoshone, NV.	4,324,212	704,749	1/1/1980		Year	0	--	USGS 1980
1842301	Connors Pass Creek near Shoshone, NV.	4,324,212	704,749	1/1/1981		Year	0	--	USGS 1981
1842301	Connors Pass Creek near Shoshone, NV.	4,324,212	704,749	1/1/1982		Year	0	--	USGS 1982
1842501	Cooper Canyon Creek near Ely, NV	4,330,737	709,988	7/16/1991		Day	0	--	USGS 1991
1842501	Cooper Canyon Creek near Ely, NV	4,330,737	709,988	10/22/1991		Day	0	--	USGS 1992
1842501	Cooper Canyon Creek near Ely, NV	4,330,737	709,988	12/5/1991		Day	0	--	USGS 1992
1842501	Cooper Canyon Creek near Ely, NV	4,330,737	709,988	3/17/1992		Day	0	--	USGS 1992
1842501	Cooper Canyon Creek near Ely, NV	4,330,737	709,988	6/25/1992		Day	0	--	USGS 1992
1842601	Dry and Williams Creeks	4,310,122	726,112	7/14/1964		Day	3	--	Rush and Kazmi 1965
1842701	Pine and Ridge Creeks	4,316,882	724,118	7/14/1964		Day	3	--	Rush and Kazmi 1965

[a]SNWA - Miscellaneous measurement collected by SNWA staff from 1993 to 2005.

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Appendix C

Annual Discharge Estimates for Ungaged Streams

Table C.1-1
Discharge Estimates for Ungaged Streams Listed by Station Number and by Measurement Date
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Station Number	Station Name	Data Source	Measurement Date	Measurement Accuracy	Date Accuracy	Q_a Discharge (cfs)	Q_b MDV (cfs)	Q_a/Q_b	Q_M (2005)	Q_m (2005)	Long Term Average (2005)
1840201	Siegel Creek at Mountain Block	SNWA[a]	7/16/1996	Fair	Day	1.3	8	0.16	10.40	1.69	0.98
1840201	Siegel Creek at Mountain Block	SNWA[a]	7/13/1998	Fair	Day	2.65	22	0.12	10.40	1.25	
1840201	Siegel Creek at Mountain Block	SNWA[a]	7/12/1999	Good	Day	2.66	16	0.17	10.40	1.73	
1840201	Siegel Creek at Mountain Block	SNWA[a]	7/24/2000	Fair	Day	0.25	7.2	0.03	10.40	0.36	
1840201	Siegel Creek at Mountain Block	SNWA[a]	7/26/2000	Fair	Day	0.474	7	0.07	10.40	0.70	
1840201	Siegel Creek at Mountain Block	SNWA[a]	8/6/2001	Fair	Day	0.12	6.1	0.02	10.40	0.20	
1840201	Siegel Creek at Mountain Block	SNWA[a]	7/16/2002	Fair	Day	0.21	6	0.04	10.40	0.36	
1840201	Siegel Creek at Mountain Block	SNWA[a]	8/6/2003	Fair	Day	0.67	5.8	0.12	10.40	1.20	
1840201	Siegel Creek at Mountain Block	SNWA[a]	7/28/2004	Fair	Day	0.29	5.3	0.05	10.40	0.57	
1840201	Siegel Creek at Mountain Block	SNWA[a]	7/28/2005	Fair	Day	2.95	18	0.16	10.40	1.70	
1840401	North Creek at Sunkist, NV	USGS, 1964	7/14/1964		Day	2.23	8.4	0.27	10.40	2.76	1.21
1840401	North Creek at Sunkist, NV	SNWA[a]	7/17/1996	Fair	Day	1.13	7.5	0.15	10.40	1.57	
1840401	North Creek at Sunkist, NV	SNWA[a]	7/14/1998	Fair	Day	3.11	21	0.15	10.40	1.54	
1840401	North Creek at Sunkist, NV	SNWA[a]	7/17/1998	Fair	Day	2.74	18	0.15	10.40	1.58	
1840401	North Creek at Sunkist, NV	SNWA[a]	7/12/1999	Fair	Day	2.47	16	0.15	10.40	1.61	
1840401	North Creek at Sunkist, NV	SNWA[a]	7/24/2000	Fair	Day	0.6	7.2	0.08	10.40	0.87	
1840401	North Creek at Sunkist, NV	SNWA[a]	7/25/2000	Fair	Day	0.64	7.2	0.09	10.40	0.92	
1840401	North Creek at Sunkist, NV	SNWA[a]	7/25/2000	Fair	Day	0.656	7.2	0.09	10.40	0.95	
1840401	North Creek at Sunkist, NV	SNWA[a]	7/25/2000	Fair	Day	0.572	7.2	0.08	10.40	0.83	
1840401	North Creek at Sunkist, NV	SNWA[a]	7/25/2000	Fair	Day	0.554	7.2	0.08	10.40	0.80	
1840401	North Creek at Sunkist, NV	SNWA[a]	8/6/2001	Good	Day	0.37	6.1	0.06	10.40	0.63	
1840401	North Creek at Sunkist, NV	SNWA[a]	8/9/2001	Fair	Day	0.42	6.3	0.07	10.40	0.69	
1840401	North Creek at Sunkist, NV	SNWA[a]	7/16/2002	Fair	Day	0.68	6	0.11	10.40	1.18	
1840401	North Creek at Sunkist, NV	SNWA[a]	8/6/2003	Good	Day	0.67	5.8	0.12	10.40	1.20	
1840401	North Creek at Sunkist, NV	SNWA[a]	7/28/2004	Fair	Day	0.564	5.3	0.11	10.40	1.11	
1840401	North Creek at Sunkist, NV	SNWA[a]	7/28/2005	Fair	Day	2.05	18	0.11	10.40	1.18	

Table C.1-1
Discharge Estimates for Ungaged Streams Listed by Station Number and by Measurement Date
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Station Number	Station Name	Data Source	Measurement Date	Measurement Accuracy	Date Accuracy	Q_a Discharge (cfs)	Q_b MDV (cfs)	Q_a/Q_b	Q_M (2005)	Q_m (2005)	Long Term Average (2005)
1840501	Frenchman Creek at Mountain Block	SNWA[a]	7/17/1996	Good	Day	0.66	7.5	0.09	10.40	0.92	0.54
1840501	Frenchman Creek at Mountain Block	SNWA[a]	7/14/1998	Fair	Day	0.898	21	0.04	10.40	0.44	
1840501	Frenchman Creek at Mountain Block	SNWA[a]	7/17/1998	Fair	Day	0.86	18	0.05	10.40	0.50	
1840501	Frenchman Creek at Mountain Block	SNWA[a]	7/12/1999	Good	Day	1.04	16	0.07	10.40	0.68	
1840501	Frenchman Creek at Mountain Block	SNWA[a]	8/7/2001	Fair	Day	0.1	6.1	0.02	10.40	0.17	
1840602	Muncy Creek near Muncy Ranch	SNWA[a]	7/16/1998	Good	Day	5.17	18	0.29	10.40	2.99	2.01
1840602	Muncy Creek near Muncy Ranch	SNWA[a]	7/17/1998	Fair	Day	5.14	18	0.29	10.40	2.97	
1840602	Muncy Creek near Muncy Ranch	SNWA[a]	7/13/1999	Good	Day	5.04	18	0.28	10.40	2.91	
1840602	Muncy Creek near Muncy Ranch	SNWA[a]	7/24/2000	Poor	Day	1.06	7.2	0.15	10.40	1.53	
1840602	Muncy Creek near Muncy Ranch	SNWA[a]	7/24/2000	Poor	Day	0.81	7.2	0.11	10.40	1.17	
1840602	Muncy Creek near Muncy Ranch	SNWA[a]	7/27/2000	Fair	Day	0.75	6.9	0.11	10.40	1.13	
1840602	Muncy Creek near Muncy Ranch	SNWA[a]	8/7/2001	Fair	Day	0.8	6.1	0.13	10.40	1.36	
1840704	Kalamazoo Creek (Site 1)	USGS, 1964	7/14/1964	--	Day	6.87	8.4	0.82	10.40	8.51	5.90
1840704	Kalamazoo Creek (Site 1)	USGS, 1964	8/15/1964	--	Day	4.56	7.1	0.64	10.40	6.68	
1840704	Kalamazoo Creek (Site 1)	USGS, 1983	12/8/1982	--	Day	5.29	12	0.44	10.40	4.58	
1840704	Kalamazoo Creek (Site 1)	USGS, 1985	10/26/1983	--	Day	6.68	15	0.45	10.40	4.63	
1840704	Kalamazoo Creek (Site 1)	USGS, 1985	11/7/1984	--	Day	7.52	15	0.50	10.40	5.21	
1840704	Kalamazoo Creek (Site 1)	USGS, 1985	2/5/1985	--	Day	5.75	12	0.48	10.40	4.98	
1840704	Kalamazoo Creek (Site 1)	USGS, 1991	7/12/1991	--	Day	4.42	7.6	0.58	10.40	6.05	
1840704	Kalamazoo Creek (Site 1)	USGS, 1992	10/22/1991	--	Day	3.18	5.4	0.59	10.40	6.12	
1840704	Kalamazoo Creek (Site 1)	USGS, 1992	12/3/1991	--	Day	3.02	5.7	0.53	10.40	5.51	
1840704	Kalamazoo Creek (Site 1)	USGS, 1992	3/16/1992	--	Day	3.42	6.3	0.54	10.40	5.65	
1840704	Kalamazoo Creek (Site 1)	SNWA[a]	7/15/1996	Good	Day	4.75	7.6	0.63	10.40	6.50	
1840704	Kalamazoo Creek (Site 1)	SNWA[a]	7/16/1996	Good	Day	5.05	8	0.63	10.40	6.57	

Table C.1-1
Discharge Estimates for Ungaged Streams Listed by Station Number and by Measurement Date
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Station Number	Station Name	Data Source	Measurement Date	Measurement Accuracy	Date Accuracy	Q_a Discharge (cfs)	Q_b MDV (cfs)	Q_a/Q_b	Q_M (2005)	Q_m (2005)	Long Term Average (2005)
1840704	Kalamazoo Creek (Site 1)	SNWA[a]	7/16/1997	Good	Day	5.62	8.4	0.67	10.40	6.96	
1840704	Kalamazoo Creek (Site 1)	SNWA[a]	7/17/1997	Good	Day	5.79	8.8	0.66	10.40	6.84	
1840704	Kalamazoo Creek (Site 1)	SNWA[a]	7/17/1997	Good	Day	5.75	8.8	0.65	10.40	6.80	
1840704	Kalamazoo Creek (Site 1)	SNWA[a]	7/17/1997	Good	Day	5.83	8.8	0.66	10.40	6.89	
1840704	Kalamazoo Creek (Site 1)	SNWA[a]	7/17/1997	Fair	Day	5.74	8.8	0.65	10.40	6.78	
1840704	Kalamazoo Creek (Site 1)	SNWA[a]	7/17/1997	Good	Day	5.98	8.8	0.68	10.40	7.07	
1840704	Kalamazoo Creek (Site 1)	SNWA[a]	7/18/1997	Good	Day	6.04	9	0.67	10.40	6.98	
1840704	Kalamazoo Creek (Site 1)	SNWA[a]	7/12/1998	Good	Day	9.31	24	0.39	10.40	4.03	
1840704	Kalamazoo Creek (Site 1)	SNWA[a]	7/14/1998	Fair	Day	9.96	21	0.47	10.40	4.93	
1840704	Kalamazoo Creek (Site 1)	SNWA[a]	7/13/1999	Good	Day	7.26	18	0.40	10.40	4.19	
1840704	Kalamazoo Creek (Site 1)	SNWA[a]	7/24/2000	Fair	Day	3.27	7.2	0.45	10.40	4.72	
1840704	Kalamazoo Creek (Site 1)	SNWA[a]	7/27/2000	Fair	Day	3.51	6.9	0.51	10.40	5.29	
1840704	Kalamazoo Creek (Site 1)	SNWA[a]	8/9/2001	Poor	Day	3.77	6.3	0.60	10.40	6.22	
1840704	Kalamazoo Creek (Site 1)	SNWA[a]	7/16/2002	Fair	Day	3.1	6	0.52	10.40	5.37	
1840704	Kalamazoo Creek (Site 1)	SNWA[a]	8/7/2003	Fair	Day	3.35	5.8	0.58	10.40	6.01	
1840704	Kalamazoo Creek (Site 1)	SNWA[a]	7/28/2004	Fair	Day	2.73	5.3	0.52	10.40	5.36	
1840704	Kalamazoo Creek (Site 1)	SNWA[a]	7/27/2005	Fair	Day	10.1	19	0.53	10.40	5.53	
1840802	Piermont Creek at Mountain Block at Piermont, NV	USGS, 1977	10/13/1976	--	Day	1.14	7.4	0.15	10.40	1.60	1.67
1840802	Piermont Creek at Mountain Block at Piermont, NV	USGS, 1977	2/23/1977	--	Day	1.06	5.2	0.20	10.40	2.12	
1840802	Piermont Creek at Mountain Block at Piermont, NV	USGS, 1977	8/24/1977	--	Day	1.04	7.3	0.14	10.40	1.48	
1840802	Piermont Creek at Mountain Block at Piermont, NV	USGS, 1978	7/24/1978	--	Day	1.53	9.2	0.17	10.40	1.73	
1840802	Piermont Creek at Mountain Block at Piermont, NV	USGS, 1979	10/2/1978	--	Day	1.08	6.2	0.17	10.40	1.81	
1840802	Piermont Creek at Mountain Block at Piermont, NV	USGS, 1979	2/21/1979	--	Day	1.06	8.5	0.12	10.40	1.30	

Table C.1-1
Discharge Estimates for Ungaged Streams Listed by Station Number and by Measurement Date
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Station Number	Station Name	Data Source	Measurement Date	Measurement Accuracy	Date Accuracy	Q_a Discharge (cfs)	Q_b MDV (cfs)	Q_a/Q_b	Q_M (2005)	Q_m (2005)	Long Term Average (2005)
1840802	Piermont Creek at Mountain Block at Piermont, NV	USGS, 1979	9/18/1979	--	Day	0.74	6.6	0.11	10.40	1.17	
1840802	Piermont Creek at Mountain Block at Piermont, NV	USGS, 1980	1/23/1980	--	Day	1.05	8.7	0.12	10.40	1.26	
1840802	Piermont Creek at Mountain Block at Piermont, NV	USGS, 1983	12/8/1982	--	Day	2.6	12	0.22	10.40	2.29	
1840802	Piermont Creek at Mountain Block at Piermont, NV	SNWA[a]	7/16/1996	Fair	Day	1.09	8	0.14	10.40	1.42	
1840802	Piermont Creek at Mountain Block at Piermont, NV	SNWA[a]	7/14/1998	Fair	Day	5.94	21	0.28	10.40	2.94	
1840802	Piermont Creek at Mountain Block at Piermont, NV	SNWA[a]	7/15/1998	Fair	Day	6.47	19	0.34	10.40	3.54	
1840802	Piermont Creek at Mountain Block at Piermont, NV	SNWA[a]	7/17/1998	Fair	Day	4.96	18	0.28	10.40	2.87	
1840802	Piermont Creek at Mountain Block at Piermont, NV	SNWA[a]	7/14/1999	Good	Day	2.82	17	0.17	10.40	1.73	
1840802	Piermont Creek at Mountain Block at Piermont, NV	SNWA[a]	7/14/1999	Good	Day	2.74	17	0.16	10.40	1.68	
1840802	Piermont Creek at Mountain Block at Piermont, NV	SNWA[a]	7/14/1999	Good	Day	2.91	17	0.17	10.40	1.78	
1840802	Piermont Creek at Mountain Block at Piermont, NV	SNWA[a]	7/14/1999	Good	Day	2.9	17	0.17	10.40	1.77	
1840802	Piermont Creek at Mountain Block at Piermont, NV	SNWA[a]	7/14/1999	Good	Day	2.87	17	0.17	10.40	1.76	
1840802	Piermont Creek at Mountain Block at Piermont, NV	SNWA[a]	7/14/1999	Good	Day	2.74	17	0.16	10.40	1.68	
1840802	Piermont Creek at Mountain Block at Piermont, NV	SNWA[a]	7/14/1999	Good	Day	2.83	17	0.17	10.40	1.73	
1840802	Piermont Creek at Mountain Block at Piermont, NV	SNWA[a]	7/24/2000	Good	Day	0.92	7.2	0.13	10.40	1.33	
1840802	Piermont Creek at Mountain Block at Piermont, NV	SNWA[a]	7/27/2000	Fair	Day	0.73	6.9	0.11	10.40	1.10	

Table C.1-1
Discharge Estimates for Ungaged Streams Listed by Station Number and by Measurement Date
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Station Number	Station Name	Data Source	Measurement Date	Measurement Accuracy	Date Accuracy	Q_a Discharge (cfs)	Q_b MDV (cfs)	Q_a/Q_b	Q_M (2005)	Q_m (2005)	Long Term Average (2005)
1840802	Piermont Creek at Mountain Block at Piermont, NV	SNWA[a]	7/27/2000	Fair	Day	0.68	6.9	0.10	10.40	1.02	
1840802	Piermont Creek at Mountain Block at Piermont, NV	SNWA[a]	8/8/2001	Fair	Day	0.51	6.3	0.08	10.40	0.84	
1840802	Piermont Creek at Mountain Block at Piermont, NV	SNWA[a]	8/9/2001	Good	Day	0.7	6.3	0.11	10.40	1.16	
1840802	Piermont Creek at Mountain Block at Piermont, NV	SNWA[a]	8/7/2003	Fair	Day	0.562	5.8	0.10	10.40	1.01	
1840802	Piermont Creek at Mountain Block at Piermont, NV	SNWA[a]	7/28/2004	Fair	Day	0.558	5.3	0.11	10.40	1.09	
1840901	Garden Creek at Mountain Block	SNWA[a]	7/14/1998	Fair	Day	1.12	21	0.05	10.40	0.55	0.42
1840901	Garden Creek at Mountain Block	SNWA[a]	7/13/1999	Fair	Day	0.926	18	0.05	10.40	0.54	
1840901	Garden Creek at Mountain Block	SNWA[a]	8/7/2001	Fair	Day	0.098	6.1	0.02	10.40	0.17	
1841002	Bassett Creek at Mountain Block	Rush and Kazmi, 1965	7/16/1964	--	Day	5	7.8	0.64	10.40	6.67	4.95
1841002	Bassett Creek at Mountain Block	USGS, 1964	8/15/1964	--	Day	3.13	7.1	0.44	10.40	4.58	
1841002	Bassett Creek at Mountain Block	USGS, 1968	9/24/1964	--	Day	2.48	6.2	0.40	10.40	4.16	
1841002	Bassett Creek at Mountain Block	USGS, 1977	10/13/1976	--	Day	2.61	7.4	0.35	10.40	3.67	
1841002	Bassett Creek at Mountain Block	USGS, 1977	2/23/1977	--	Day	2.14	5.2	0.41	10.40	4.28	
1841002	Bassett Creek at Mountain Block	USGS, 1977	8/24/1977	--	Day	2.46	7.3	0.34	10.40	3.50	
1841002	Bassett Creek at Mountain Block	USGS, 1978	7/24/1978	--	Day	4.97	9.2	0.54	10.40	5.62	
1841002	Bassett Creek at Mountain Block	USGS, 1979	10/2/1978	--	Day	3.32	6.2	0.54	10.40	5.57	
1841002	Bassett Creek at Mountain Block	USGS, 1979	2/21/1979	--	Day	1.88	8.5	0.22	10.40	2.30	
1841002	Bassett Creek at Mountain Block	USGS, 1979	9/18/1979	--	Day	3.61	6.6	0.55	10.40	5.69	
1841002	Bassett Creek at Mountain Block	USGS, 1980	1/22/1980	--	Day	3.1	7.7	0.40	10.40	4.19	
1841002	Bassett Creek at Mountain Block	USGS, 1991	7/16/1991	--	Day	4.65	6.7	0.69	10.40	7.22	
1841002	Bassett Creek at Mountain Block	USGS, 1992	10/22/1991	--	Day	2.15	5.4	0.40	10.40	4.14	
1841002	Bassett Creek at Mountain Block	USGS, 1992	12/3/1991	--	Day	2.54	5.7	0.45	10.40	4.63	
1841002	Bassett Creek at Mountain Block	USGS, 1992	3/16/1992	--	Day	1.72	6.3	0.27	10.40	2.84	

Table C.1-1
Discharge Estimates for Ungaged Streams Listed by Station Number and by Measurement Date
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Station Number	Station Name	Data Source	Measurement Date	Measurement Accuracy	Date Accuracy	Q_a Discharge (cfs)	Q_b MDV (cfs)	Q_a/Q_b	Q_M (2005)	Q_m (2005)	Long Term Average (2005)
1841002	Bassett Creek at Mountain Block	SNWA[a]	7/18/1996	Good	Day	5.26	7.3	0.72	10.40	7.49	
1841002	Bassett Creek at Mountain Block	SNWA[a]	7/17/1998	Fair	Day	11.5	18	0.64	10.40	6.64	
1841002	Bassett Creek at Mountain Block	SNWA[a]	7/13/1999	Fair	Day	5.96	18	0.33	10.40	3.44	
1841002	Bassett Creek at Mountain Block	SNWA[a]	7/24/2000	Fair	Day	4.13	7.2	0.57	10.40	5.97	
1841002	Bassett Creek at Mountain Block	SNWA[a]	7/26/2000	Fair	Day	3.49	7	0.50	10.40	5.19	
1841002	Bassett Creek at Mountain Block	SNWA[a]	7/26/2000	Fair	Day	3.58	7	0.51	10.40	5.32	
1841002	Bassett Creek at Mountain Block	SNWA[a]	7/26/2000	Fair	Day	3.28	7	0.47	10.40	4.87	
1841002	Bassett Creek at Mountain Block	SNWA[a]	7/26/2000	Fair	Day	4.34	7	0.62	10.40	6.45	
1841002	Bassett Creek at Mountain Block	SNWA[a]	7/26/2000	Fair	Day	4.51	7	0.64	10.40	6.70	
1841002	Bassett Creek at Mountain Block	SNWA[a]	7/26/2000	Fair	Day	3.54	7	0.51	10.40	5.26	
1841002	Bassett Creek at Mountain Block	SNWA[a]	8/8/2001	Fair	Day	1.93	6.3	0.31	10.40	3.19	
1841002	Bassett Creek at Mountain Block	SNWA[a]	8/9/2001	Fair	Day	2.09	6.3	0.33	10.40	3.45	
1841002	Bassett Creek at Mountain Block	SNWA[a]	7/16/2002	Good	Day	2.6	6	0.43	10.40	4.51	
1841002	Bassett Creek at Mountain Block	SNWA[a]	8/7/2003	Fair	Day	2.76	5.8	0.48	10.40	4.95	
1841002	Bassett Creek at Mountain Block	SNWA[a]	7/28/2004	Good	Day	3.07	5.3	0.58	10.40	6.02	
1841101	Little Negro Creek abv Diversion nr Bassett Ranch	SNWA[a]	7/17/1996	Fair	Day	0.94	7.5	0.13	10.40	1.30	0.85
1841101	Little Negro Creek abv Diversion nr Bassett Ranch	SNWA[a]	7/15/1998	Fair	Day	2.48	19	0.13	10.40	1.36	
1841101	Little Negro Creek abv Diversion nr Bassett Ranch	SNWA[a]	7/17/1998	Fair	Day	1.8	18	0.10	10.40	1.04	
1841101	Little Negro Creek abv Diversion nr Bassett Ranch	SNWA[a]	7/13/1999	Good	Day	1.26	18	0.07	10.40	0.73	
1841101	Little Negro Creek abv Diversion nr Bassett Ranch	SNWA[a]	7/24/2000	Fair	Day	0.45	7.2	0.06	10.40	0.65	
1841101	Little Negro Creek abv Diversion nr Bassett Ranch	SNWA[a]	7/27/2000	Fair	Day	0.48	6.9	0.07	10.40	0.72	
1841101	Little Negro Creek abv Diversion nr Bassett Ranch	SNWA[a]	8/8/2001	Fair	Day	0.44	6.3	0.07	10.40	0.73	

Table C.1-1
Discharge Estimates for Ungaged Streams Listed by Station Number and by Measurement Date
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Station Number	Station Name	Data Source	Measurement Date	Measurement Accuracy	Date Accuracy	Q_a Discharge (cfs)	Q_b MDV (cfs)	Q_a/Q_b	Q_M (2005)	Q_m (2005)	Long Term Average (2005)
1841101	Little Negro Creek abv Diversion nr Bassett Ranch	SNWA[a]	8/7/2003	Fair	Day	0.28	5.8	0.05	10.40	0.50	
1841101	Little Negro Creek abv Diversion nr Bassett Ranch	SNWA[a]	7/29/2004	Fair	Day	0.315	5.1	0.06	10.40	0.64	
1841201	Odgers Creek at Mountain Block	USGS, 1977	10/13/1976	--	Day	0.95	7.4	0.13	10.40	1.34	2.40
1841201	Odgers Creek at Mountain Block	USGS, 1977	2/23/1977	--	Day	1.31	5.2	0.25	10.40	2.62	
1841201	Odgers Creek at Mountain Block	USGS, 1977	8/24/1977	--	Day	1.49	7.3	0.20	10.40	2.12	
1841201	Odgers Creek at Mountain Block	USGS, 1978	7/24/1978	--	Day	2.77	9.2	0.30	10.40	3.13	
1841201	Odgers Creek at Mountain Block	USGS, 1979	10/2/1978	--	Day	1.34	6.2	0.22	10.40	2.25	
1841201	Odgers Creek at Mountain Block	USGS, 1979	2/21/1979	--	Day	1.24	8.5	0.15	10.40	1.52	
1841201	Odgers Creek at Mountain Block	USGS, 1979	9/18/1979	--	Day	0.7	6.6	0.11	10.40	1.10	
1841201	Odgers Creek at Mountain Block	USGS, 1980	1/23/1980	--	Day	0.67	8.7	0.08	10.40	0.80	
1841201	Odgers Creek at Mountain Block	USGS, 1991	7/16/1991	--	Day	2.51	6.7	0.37	10.40	3.90	
1841201	Odgers Creek at Mountain Block	USGS, 1992	10/23/1991	--	Day	1.24	5.6	0.22	10.40	2.30	
1841201	Odgers Creek at Mountain Block	USGS, 1992	12/3/1991	--	Day	0.98	5.7	0.17	10.40	1.79	
1841201	Odgers Creek at Mountain Block	USGS, 1992	3/17/1992	--	Day	1.06	6.4	0.17	10.40	1.72	
1841201	Odgers Creek at Mountain Block	SNWA[a]	7/18/1996	Fair	Day	2.18	7.3	0.30	10.40	3.11	
1841201	Odgers Creek at Mountain Block	SNWA[a]	7/15/1998	Fair	Day	6.39	19	0.34	10.40	3.50	
1841201	Odgers Creek at Mountain Block	SNWA[a]	7/17/1998	Fair	Day	6.34	18	0.35	10.40	3.66	
1841201	Odgers Creek at Mountain Block	SNWA[a]	7/15/1999	Good	Day	4.35	15	0.29	10.40	3.02	
1841201	Odgers Creek at Mountain Block	SNWA[a]	7/24/2000	Fair	Day	2	7.2	0.28	10.40	2.89	
1841201	Odgers Creek at Mountain Block	SNWA[a]	8/7/2001	Fair	Day	1.34	6.1	0.22	10.40	2.28	
1841201	Odgers Creek at Mountain Block	SNWA[a]	7/29/2004	Fair	Day	1.25	5.1	0.25	10.40	2.55	
1841302	Mc Coy Creek at Mountain Block	USGS, 1964	7/14/1964	--	Day	9.52	8.4	1.13	10.40	11.79	7.03
1841302	Mc Coy Creek at Mountain Block	USGS, 1964	8/15/1964	--	Day	5.95	7.1	0.84	10.40	8.72	
1841302	Mc Coy Creek at Mountain Block	USGS, 1991	7/16/1991	--	Day	7.58	6.7	1.13	10.40	11.77	
1841302	Mc Coy Creek at Mountain Block	USGS, 1992	10/22/1991	--	Day	3.49	5.4	0.65	10.40	6.72	
1841302	Mc Coy Creek at Mountain Block	USGS, 1992	12/3/1991	--	Day	2.89	5.7	0.51	10.40	5.27	

Table C.1-1
Discharge Estimates for Ungaged Streams Listed by Station Number and by Measurement Date
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Station Number	Station Name	Data Source	Measurement Date	Measurement Accuracy	Date Accuracy	Q_a Discharge (cfs)	Q_b MDV (cfs)	Q_a/Q_b	Q_M (2005)	Q_m (2005)	Long Term Average (2005)
1841302	Mc Coy Creek at Mountain Block	USGS, 1992	3/17/1992	--	Day	2.78	6.4	0.43	10.40	4.52	
1841302	Mc Coy Creek at Mountain Block	SNWA[a]	7/17/1996	Fair	Day	5.82	7.5	0.78	10.40	8.07	
1841302	Mc Coy Creek at Mountain Block	SNWA[a]	7/15/1998	Fair	Day	15.45	19	0.81	10.40	8.46	
1841302	Mc Coy Creek at Mountain Block	SNWA[a]	7/15/1998	Fair	Day	14.9	19	0.78	10.40	8.16	
1841302	Mc Coy Creek at Mountain Block	SNWA[a]	7/17/1998	Good	Day	10.8	18	0.60	10.40	6.24	
1841302	Mc Coy Creek at Mountain Block	SNWA[a]	7/15/1999	Good	Day	8.7	15	0.58	10.40	6.03	
1841302	Mc Coy Creek at Mountain Block	SNWA[a]	7/15/1999	Good	Day	8.46	15	0.56	10.40	5.87	
1841302	Mc Coy Creek at Mountain Block	SNWA[a]	7/15/1999	Good	Day	8.61	15	0.57	10.40	5.97	
1841302	Mc Coy Creek at Mountain Block	SNWA[a]	7/15/1999	Good	Day	7.98	15	0.53	10.40	5.53	
1841302	Mc Coy Creek at Mountain Block	SNWA[a]	7/15/1999	Good	Day	8.33	15	0.56	10.40	5.78	
1841302	Mc Coy Creek at Mountain Block	SNWA[a]	7/15/1999	Good	Day	8.51	15	0.57	10.40	5.90	
1841302	Mc Coy Creek at Mountain Block	SNWA[a]	7/24/2000	Fair	Day	4.31	7.2	0.60	10.40	6.23	
1841302	Mc Coy Creek at Mountain Block	SNWA[a]	7/27/2000	Fair	Day	3.54	6.9	0.51	10.40	5.34	
1841302	Mc Coy Creek at Mountain Block	SNWA[a]	8/8/2001	Fair	Day	4.38	6.3	0.70	10.40	7.23	
1841302	Mc Coy Creek at Mountain Block	SNWA[a]	8/9/2001	Fair	Day	3.88	6.3	0.62	10.40	6.41	
1841302	Mc Coy Creek at Mountain Block	SNWA[a]	7/16/2002	Fair	Day	4.55	6	0.76	10.40	7.89	
1841302	Mc Coy Creek at Mountain Block	SNWA[a]	8/7/2003	Fair	Day	3.38	5.8	0.58	10.40	6.06	
1841302	Mc Coy Creek at Mountain Block	SNWA[a]	7/28/2004	Fair	Day	3.77	5.3	0.71	10.40	7.40	
1841302	Mc Coy Creek at Mountain Block	SNWA[a]	7/27/2005	Fair	Day	13.3	19	0.70	10.40	7.28	
1841401	Taft Creek at Diversion	USGS, 1991	7/16/1991	--	Day	2.51	6.7	0.37	10.40	3.90	2.66
1841401	Taft Creek at Diversion	USGS, 1992	10/23/1991	--	Day	0.71	5.6	0.13	10.40	1.32	
1841401	Taft Creek at Diversion	USGS, 1992	12/4/1991	--	Day	0.77	5.3	0.15	10.40	1.51	
1841401	Taft Creek at Diversion	USGS, 1992	3/17/1992	--	Day	0.37	6.4	0.06	10.40	0.60	
1841401	Taft Creek at Diversion	SNWA[a]	7/18/1996	Fair	Day	2.08	7.3	0.28	10.40	2.96	
1841401	Taft Creek at Diversion	SNWA[a]	7/15/1998	Fair	Day	10.7	19	0.56	10.40	5.86	
1841401	Taft Creek at Diversion	SNWA[a]	7/16/1998	Fair	Day	8.43	18	0.47	10.40	4.87	
1841401	Taft Creek at Diversion	SNWA[a]	7/13/1999	Good	Day	4.32	18	0.24	10.40	2.50	
1841401	Taft Creek at Diversion	SNWA[a]	7/24/2000	Fair	Day	1.24	7.2	0.17	10.40	1.79	

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Discharge Estimates for Ungaged Streams Listed by Station Number and by Measurement Date
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Station Number	Station Name	Data Source	Measurement Date	Measurement Accuracy	Date Accuracy	Q_a Discharge (cfs)	Q_b MDV (cfs)	Q_a/Q_b	Q_M (2005)	Q_m (2005)	Long Term Average (2005)
1841401	Taft Creek at Diversion	SNWA[a]	7/27/2000	Fair	Day	1.27	6.9	0.18	10.40	1.91	
1841401	Taft Creek at Diversion	SNWA[a]	8/7/2001	Fair	Day	1.21	6.1	0.20	10.40	2.06	
1841501	Stephens Creek at Mountain Block	SNWA[a]	7/25/2000	Fair	Day	0.69	7.2	0.10	10.40	1.00	1.07
1841501	Stephens Creek at Mountain Block	SNWA[a]	7/27/2000	Good	Day	0.76	6.9	0.11	10.40	1.15	
1841701	Bastian Creek at Mountain Block	SNWA[a]	7/15/1998	Fair	Day	10.5	19	0.55	10.40	5.75	2.57
1841701	Bastian Creek at Mountain Block	SNWA[a]	7/17/1998	Fair	Day	6.52	18	0.36	10.40	3.77	
1841701	Bastian Creek at Mountain Block	SNWA[a]	7/13/1999	Fair	Day	5.95	18	0.33	10.40	3.44	
1841701	Bastian Creek at Mountain Block	SNWA[a]	7/25/2000	Fair	Day	0.78	7.2	0.11	10.40	1.13	
1841701	Bastian Creek at Mountain Block	SNWA[a]	7/27/2000	Fair	Day	0.789	6.9	0.11	10.40	1.19	
1841701	Bastian Creek at Mountain Block	SNWA[a]	8/7/2001	Fair	Day	1.27	6.1	0.21	10.40	2.17	
1841701	Bastian Creek at Mountain Block	SNWA[a]	7/16/2002	Fair	Day	0.363	6	0.06	10.40	0.63	
1841701	Bastian Creek at Mountain Block	SNWA[a]	8/7/2003	Good	Day	0.74	5.8	0.13	10.40	1.33	
1841701	Bastian Creek at Mountain Block	SNWA[a]	7/28/2004	Fair	Day	0.455	5.3	0.09	10.40	0.89	
1841701	Bastian Creek at Mountain Block	SNWA[a]	7/27/2005	Fair	Day	9.91	19	0.52	10.40	5.42	
1841901	Eight Mile Creek at Mountain Block	USGS, 1964	7/14/1964		Day	0.07	8.4	0.01	10.40	0.09	0.97
1841901	Eight Mile Creek at Mountain Block	SNWA[a]	7/14/1998	Fair	Day	2.17	21	0.10	10.40	1.07	
1841901	Eight Mile Creek at Mountain Block	SNWA[a]	7/16/1998	Poor	Day	2.02	18	0.11	10.40	1.17	
1841901	Eight Mile Creek at Mountain Block	SNWA[a]	7/13/1999	Good	Day	1.67	18	0.09	10.40	0.96	
1841901	Eight Mile Creek at Mountain Block	SNWA[a]	7/24/2000	Fair	Day	0.482	7.2	0.07	10.40	0.70	
1841901	Eight Mile Creek at Mountain Block	SNWA[a]	7/26/2000	Fair	Day	0.555	7	0.08	10.40	0.82	
1841901	Eight Mile Creek at Mountain Block	SNWA[a]	8/7/2001	Fair	Day	0.52	6.1	0.09	10.40	0.89	
1841901	Eight Mile Creek at Mountain Block	SNWA[a]	7/29/2004	Fair	Day	0.256	5.1	0.05	10.40	0.52	
1841901	Eight Mile Creek at Mountain Block	SNWA[a]	7/28/2005	Fair	Day	4.28	18	0.24	10.40	2.47	
1842003	Lower Lower Negro Creek near Ranch House (Site 2)	Rush and Kazmi, 1965	7/14/1964	--	Day	3.03	8.4	0.36	10.40	3.75	2.59
1842003	Lower Lower Negro Creek near Ranch House (Site 2)	SNWA[a]	7/14/1998	Fair	Day	4.44	21	0.21	10.40	2.20	

Table C.1-1
Discharge Estimates for Ungaged Streams Listed by Station Number and by Measurement Date
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Station Number	Station Name	Data Source	Measurement Date	Measurement Accuracy	Date Accuracy	Q_a Discharge (cfs)	Q_b MDV (cfs)	Q_a/Q_b	Q_M (2005)	Q_m (2005)	Long Term Average (2005)
1842003	Lower Lower Negro Creek near Ranch House (Site 2)	SNWA[a]	7/16/1998	Good	Day	6.69	18	0.37	10.40	3.87	
1842003	Lower Lower Negro Creek near Ranch House (Site 2)	SNWA[a]	7/13/1999	Good	Day	5.8	18	0.32	10.40	3.35	
1842003	Lower Lower Negro Creek near Ranch House (Site 2)	SNWA[a]	7/24/2000	Fair	Day	1.17	7.2	0.16	10.40	1.69	
1842003	Lower Lower Negro Creek near Ranch House (Site 2)	SNWA[a]	7/26/2000	Fair	Day	1.08	7	0.15	10.40	1.60	
1842003	Lower Lower Negro Creek near Ranch House (Site 2)	SNWA[a]	8/8/2001	Fair	Day	1.67	6.3	0.27	10.40	2.76	
1842003	Lower Lower Negro Creek near Ranch House (Site 2)	SNWA[a]	8/8/2001	Fair	Day	1.62	6.3	0.26	10.40	2.67	
1842003	Lower Lower Negro Creek near Ranch House (Site 2)	SNWA[a]	8/8/2001	Fair	Day	1.51	6.3	0.24	10.40	2.49	
1842003	Lower Lower Negro Creek near Ranch House (Site 2)	SNWA[a]	8/8/2001	Fair	Day	1.61	6.3	0.26	10.40	2.66	
1842003	Lower Lower Negro Creek near Ranch House (Site 2)	SNWA[a]	8/8/2001	Fair	Day	1.67	6.3	0.27	10.40	2.76	
1842003	Lower Lower Negro Creek near Ranch House (Site 2)	SNWA[a]	8/6/2003	Good	Day	0.69	5.8	0.12	10.40	1.24	
1842101	Willard Creek (USGS)	USGS, 1964	7/12/1964	--	Day	0.35	8.6	0.04	10.40	0.42	0.68
1842101	Willard Creek (USGS)	USGS, 1991	7/18/1991	--	Day	0.46	6.6	0.07	10.40	0.72	
1842101	Willard Creek (USGS)	USGS, 1992	10/24/1991	--	Day	0.29	5.5	0.05	10.40	0.55	
1842101	Willard Creek (USGS)	USGS, 1993	12/3/1991	--	Day	1.39	5.7	0.24	10.40	2.50	
1842101	Willard Creek (USGS)	USGS, 1992	3/17/1992	--	Day	0.62	6.4	0.10	10.40	1.01	
1842201	Swallow Canyon above Diversion nr Minerva, NV	SNWA[a]	7/13/1998	Fair	Day	52.41	22	2.38	10.40	24.78	8.31
1842201	Swallow Canyon above Diversion nr Minerva, NV	SNWA[a]	7/14/1998	Fair	Day	21.5	21	1.02	10.40	10.65	
1842201	Swallow Canyon above Diversion nr Minerva, NV	SNWA[a]	7/16/1998	Fair	Day	35.4	18	1.97	10.40	20.45	

Table C.1-1
Discharge Estimates for Ungaged Streams Listed by Station Number and by Measurement Date
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Station Number	Station Name	Data Source	Measurement Date	Measurement Accuracy	Date Accuracy	Q_a Discharge (cfs)	Q_b MDV (cfs)	Q_a/Q_b	Q_M (2005)	Q_m (2005)	Long Term Average (2005)
1842201	Swallow Canyon above Diversion nr Minerva, NV	SNWA[a]	7/18/1998	Fair	Day	32.3	18	1.79	10.40	18.66	
1842201	Swallow Canyon above Diversion nr Minerva, NV	SNWA[a]	7/14/1999	Fair	Day	7.75	17	0.46	10.40	4.74	
1842201	Swallow Canyon above Diversion nr Minerva, NV	SNWA[a]	7/16/1999	Fair	Day	6.87	14	0.49	10.40	5.10	
1842201	Swallow Canyon above Diversion nr Minerva, NV	SNWA[a]	7/23/2000	Fair	Day	0.969	7.1	0.14	10.40	1.42	
1842201	Swallow Canyon above Diversion nr Minerva, NV	SNWA[a]	7/25/2000	Fair	Day	0.75	7.2	0.10	10.40	1.08	
1842201	Swallow Canyon above Diversion nr Minerva, NV	SNWA[a]	8/7/2001	Fair	Day	1.13	6.1	0.19	10.40	1.93	
1842201	Swallow Canyon above Diversion nr Minerva, NV	SNWA[a]	7/17/2002	Fair	Day	2.31	5.8	0.40	10.40	4.14	
1842201	Swallow Canyon above Diversion nr Minerva, NV	SNWA[a]	8/7/2003	Good	Day	0.953	5.8	0.16	10.40	1.71	
1842201	Swallow Canyon above Diversion nr Minerva, NV	SNWA[a]	7/28/2004	Good	Day	0.658	5.3	0.12	10.40	1.29	
1842201	Swallow Canyon above Diversion nr Minerva, NV	SNWA[a]	7/28/2005	Fair	Day	21	18	1.17	10.40	12.13	
1842601	Dry and Williams Creeks	Rush and Kazmi, 1965	7/14/1964	--	Day	3	8.4	0.36	10.40	3.71	3.71
1842701	Pine and Ridge Creeks	Rush and Kazmi, 1965	7/14/1964	--	Day	3	8.4	0.36	10.40	3.71	3.71

Ungaged Streams Estimated Long Term Annual Discharge (cfs):	**54.2**
Cleve Creek Measured Long Term Annual Discharge (cfs):	**10.4**
Total Estimated Discharge (cfs):	**64.6**
Total Estimated Discharge (afy):	**46,770**

[a]SNWA - Miscellaneous measurement collected by SNWA staff from 1993 to 2005.

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Appendix D

Groundwater Level Data for Wells and Springs and Selected Hydrographs for Wells in Spring Valley

Table D.1-1
Water Level Data for Selected Wells and Springs in the Spring Valley Area
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Map ID[a]	HA	Site No	Station Name	UTM Northing (m)[b]	UTM Easting (m)[b]	Reference Point Elev. (ft-amsl)[b]	Site Type[c]	Well Depth (ft-bgs)	Well Diameter (in.)	Date of First Meas.	Date of Last Meas.	Date of Selected Meas.	DTW	Elevation (ft-amsl)[d]	No. of Meas.	Avg. Elev. (ft-amsl)	Std. Dev.
1	179	395740114383601	179 N24 E65 17AADC1 USBLM	4,426,091	701,216	6,730.1	Basin Fill	21	6	8/17/1948	8/17/1948	8/17/1948	10	6,720.1	1	6720.1	
2	179	179 N24 E65 30DC 1	179 N24 E65 30DC 1	4,421,947	699,686	6,737.6	Volcanic	180	6.62	7/15/2003	7/15/2003	7/15/2003	20	6,717.6	1	6717.6	
3	183	382946114301201	183 N07 E67 06B 1	4,264,484	717,544	6,104.0	Basin Fill	872	10	2/1/1955	2/1/1955	2/1/1955	16	6,088.0	1	6088.0	
4	183	382702114283801	183 N07 E67 20C 1	4,258,801	719,566	6,047.9	Basin Fill	180		7/17/1963	7/17/1963	7/17/1963	168.4	5,879.5	1	5879.5	
5	183	382738114265801	183 N07 E67 21A 1 USBLM - Fortifin Well	4,259,795	722,062	6,179.0	Basin Fill	307		7/18/1963	7/18/1963	7/18/1963	292	5,887.0	1	5887.0	
6	183	183 N07 E67 27CA 1	183 N07 E67 27CA 1	4,257,568	722,973	6,244.3	Volcanic	389	12	9/15/1965	9/15/1965	9/15/1965	192	6,052.3	1	6052.3	
7	183	384338114380001	183 N10 E65 13CBDA1 USBLM	4,289,158	705,659	6,221.1	Basin Fill		8	3/23/1990	3/23/1990	3/23/1990	310.25	5,910.8	1	5910.8	
8	183	384120114372401	183 N10 E65 36D 1	4,284,307	706,558	5,984.0	Basin Fill	165		4/19/1947	7/17/1963	7/17/1963	25.92	5,958.1	3	5959.1	0.865
9	183	183 N10 E65 36DA 1	183 N10 E65 36DA 1	4,284,274	706,813	5,944.0	Basin Fill	843	14	10/15/1965	10/15/1965	10/15/1965	10	5,934.0	1	5934.0	
10	183	384529114335601	183 N10 E66 09ABAA1 USBLM	4,291,862	711,121	6,054.1	Basin Fill		6	7/16/1963	3/23/1990	3/23/1990	176.3	5,877.8	2	5876.7	1.485
11	183	384343114355201	183 N10 E66 17A 1 USBLM - Twissleman	4,289,964	709,335	6,024.0	Basin Fill	125		7/15/1963	7/15/1963	7/15/1963	99	5,925.0	1	5925.0	
12	183	384324114355401	183 N10 E66 17CCAC1 USBLM	4,288,806	708,713	6,027.0	Basin Fill	125	8	7/16/1963	3/23/1990	3/23/1990	99.68	5,927.3	3	5926.9	1.225
13	183	183 N10 E66 22BB 1	183 N10 E66 22BB 1	4,288,449	711,526	6,072.3	Basin Fill	173	8	12/15/1980	12/15/1980	12/15/1980	30	6,042.3	1	6042.3	
14	183	384143114363301	183 N10 E66 31A 1	4,284,928	707,896	5,969.0	Basin Fill	46	6	7/15/1963	7/15/1963	7/15/1963	33	5,936.0	1	5936.0	
15	183	183 N10 E66 31AB 1	183 N10 E66 31AB 1	4,285,125	707,954	5,944.0	Basin Fill	690	12	5/15/1967	5/15/1967	5/15/1967	18	5,926.0	1	5926.0	
16	183	384131114363601	183 N10 E66 31BAAA1 USBLM	4,285,296	707,789	5,963.0	Basin Fill			4/22/1983	3/23/1990	3/23/1990	28.9	5,934.1	2	5934.9	1.202
17	183	183 N10 E66 31BB 1	183 N10 E66 31BB 1	4,285,127	707,174	5,965.6	Basin Fill	468		5/15/1965	5/15/1965	5/15/1965	60	5,905.6	1	5905.6	
18	183	183 N10 E66 34BB 1	183 N10 E66 34BB 1	4,285,206	711,970	6,034.0	Basin Fill	110	8	6/15/1966	6/15/1966	6/15/1966	110	5,924.0	1	5924.0	
19	183	384125114334501	183 N10 E66 34BBBC1 USBLM	4,285,220	711,926	6,028.0	Basin Fill			3/23/1990	3/23/1990	3/23/1990	118.6	5,909.4	1	5909.4	
20	184	383351114180201	184 N08 E68 14A 1 USBLM	4,271,379	734,461	6,142.4	Basin Fill	495	6	7/15/1964	11/15/2005	7/27/2005	408	5,734.4	7	5733.1	4.094
21	184	383645114265401	184 N09 E67 27BC 1 Cottonwood Spring	4,276,858	722,098	6,624.3	Spring							6,624.3			
22	184	383704114225001	184 N09 E68 30AAAB1 USGS-MX (Spring Valley S.)	4,277,638	727,886	6,014.0	Basin Fill	679	10.75	8/7/1980	5/10/2006	5/10/2006	225.3	5,788.7	72	5788.2	1.086
23	184	383707114231201	184 N09 E68 30AB 1 USGS-MX	4,277,687	727,449	6,029.0	Basin Fill	699	10	9/1/1980	9/22/1980	9/22/1980	230	5,799.0	2	5799.5	0.707
24	184	383707114231202	184 N09 E68 30AB 2 USGS-MX	4,277,687	727,449	6,029.0	Basin Fill	700	2	9/22/1980	7/16/1996	7/16/1996	217.35	5,811.6	3	5811.1	0.967
25	184	384448114300901	184 N10 E67 07BA 1 USGS	4,291,619	716,975	5,884.0	Basin Fill	200	2	7/1/1980	4/20/1983	4/20/1983	85.5	5,798.5	3	5799.2	0.764
26	184	384331114261001	184 N10 E67 15DA 1 USGS	4,289,404	722,812	5,863.9	Basin Fill	200	2	4/20/1983	4/20/1983	4/20/1983	66.18	5,797.8	1	5797.8	
27	184	384403114272301	184 N10 E67 16AABA1 USBLM	4,290,342	721,021	5,834.0	Basin Fill	54		4/22/1960	5/10/2006	7/28/2005	41.69	5,792.3	11	5791.8	1.793
28	184	384310114261401	184 N10 E67 22AA 1 USGS-MX (Spring V Central)	4,288,754	722,733	5,892.9	Basin Fill	100	2	7/1/1980	5/10/2006	5/10/2006	64.71	5,828.2	57	5827.3	0.745
29	184	384254114252801	184 N10 E67 23ACBD1	4,288,292	723,858	5,871.9	Basin Fill		6	4/20/1983	7/16/1996	7/16/1996	93.54	5,778.4	3	5777.0	1.451
30	184	384216114260001	184 N10 E67 26BB 1 USGS-MX	4,287,099	723,118	5,948.0	Basin Fill	200	2	7/1/1980	9/29/1991	8/6/2001		5,748.0	6	5901.6	37.080

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Map ID[a]	HA	Site No	Station Name	UTM Northing (m)[b]	UTM Easting (m)[b]	Reference Point Elev. (ft-amsl)[b]	Site Type[c]	Well Depth (ft-bgs)	Well Diameter (in.)	Date of First Meas.	Date of Last Meas.	Date of Selected Meas.	DTW	Elevation (ft-amsl)[d]	No. of Meas.	Avg. Elev. (ft-amsl)	Std. Dev.
31	184	184 N10 E68 30DD 1	184 N10 E68 30DD 1	4,286,020	727,785	5,930.4	Basin Fill			6/1/1980	7/28/2005	7/28/2005	155.61	5,774.8	6	5774.1	0.591
32	184	384039114232701	184 N10 E68 31CD 1 USGS-MX	4,284,213	726,900	5,910.0	Basin Fill	150	2	7/1/1980	11/15/2005	9/9/1994	119.37	5,790.6	14	5787.5	9.687
33	184	184 N10 E68 36DA 1	184 N10 E68 36DA 1	4,284,975	735,813	6,515.9	Basin Fill	410	14	3/1/1965	3/1/1965	3/1/1965	60	6,455.9	1	6455.9	
34	184	385108114302602	184 N11 E66 01AABB2	4,303,323	716,245	5,794.0	Basin Fill	30		4/20/1983	7/27/2004	7/27/2004	2.08	5,792.0	5	5791.9	0.260
35	184	384831114314301	184 N11 E66 23AB 1 USGS-MX	4,298,432	714,519	5,844.0	Basin Fill	102	2	7/1/1980	5/9/2006	7/28/2005	47.24	5,796.8	16	5796.8	0.596
36	184	384818114314201	184 N11 E66 24A 1	4,298,059	715,568	5,787.9	Basin Fill	28	42	8/24/1949	7/16/1963	7/16/1963	17.1	5,770.8	3	5770.5	0.436
37	184	384814114305101	184 N11 E66 24BDAC1	4,297,942	715,788	5,778.5	Basin Fill	18	4	8/24/1949	12/18/2005	7/28/2005	14.48	5,764.0	9	5763.2	1.424
38	184	184 N11 E66 24D 1	184 N11 E66 24D 1	4,297,376	716,366	5,769.0	Basin Fill	28		6/15/1980	6/15/1980	6/15/1980	19	5,750.0	1	5750.0	
39	184	384620114313601	184 N11 E66 35DBAC1	4,294,398	714,797	5,789.0	Basin Fill-Flowing	240	4	4/20/1983	5/10/2006	3/9/1990	-7.6	5,796.6	4	5794.2	2.984
40	184	384620114313602	184 N11 E66 35DBAC2	4,294,398	714,797	5,789.0	Basin Fill	12	3	4/22/1960	5/10/2006	7/28/2005	4.29	5,784.7	7	5786.1	1.238
41	184	385052114234501	184 N11 E67 01A 1 Shoshone Spring	4,303,100	725,927	5,784.1	Spring							5,784.1			
42	184	184 N11 E67 01BC 1	184 N11 E67 01BC 1	4,303,023	724,909	5,794.0	Basin Fill-Flowing	54	4			6/15/1980		5,794.0			
43	184	385038114243801	184 N11 E67 01C 1	4,302,312	725,346	5,806.8	Basin Fill-Flowing	55	4			3/10/1950		5,806.8			
44	184	184 N11 E67 01C 1	184 N11 E67 01C 1	4,302,434	725,128	5,824.0	Basin Fill-Flowing	353	8			6/15/1980		5,824.0			
45	184	384944114235101	184 N11 E67 12DB 1 Minerva Spring	4,300,999	725,842	5,804.0	Spring							5,804.0			
46	184	384917114245801	184 N11 E67 13B 1 USBLM	4,300,144	725,069	5,804.0	Basin Fill	15		1/1/1935	1/1/1935	1/1/1935	7	5,797.0	1	5797.0	
47	184	184 N11 E67 13DC 1	184 N11 E67 13DC 1	4,298,995	725,824	5,780.0	Basin Fill			9/1/1964	9/1/1964	9/1/1964	10	5,770.0	1	5770.0	
48	184	184 N11 E67 23DA 1	184 N11 E67 23DA 1 Blind Spring	4,297,977	724,792	5,772.7	Spring							5,772.7			
49	184	385040114213901	184 N11 E68 5DBAB1 Little Swallow Spring	4,302,817	728,975	6,204.3	Spring							6,204.3			
50	184	385026114205701	184 N11 E68 04C 1 Swallow Spring	4,302,614	729,503	6,294.3	Spring							6,294.3			
51	184	385033114215601	184 N11 E68 05CA 1 Spring	4,302,589	728,572	6,084.2	Spring							6,084.2			
52	184	384745114224401	184 N11 E68 19DCDC1 USGS-MX (Spring Valley)	4,297,254	727,590	5,910.1	Basin Fill	200	2	1/1/1981	5/10/2006	5/10/2006	96.16	5,814.0	57	5812.2	1.666
53	184	384604114234301	184 N11 E68 31C 1 USBLM	4,294,404	726,982	5,874.0	Basin Fill	80	38	7/15/1964	7/15/1964	7/15/1964	71.2	5,802.8	1	5802.8	
54	184	384558114230501	184 N11 E68 31CDCD1 USBLM	4,294,033	727,175	5,853.0	Basin Fill	260	4	3/8/1990	3/8/1990	3/8/1990	70.14	5,782.9	1	5782.9	
55	184	184 N12 E66 21CD 1	184 N12 E66 21CD 1	4,306,564	710,561	6,397.3	Carbonate Well	633	6	9/15/1966	9/15/1966	9/15/1966	564	5,833.3	1	5833.3	
56	184	184 N12 E67 02A	184 N12 E67 02A	4,312,920	724,031	5,800.0	Basin Fill-Flowing					6/1/1980		5,800.0			

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Map ID[a]	HA	Site No	Station Name	UTM Northing (m)[b]	UTM Easting (m)[b]	Reference Point Elev. (ft-amsl)[b]	Site Type[c]	Well Depth (ft-bgs)	Well Diameter (in.)	Date of First Meas.	Date of Last Meas.	Date of Selected Meas.	DTW	Elevation (ft-amsl)[d]	No. of Meas.	Avg. Elev. (ft-amsl)	Std. Dev.
57	184	184 N12 E67 02A 1	184 N12 E67 02A 1	4,312,920	724,031	5,800.0	Basin Fill-Flowing					6/1/1980		5,800.0			
58	184	184 N12 E67 02A 2	184 N12 E67 02A 2	4,312,920	724,031	5,800.0	Basin Fill-Flowing					6/1/1980		5,800.0			
59	184	184 N12 E67 02A 3	184 N12 E67 02A 3	4,312,920	724,031	5,800.0	Basin Fill-Flowing					6/1/1980		5,800.0			
60	184	184 N12 E67 02A 4	184 N12 E67 02A 4	4,312,920	724,031	5,800.0	Basin Fill-Flowing					6/1/1980		5,800.0			
61	184	184 N12 E67 02A 5	184 N12 E67 02A 5	4,312,920	724,031	5,800.0	Basin Fill-Flowing					3/1/1980		5,800.0			
62	184	184 N12 E67 02AB 1	184 N12 E67 02AB 1 Cedars	4,312,911	723,712	5,783.4	Spring							5,783.4			
63	184	385622114250001	184 N12 E67 02ABA 1	4,313,222	723,830	5,804.1	Basin Fill-Flowing					4/19/1983		5,804.1			
64	184	385617114245901	184 N12 E67 02ABD 1	4,313,069	723,858	5,814.1	Basin Fill-Flowing					4/19/1983		5,814.1			
65	184	385613114250401	184 N12 E67 02ACBA1 USBLM	4,312,880	723,719	5,781.1	Basin Fill-Flowing	441	8	10/24/1971	5/10/2006	7/17/1997		5,781.1	5	5806.1	14.667
66	184	385623114272501	184 N12 E67 03B 1 USGS	4,313,009	721,739	5,774.0	Basin Fill	30	60	8/15/1953	12/13/1969	12/13/1969	3.9	5,770.1	3	5768.3	2.084
67	184	385526114290701	184 N12 E67 08A 1	4,311,550	719,225	5,764.2	Basin Fill	45	38	1/1/1935	1/1/1935	1/1/1935	20	5,744.2	1	5744.2	
68	184	184 N12 E67 11A 1	184 N12 E67 11A 1	4,311,293	724,080	5,804.1	Basin Fill	21.3	36	8/15/1949	8/15/1949	8/15/1949	12	5,792.1	1	5792.1	
69	184	184 N12 E67 11A 2	184 N12 E67 11A 2	4,311,306	724,078	5,804.1	Basin Fill	10	24	8/18/1949	8/18/1949	8/18/1949	6	5,798.1	1	5798.1	
70	184	385504114240801	184 N12 E67 12CAAD1	4,310,792	725,177	5,886.1	Basin Fill	182	12.75	7/8/1976	3/7/1990	3/7/1990	29.15	5,856.9	4	5855.7	4.445
71	184	184 N12 E67 12D 1	184 N12 E67 12D 1	4,310,532	725,719	5,924.1	Basin Fill	300	6	8/15/1949	8/15/1949	8/15/1949	14	5,910.1	1	5910.1	
72	184	184 N12 E67 12D 2	184 N12 E67 12D 2	4,310,546	725,717	5,924.1	Basin Fill	21	48	8/15/1949	8/15/1949	8/15/1949	14	5,910.1	1	5910.1	
73	184	184 N12 E67 12D 3	184 N12 E67 12D 3	4,310,559	725,717	5,944.1	Basin Fill	169	12	7/15/1959	7/15/1959	7/15/1959	50	5,894.1	1	5894.1	
74	184	385433114242501	184 N12 E67 13A 1	4,309,504	725,454	5,904.1	Basin Fill	80	6	10/10/1955	10/10/1955	10/10/1955	8	5,896.1	1	5896.1	
75	184	385435114250601	184 N12 E67 13B 1	4,309,698	724,677	5,804.1	Basin Fill-Flowing	220	6			1/1/1959		5,804.1			
76	184	184 N12 E67 13DD 1	184 N12 E67 13DD 1	4,308,728	725,971	5,894.1	Basin Fill	220	16	6/15/1980	6/15/1980	6/15/1980	44	5,850.1	1	5850.1	
77	184	184 N12 E67 18AD 1	184 N12 E67 18AD 1 North Spring	4,309,388	717,768	5,763.2	Spring							5,763.2			
78	184	184 N12 E67 20BD 1	184 N12 E67 20BD 1	4,307,621	718,828	5,754.0	Basin Fill-Flowing	99	6	6/15/1979	6/15/1979	8/2/2005		5,754.0	1	5739.0	
79	184	385348114243301	184 N12 E67 24BBB 1	4,308,493	724,615	5,784.0	Basin Fill-Flowing	155	8	4/20/1983	4/20/1983	4/20/1983	-11.4	5,795.4	1	5795.4	
80	184	385314114250901	184 N12 E67 24C 1	4,307,668	724,904	5,854.0	Basin Fill		10	7/15/1960	7/15/1960	7/15/1960	23	5,831.0	1	5831.0	
81	184	385259114240701	184 N12 E67 24CDDD1	4,306,970	725,334	5,847.0	Basin Fill	260	10	7/15/1960	3/8/1990	3/8/1990	21.35	5,825.7	4	5824.6	2.808
82	184	385315114233501	184 N12 E67 24DAD 1	4,307,515	726,042	5,924.1	Basin Fill			4/19/1983	4/19/1983	4/19/1983	57.3	5,866.8	1	5866.8	

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Map ID[a]	HA	Site No	Station Name	UTM Northing (m)[b]	UTM Easting (m)[b]	Reference Point Elev. (ft-amsl)[b]	Site Type[c]	Well Depth (ft-bgs)	Well Diameter (in.)	Date of First Meas.	Date of Last Meas.	Date of Selected Meas.	DTW	Elevation (ft-amsl)[d]	No. of Meas.	Avg. Elev. (ft-amsl)	Std. Dev.
83	184	385259114234901	184 N12 E67 24DCD 1	4,307,012	725,718	5,904.1	Basin Fill	300	16	7/15/1976	4/19/1983	4/19/1983	62.8	5,841.3	2	5833.7	10.748
84	184	184 N12 E67 26AA 1	184 N12 E67 26AA 1	4,306,662	724,410	5,784.0	Basin Fill			6/15/1980	6/15/1980	6/15/1980	19	5,765.0	1	5765.0	
85	184	184 N12 E67 26AC 1	184 N12 E67 26AC 1 The Seep	4,306,337	723,833	5,760.5	Spring							5,760.5			
86	184	385251114272701	184 N12 E67 27B 1	4,306,167	722,004	5,754.0	Basin Fill	30	6	10/13/1955	10/13/1955	10/13/1955	13	5,741.0	1	5741.0	
87	184	184 N12 E67 31DD 1	184 N12 E67 31DD 1	4,303,662	718,022	5,759.0	Basin Fill	456	16	4/15/1964	4/15/1964	4/15/1964	15	5,744.0	1	5744.0	
88	184	385403114202501	184 N12 E68 15CB 1 Mount Wheeler Mine Spring	4,309,127	730,577	7,964.7	Spring							7,964.7			
89	184	390127114350101	184 N13 E66 05ACAB1	4,322,229	709,109	6,478.3	Carbonate Well	45	6	10/5/1955	3/5/1990	3/5/1990	26.5	6,451.8	3	6455.7	6.544
90	184	390032114281901	184 N13 E67 08ACAB1	4,320,794	718,752	5,774.0	Basin Fill	45	38	12/29/1947	7/3/1990	7/3/1990	13.73	5,760.3	51	5760.6	1.187
91	184	385928114264901	184 N13 E67 15CBBB1	4,318,883	721,044	5,864.0	Basin Fill			4/20/1983	4/20/1983	4/20/1983	83.64	5,780.4	1	5780.4	
92	184	385915114261901	184 N13 E67 15CDAA1	4,318,502	721,778	5,884.1	Basin Fill	272	16	4/20/1983	4/20/1983	4/20/1983	103.37	5,780.7	1	5780.7	
93	184	385915114261902	184 N13 E67 15CDAA2	4,318,502	721,778	5,884.1	Basin Fill	487	10	4/20/1983	4/20/1983	4/20/1983	102.3	5,781.8	1	5781.8	
94	184	385903114261701	184 N13 E67 15CDDD1	4,318,134	721,836	5,869.1	Basin Fill	550		1/23/1968	4/20/1983	4/20/1983	85.34	5,783.7	2	5799.4	22.161
95	184	184 N13 E67 15D 1	184 N13 E67 15D 1	4,318,523	722,249	5,950.0	Basin Fill		16	11/1/1964	11/1/1964	11/1/1964	73	5,877.0	1	5877.0	
96	184	184 N13 E67 15D 2	184 N13 E67 15D 2	4,318,523	722,249	5,900.0	Basin Fill			8/1/1949	8/1/1949	8/1/1949	60	5,840.0	1	5840.0	
97	184	385906114260501	184 N13 E67 15DCDC1 USGS-MX	4,318,234	722,122	5,890.1	Basin Fill	160		7/1/1980	4/20/1983	4/20/1983	95.11	5,795.0	4	5796.6	1.812
98	184	184 N13 E67 16DC 1	184 N13 E67 16DC 1	4,318,272	720,422	5,925.0	Basin Fill			7/1/1971	7/1/1971	7/1/1971	72	5,853.0	1	5853.0	
99	184	385949114291801	184 N13 E67 17D 1 USBLM	4,318,972	718,706	5,774.1	Basin Fill			4/22/1960	4/22/1960	4/22/1960	53.3	5,720.8	1	5720.8	
100	184	385927114281501	184 N13 E67 17DBAA1	4,318,794	718,976	5,779.0	Basin Fill			4/22/1960	4/20/1983	4/20/1983	2.04	5,777.0	2	5776.9	0.113
101	184	385920114294001	184 N13 E67 18DCAB1 Majorwoods Windmill	4,318,402	717,060	5,854.1	Basin Fill	120	6	4/22/1960	5/10/2006	5/10/2006	52.25	5,801.8	53	5802.2	0.981
102	184	385911114264901	184 N13 E67 22A 1	4,317,976	721,720	5,854.1	Basin Fill			4/22/1960	4/22/1960	4/22/1960	70	5,784.1	1	5784.1	
103	184	184 N13 E67 22AD 1	184 N13 E67 22AD 1	4,317,535	722,489	5,860.0	Basin Fill			2/1/1972	2/1/1972	2/1/1972	60	5,800.0	1	5800.0	
104	184	385849114255901	184 N13 E67 22ADBB1	4,317,714	722,281	5,869.1	Basin Fill	300	8	4/20/1983	4/20/1983	4/20/1983	72.21	5,796.9	1	5796.9	
105	184	385852114261701	184 N13 E67 22BADD1	4,317,795	721,846	5,859.1	Basin Fill	500	14	1/1/1968	4/20/1983	4/20/1983	72.36	5,786.7	3	5789.6	10.312
106	184	385902114264801	184 N13 E67 22BBBB1	4,318,082	721,091	5,844.0	Basin Fill			4/20/1983	4/20/1983	4/20/1983	58.89	5,785.2	1	5785.2	
107	184	184 N13 E67 22D 1	184 N13 E67 22D 1	4,316,903	722,299	5,830.0	Basin Fill	63	6	8/1/1949	8/1/1949	8/1/1949	25	5,805.0	1	5805.0	
108	184	385757114251601	184 N13 E67 26BADC1	4,316,078	723,339	5,864.1	Basin Fill	300	10	6/4/1967	3/7/1990	3/7/1990	72.82	5,791.3	4	5801.3	10.496
109	184	184 N13 E67 26BD 1	184 N13 E67 26BD 1	4,315,936	723,315	5,818.0	Basin Fill			12/1/1964	12/1/1964	12/1/1964	28	5,790.0	1	5790.0	
110	184	385723114250801	184 N13 E67 26DCCB1	4,315,098	723,584	5,854.1	Basin Fill	300	10	6/4/1962	4/20/1983	4/20/1983	46.45	5,807.7	3	5806.6	0.895
111	184	385627114292101	184 N13 E67 31DDCC1	4,313,201	717,565	5,792.1	Basin Fill			4/22/1960	12/18/2005	7/27/2005	19.87	5,772.2	6	5768.7	3.448
112	184	385659114280301	184 N13 E67 33D 1 USBLM	4,314,003	720,868	5,774.0	Basin Fill	30	38	4/22/1960	6/1/1980	6/1/1980	6	5,768.0	2	5766.9	1.626
113	184	385636114265501	184 N13 E67 33DDA 1	4,313,576	721,049	5,774.0	Basin Fill	6		6/1/1980	5/10/2006	7/27/2005	7.38	5,766.7	9	5767.1	2.963

Table D.1-1
Water Level Data for Selected Wells and Springs in the Spring Valley Area
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Map ID[a]	HA	Site No	Station Name	UTM Northing (m)[b]	UTM Easting (m)[b]	Reference Point Elev. (ft-amsl)[b]	Site Type[c]	Well Depth (ft-bgs)	Well Diameter (in.)	Date of First Meas.	Date of Last Meas.	Date of Selected Meas.	DTW	Elevation (ft-amsl)[d]	No. of Meas.	Avg. Elev. (ft-amsl)	Std. Dev.
114	184	385714114264001	184 N13 E67 34A 1	4,314,714	722,005	5,784.1	Basin Fill-Flowing					2/5/1986		5,784.1			
115	184	184 N13 E67 34AA 1	184 N13 E67 34AA 1	4,314,694	722,560	5,780.0	Basin Fill			7/1/1966	7/1/1966	7/1/1966	14	5,766.0	1	5766.0	
116	184	385715114254501	184 N13 E67 34AAAA1	4,314,826	722,700	5,809.1	Basin Fill	916	12	4/19/1983	11/9/1983	11/9/1983	2.25	5,806.8	4	5806.7	0.127
117	184	385651114252601	184 N13 E67 34ADDD1	4,314,099	723,179	5,799.1	Basin Fill-Flowing					4/19/1983		5,799.1			
118	184	385655114261301	184 N13 E67 35C 1 USBLM	4,314,001	722,989	5,804.1	Basin Fill-Flowing					2/5/1986		5,804.1			
119	184	385655114254201	184 N13 E67 35D 1 USBLM	4,313,710	723,623	5,834.1	Basin Fill-Flowing	396	6			7/1/1964		5,834.1			
120	184	392438114190801	184 N13 E68 11CAA 1 Sp NE Face Mount Wheeler	4,365,760	730,759	6,523.1	Spring							6,523.1			
121	184	390417114302701	184 N14 E66 24AABB1 USBLM	4,327,648	715,555	5,842.0	Basin Fill	27	60	8/15/1949	3/6/1990	3/6/1990	23.27	5,818.7	4	5817.2	0.990
122	184	390352114305401	184 N14 E66 24BDDD1 USGS-MX (Spring Valley N.)	4,326,859	714,927	5,844.0	Basin Fill	160	2	1/1/1981	4/23/2006	4/23/2006	38.4	5,805.6	63	5806.7	0.789
123	184	390315114304701	184 N14 E66 25BADD1 USBLM	4,325,723	715,126	5,842.0	Basin Fill	61	24	8/15/1944	3/6/1990	3/6/1990	19.18	5,822.8	4	5819.6	2.267
124	184	184 N14 E66 34CD 1	184 N14 E66 34CD 1	4,322,897	711,828	6,160.0	Basin Fill			6/1/1980	6/1/1980	6/1/1980	338	5,822.0	1	5822.0	
125	184	184 N14 E67 04DB 1	184 N14 E67 04DB 1 Layton Spring	4,331,794	720,204	5,698.0	Spring							5,698.0			
126	184	390556114303901	184 N14 E67 07D 1 UNR Agricultural Exp Sta	4,329,531	716,705	5,854.0	Basin Fill-Flowing	340	8			11/12/1944		5,854.0			
127	184	390448114274401	184 N14 E67 15C 1	4,328,000	721,558	5,894.3	Basin Fill	600	14	4/22/1960	4/22/1960	4/22/1960	12	5,882.3	1	5882.3	
128	184	184 N14 E67 16DD 1	184 N14 E67 16DD 1 QUEEN CITY	4,327,835	720,417	5,763.1	Basin Fill					7/16/1999	42.42	5,720.6			
129	184	184 N14 E67 16DD 2	184 N14 E67 16DD 2	4,328,008	720,529	5,774.0	Basin Fill	200	14	9/15/1970	9/15/1970	9/15/1970	30	5,744.0	1	5744.0	
130	184	184 N14 E67 21DC 1	184 N14 E67 21DC 1	4,326,376	720,168	5,754.0	Basin Fill	154		5/15/1968	5/15/1968	5/15/1968	33	5,721.0	1	5721.0	
131	184	390330114264401	184 N14 E67 22CCCA1	4,326,409	720,953	5,794.0	Basin Fill	238	14	8/1/1969	3/7/1990	3/7/1990	56.6	5,737.4	3	5734.6	3.980
132	184	390336114272701	184 N14 E67 27B 1	4,325,794	721,019	5,828.2	Basin Fill	16	48	8/22/1949	8/22/1949	8/22/1949	12.2	5,816.0	1	5816.0	
133	184	184 N14 E67 32AC 1	184 N14 E67 32AC 1 Willard Springs	4,323,976	718,691	5,758.9	Spring							5,758.9			
134	184	390940114302001	184 N15 E66 13D 1	4,337,611	715,449	5,764.0	Basin Fill	82		9/10/1952	3/17/1992	3/17/1992	12.23	5,751.8	23	5745.6	4.018
135	184	390952114214401	184 N15 E66 14DBBD1	4,338,331	727,825	6,537.7	Basin Fill	168	10	6/29/1999	9/3/2003	9/3/2003	26.24	6,511.5	2	6512.6	1.584
136	184	390907114340001	184 N15 E66 21AC 1 Bastion Spring	4,336,450	710,196	6,697.3	Spring							6,697.3			
137	184	390912114335701	184 N15 E66 21AC 2 Bastion Spring	4,336,606	710,264	6,644.3	Spring							6,644.3			
138	184	390940114314801	184 N15 E66 24B 1 USGS	4,337,587	714,561	5,841.4	Basin Fill	82	6	9/14/1947	11/11/1964	11/11/1964	19.6	5,821.8	5	5821.9	2.951
139	184	390802114303001	184 N15 E66 25DADC1 White Pine Power Project	4,334,583	715,292	5,849.0	Basin Fill	470	12 to 50' and 4 to 470'	8/17/1982	3/7/1990	3/7/1990	31.44	5,817.5	3	5811.8	12.036

Table D.1-1
Water Level Data for Selected Wells and Springs in the Spring Valley Area
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Map ID[a]	HA	Site No	Station Name	UTM Northing (m)[b]	UTM Easting (m)[b]	Reference Point Elev. (ft-amsl)[b]	Site Type[c]	Well Depth (ft-bgs)	Well Diameter (in.)	Date of First Meas.	Date of Last Meas.	Date of Selected Meas.	DTW	Elevation (ft-amsl)[d]	No. of Meas.	Avg. Elev. (ft-amsl)	Std. Dev.
140	184	390807114304101	184 N15 E66 25DBCB1 White Pine Power Project	4,334,730	715,024	5,859.0	Basin Fill	178	12 to 50' and 6 to 178'	4/21/1983	4/21/1983	4/21/1983	46.67	5,812.3	1	5812.3	
141	184	390802114303901	184 N15 E66 25DBCC1 White Pine Power Project	4,334,577	715,076	5,862.0	Basin Fill	580	24 to 50' and 12 to 580'	9/2/1982	9/2/1982	9/2/1982	50.78	5,811.2	1	5811.2	
142	184	391123114245001	184 N15 E67 02DA 1 USGS-MX	4,341,009	723,280	5,772.9	Basin Fill	185	2	7/1/1980	7/1/1980	7/1/1980	150	5,622.9	1	5622.9	
143	184	391135114244701	184 N15 E67 02DACB1 USAF	4,341,381	723,341	5,783.9	Basin Fill	185	2	7/1/1980	4/21/1983	4/21/1983	150.44	5,633.5	4	5625.5	14.441
144	184	390936114305801	184 N15 E67 19B 1	4,336,763	716,025	5,723.5	Basin Fill	83	16	9/30/1947	6/15/1980	6/15/1980	7	5,716.5	2	5715.5	1.414
145	184	390803114251001	184 N15 E67 26CA 1 USGS-MX	4,334,817	722,567	5,663.7	Basin Fill	200	2	1/1/1981	4/23/2006	7/27/2005	39.38	5,624.3	11	5627.9	4.628
146	184	184 N15 E67 26CA 1	184 N15 E67 26CA 1	4,334,907	722,765	5,686.3	Basin Fill-Flowing	200				6/1/1980		5,686.3			
147	184	184 N15 E67 29DB 1	184 N15 E67 29DB 1 South Bastian Spring	4,334,865	718,388	5,660.3	Spring							5,660.3			
148	184	184 N15 E67 35BD 1	184 N15 E67 35BD 1	4,333,730	722,777	5,774.4	Basin Fill	200	2	3/15/1981	3/15/1981	3/15/1981	23	5,751.4	1	5751.4	
149	184	184 N15 E68 17DD 1	184 N15 E68 17DD 1	4,337,693	728,132	6,812.2	Carbonate Well	265	6.625	6/15/1999	6/15/1999	6/15/1999	167	6,645.2	1	6645.2	
150	184	391516114292001	184 N16 E66 13A 1 Spring	4,348,010	716,602	5,704.0	Spring							5,704.0			
151	184	184 N16 E66 26A 1	184 N16 E66 26A 1	4,344,801	714,703	5,950.0	Basin Fill	260		12/1/1964	12/1/1964	12/1/1964	230	5,720.0	1	5720.0	
152	184	391224114293601	184 N16 E66 36DBAD1 USBLM - CLEVE CREEK WELL	4,342,689	716,361	5,862.0	Basin Fill			3/7/1990	4/23/2006	7/27/2005	208.07	5,653.9	7	5652.6	3.233
153	184	184 N16 E67 02BC 1	184 N16 E67 02BC 1	4,351,231	723,229	5,610.6	Basin Fill	140	10	6/15/1983	6/15/1983	6/15/1983	25	5,585.6	1	5585.6	
154	184	184 N16 E67 03A 1	184 N16 E67 03A 1	4,351,424	722,655	5,583.9	Basin Fill	16		5/15/1949	5/15/1949	5/15/1949	3	5,580.9	1	5580.9	
155	184	391713114244701	184 N16 E67 03AAAA1	4,351,771	723,044	5,589.9	Basin Fill	187	6	8/1/1949	3/7/1990	3/7/1990	4.1	5,585.8	5	5585.9	0.709
156	184	184 N16 E67 04DA 1	184 N16 E67 04DA 1	4,350,769	721,242	5,569.0	Basin Fill-Flowing					2/1/1970		5,569.0			
157	184	184 N16 E67 11AB 1	184 N16 E67 11AB 1	4,350,046	724,070	5,635.0	Basin Fill			5/1/1973	5/1/1973	5/1/1973	35	5,600.0	1	5600.0	
158	184	391524114300801	184 N16 E67 18A 1	4,347,886	717,685	5,598.3	Basin Fill	16	48	8/15/1949	6/30/2005	6/1/1980	3	5,595.3	3	5589.9	4.694
159	184	391327114255901	184 N16 E67 27D 1	4,343,860	721,542	5,597.7	Basin Fill	16	38	7/15/1964	6/1/1980	6/1/1980	10	5,587.7	2	5589.2	2.121
160	184	391308114245101	184 N16 E67 27DADD1 USBLM	4,344,245	723,164	5,617.4	Basin Fill	13	48	8/5/1948	4/23/2006	7/27/2005	10.37	5,607.0	9	5607.4	1.408
161	184	184 N17 E67 08BC 1	184 N17 E67 08BC 1	4,359,134	718,178	5,570.0	Basin Fill-Flowing					6/1/1980		5,570.0			
162	184	392028114290301	184 N17 E67 18BCAA1	4,357,641	716,742	5,623.9	Basin Fill	125	6.62	6/3/1996	6/3/1996	6/3/1996	21	5,602.9	1	5602.9	
163	184	184 N17 E67 25CD 1	184 N17 E67 25CD 1 South Millick Spring	4,353,599	725,201	5,592.6	Spring							5,592.6			
164	184	184 N17 E67 25DB 1	184 N17 E67 25DB 1 North Millick Spring	4,353,981	725,760	5,590.1	Spring							5,590.1			
165	184	391908114270801	184 N17 E67 28A 1 USBLM	4,354,634	720,637	5,563.9	Basin Fill-Flowing	29	38	2/18/1949	2/18/1949	6/1/1980		5,563.9	1	5541.8	
166	184	391835114282001	184 N17 E67 30AC 1	4,354,186	717,869	5,579.0	Basin Fill	15	12	8/18/1949	4/21/1983	3/7/1990		5,564.0	2	5573.3	4.667

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Map ID[a]	HA	Site No	Station Name	UTM Northing (m)[b]	UTM Easting (m)[b]	Reference Point Elev. (ft-amsl)[b]	Site Type[c]	Well Depth (ft-bgs)	Well Diameter (in.)	Date of First Meas.	Date of Last Meas.	Date of Selected Meas.	DTW	Elevation (ft-amsl)[d]	No. of Meas.	Avg. Elev. (ft-amsl)	Std. Dev.
167	184	184 N17 E67 30CB 1	184 N17 E67 30CB 1	4,353,862	716,698	5,718.0	Basin Fill-Flowing	100				8/1/1972		5,718.0			
168	184	392238114222801	184 N17 E68 06A 1 USBLM	4,361,357	726,938	5,573.9	Basin Fill	31	38	8/16/1949	8/16/1949	8/16/1949	23.7	5,550.2	1	5550.2	
169	184	392234114222801	184 N17 E68 06D 1 USGS	4,359,261	727,023	5,573.8	Basin Fill	28	48	8/5/1948	11/11/1964	11/11/1964	29.2	5,544.6	6	5548.7	2.420
170	184	392137114222801	184 N17 E68 07AB 1	4,359,940	727,003	5,561.8	Basin Fill	30	38	8/16/1949	3/6/1990	3/6/1990	19.82	5,542.0	4	5536.7	4.261
171	184	392750114310601	184 N18 E66 01B 1	4,370,756	714,534	5,636.0	Basin Fill	68	6	7/11/1953	7/11/1953	7/11/1953	20	5,616.0	1	5616.0	
172	184	184 N18 E66 02A 1	184 N18 E66 02A 1	4,370,522	714,052	5,705.7	Basin Fill	60		10/1/1962	10/1/1962	10/1/1962	31	5,674.7	1	5674.7	
173	184	184 N18 E66 24DC 1	184 N18 E66 24DC 1	4,364,678	715,684	5,616.6	Basin Fill	80	6	11/15/1948	11/15/1948	11/15/1948	60	5,556.6	1	5556.6	
174	184	184 N18 E66 25A 2	184 N18 E66 25A 2	4,364,117	715,825	5,620.7	Basin Fill	160		7/1/1950	7/1/1950	7/1/1950	26	5,594.7	1	5594.7	
175	184	392729114241101	184 N18 E67 01C 1	4,370,846	724,268	5,590.9	Basin Fill	45	38	7/16/1964	7/16/1964	7/16/1964	58.9	5,532.0	1	5532.0	
176	184	392703114230501	184 N18 E67 01CCAA1	4,369,928	724,534	5,590.9	Basin Fill	42	38	7/16/1964	4/23/2006	7/27/2005	34.51	5,556.4	7	5551.0	9.938
177	184	184 N18 E68 31A 1	184 N18 E68 31A 1	4,362,806	727,135	5,595.0	Basin Fill	465		3/1/1961	3/1/1961	3/1/1961	58	5,537.0	1	5537.0	
178	184	184 N18 E68 31A 2	184 N18 E68 31A 2	4,362,806	727,135	5,595.0	Basin Fill	80		3/1/1949	3/1/1949	3/1/1949	45	5,550.0	1	5550.0	
179	184	393211114320701	184 N19 E66 11B 1	4,378,169	712,561	5,762.4	Basin Fill	400		4/22/1960	4/22/1960	4/22/1960	40.8	5,721.6	1	5721.6	
180	184	393055114310001	184 N19 E66 14AB 1	4,377,300	713,292	5,703.9	Basin Fill	805	12	9/1/1972	8/14/2002	8/14/2002	43.98	5,659.9	5	5658.2	4.068
181	184	393059114221501	184 N19 E67 13AAAC1	4,377,545	725,389	5,617.9	Basin Fill	53	6	8/16/1949	7/25/2005	7/25/2005	49.24	5,568.7	8	5569.3	1.755
182	184	184 N20 E66 13AB 1	184 N20 E66 13AB 1	4,386,972	715,087	5,770.9	Basin Fill	296	12	6/15/1966	7/25/2000	7/25/2000	128.02	5,642.9	3	5641.6	5.129
183	184	393603114335801	184 N20 E66 17A 1 Muncy Creek Spring	4,386,277	708,900	7,004.2	Spring							7,004.2			
184	184	393347114361801	184 N20 E66 30DCC 1 Kalamazoo Creek Spring	4,382,117	706,815	7,204.4	Spring							7,204.4			
185	184	393729114265401	184 N20 E67 08D 1	4,388,619	719,886	5,783.9	Basin Fill	280		4/22/1960	4/23/2006	7/27/2005	178.38	5,605.5	7	5605.3	1.777
186	184	184 N20 E67 25BD 1	184 N20 E67 25BD 1	4,383,568	724,400	5,720.0	Basin Fill			6/1/1980	6/1/1980	6/1/1980	144	5,576.0	1	5576.0	
187	184	184 N20 E67 26A 2	184 N20 E67 26A 2	4,383,760	723,403	5,700.0	Basin Fill	123		7/1/1964	7/1/1964	7/1/1964	121	5,579.0	1	5579.0	
188	184	393442114231801	184 N20 E67 26ABBD1 USBLM	4,383,964	723,291	5,708.8	Basin Fill	130	6	6/21/1950	4/23/2006	7/27/2005	120.85	5,588.0	7	5592.8	7.301
189	184	394059114363301	184 N21 E65 15D 1 North Creek Spring	4,395,982	704,918	8,004.5	Spring							8,004.5			
190	184	394333114311001	184 N21 E66 04B 2	4,400,261	712,524	6,056.3	Basin Fill	29	6	4/21/1983	4/21/1983	4/21/1983	16.68	6,039.6	1	6039.6	
191	184	184 N21 E66 15BC 1	184 N21 E66 15BC 1 Willow Spring	4,397,068	713,830	5,986.3	Spring							5,986.3			
192	184	395314114373101	184 N23 E65 10D 1	4,417,131	704,234	6,926.7	Basin Fill			4/22/1960	4/22/1960	4/22/1960	65	6,861.7	1	6861.7	
193	184	395204114354101	184 N23 E65 14 1 Egan Creek Springs	4,415,842	705,647	6,654.1	Spring							6,654.1			
194	184	395234114363601	184 N23 E65 14C 1	4,415,988	705,580	6,704.0	Basin Fill	140		5/31/1977	5/31/1977	5/31/1977	124	6,580.0	1	6580.0	
195	184	395321114344001	184 N23 E66 07C 1	4,417,531	708,764	6,521.3	Basin Fill	23	36	8/19/1949	8/19/1949	8/19/1949	15.8	6,505.5	1	6505.5	
196	184	395200114341201	184 N23 E66 19A 1	4,415,055	709,616	6,503.7	Basin Fill	30	6	8/19/1949	8/19/1949	8/19/1949	20	6,483.7	1	6483.7	

Table D.1-1
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Map ID[a]	HA	Site No	Station Name	UTM Northing (m)[b]	UTM Easting (m)[b]	Reference Point Elev. (ft-amsl)[b]	Site Type[c]	Well Depth (ft-bgs)	Well Diameter (in.)	Date of First Meas.	Date of Last Meas.	Date of Selected Meas.	DTW	Elevation (ft-amsl)[d]	No. of Meas.	Avg. Elev. (ft-amsl)	Std. Dev.
197	184	394949114331801	184 N23 E66 31AB 1	4,411,771	709,159	6,354.0	Basin Fill	104	16	8/1/1949	4/21/1983	4/21/1983	19.98	6,334.1	3	6333.0	4.585
198	184	394949114331802	184 N23 E66 31AB 2	4,411,771	709,159	6,354.0	Basin Fill-Flowing					4/21/1983		6,354.0			
199	184	184 N23 E66 31B 1	184 N23 E66 31B 1	4,411,814	708,579	6,370.0	Basin Fill	49	8	8/19/1949	8/19/1949	8/1/1949	16	6,354.0	1	6354.0	
200	184	184 N23 E66 31B 2	184 N23 E66 31B 2	4,411,814	708,579	6,370.0	Basin Fill-Flowing	1040				8/1/1949		6,370.0			
201	184	394942114342001	184 N23 E66 31C 1	4,410,927	708,754	6,374.0	Basin Fill	95.6667	16	6/4/1953	6/4/1953	6/4/1953	26	6,348.0	1	6348.0	
202	184	184 N24 E66 31CB 1	184 N24 E66 31CB 1	4,420,817	708,166	6,726.8	Basin Fill	211	8	9/15/1966	9/15/1966	9/15/1966	140	6,586.8	1	6586.8	
203	185	394422114205201	185 N22 E67 36DBAC1 USBLM	4,402,194	727,194	5,778.8	Basin Fill	350	6	12/7/1956	8/2/1984	8/2/1984	294.87	5,484.0	2	5486.4	3.444
204	185	395433114173701	185 N23 E68 04B 1 USBLM	4,420,610	730,729	5,683.8	Basin Fill	175	6	5/10/1963	10/22/1969	10/22/1969	115.18	5,568.7	2	5571.2	3.663
205	185	395106114150601	185 N23 E68 23DDBB1 USBLM	4,414,900	735,048	5,768.6	Basin Fill			8/2/1984	8/2/1984	8/2/1984	263.5	5,505.1	1	5505.1	
206	185	395245114125901	185 N23 E69 07DCBD1 GOSHUTE RESERVATION	4,418,032	737,896	5,803.9	Basin Fill			10/22/1969	8/14/2002	8/14/2002	275.46	5,528.4	3	5525.3	4.712
207	185	185 N24 E68 17 1	185 N24 E68 17 1	4,426,449	729,449	5,962.6	Basin Fill	285	8	5/15/1965	5/15/1965	5/15/1965	256	5,706.6	1	5706.6	
208	185	395750114112201	185 N24 E69 17AAAA1 GOSHUTE RESERVATION	4,427,527	739,820	5,849.9	Basin Fill			10/22/1969	8/14/2002	8/14/2002	319.09	5,530.8	3	5526.8	5.209
209	185	395608114123601	185 N24 E69 19DDCD1 GOSHUTE RESERVATION	4,424,323	738,322	5,744.9	Basin Fill	252	6	10/22/1969	8/2/1984	8/2/1984	213.49	5,531.4	2	5525.4	8.492
210	185	400110114154101	185 N25 E68 26B 1 USBLM	4,433,383	732,865	5,903.9	Basin Fill	448	6	10/22/1969	10/22/1969	10/22/1969	378.2	5,525.7	1	5525.7	
211	195	393047114124001	195 N19 E69 15C 1	4,377,038	740,345	7,184.2	Basin Fill	28		7/18/1953	7/18/1953	7/18/1953	9	7,175.2	1	7175.2	
212	196	195 N10 E69 08BB 1	195 N10 E69 08BB 1	4,293,212	738,145	7,461.5	Basin Fill	200	6.62	5/15/1966	5/15/1966	5/15/1966	85	7,376.5	1	7376.5	
213	196	383325114134901	196 N08 E69 15B 1	4,271,290	741,829	5,715.5	Basin Fill	110	6	7/15/1964	7/15/1979	7/15/1979	75	5,640.5	3	5640.2	1.528
214	196	383023114115301	196 N08 E69 35DC 1 USGS-MX	4,265,716	744,253	5,778.6	Basin Fill	475	10	9/14/1980	8/2/2005	8/2/2005	157.95	5,620.6	3	5621.2	1.141
215	196	383023114115302	196 N08 E69 35DC 2 USGS-MX (Hamlin Valley S.)	4,265,716	744,253	5,778.6	Basin Fill	435	2	8/7/1980	12/16/2003	12/16/2003	176.38	5,602.2	44	5604.4	1.246
216	196	383047114110001	196 N08 E69 36A 1 USBLM - Rosencran Well	4,266,575	746,094	5,761.8	Basin Fill	225	6	3/18/1947	3/18/1947	3/18/1947	152.3	5,609.5	1	5609.5	
217	196	196 N08 E69 36AAA 1	196 N08 E69 36AAA 1	4,267,010	746,086	5,748.3	Basin Fill	480		8/15/1979	8/15/1979	8/15/1979	145	5,603.3	1	5603.3	
218	196	383533114102901	196 N08 E70 06B 1 USBLM - Monument Well	4,275,263	746,626	5,673.9	Basin Fill	164	6	8/18/1947	7/15/1979	7/15/1979	88	5,585.9	2	5584.4	2.121
219	196	383252114075101	196 N08 E70 21A 1	4,270,511	750,602	5,713.9	Basin Fill	153		11/3/1964	5/15/1979	5/15/1979	122	5,591.9	2	5588.9	4.243
220	196	383545114070101	196 N09 E70 34D 1	4,275,700	751,723	5,693.9	Basin Fill	217	8	8/18/1947	8/15/1979	8/15/1979	110	5,583.9	2	5584.4	0.707
221	196	196 N09 E70 35 1	196 N09 E70 35 1	4,276,153	753,380	5,736.2	Basin Fill	165	6	2/15/1951	2/15/1951	2/15/1951	110	5,626.2	1	5626.2	

[a]Map ID Number can be used in conjunction with Figure 6-1 to locate a particular site found in this table.
[b]Coordinates use the Universal Transverse Mercator projection, North American Datum 1983, Zone 11 meters; Elevations use the North American Vertical Datum 1988.
[c]For basin-fill flowing wells and springs, it is assumed that the actual water-level elevation is greater than the reported value.
[d]Water-level elevations rounded to the nearest tenth of a foot. Some differences may exist between this table and Figure 6-1 due to the water-level elevations posted on the figure being rounded to the nearest foot.

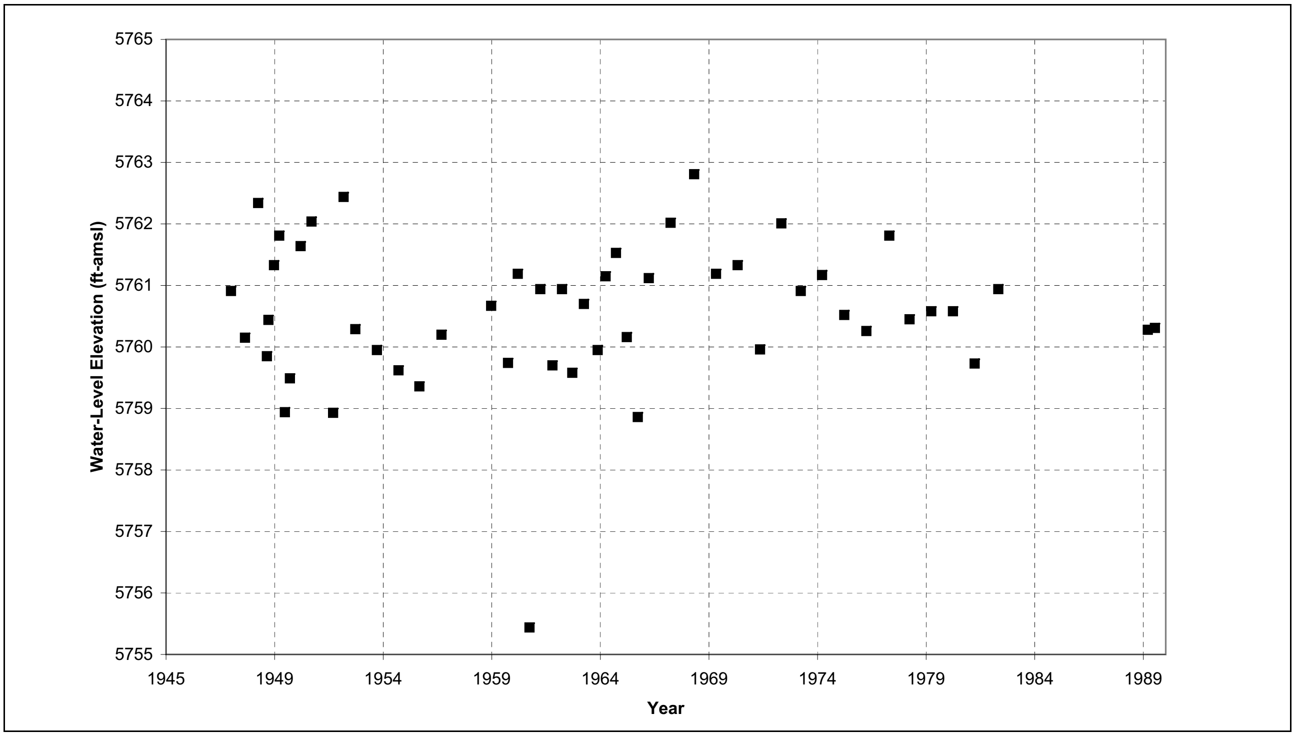

Figure D.1-1
Historical Water-Level Elevations for Well 184 N13 E67 08ACAB1

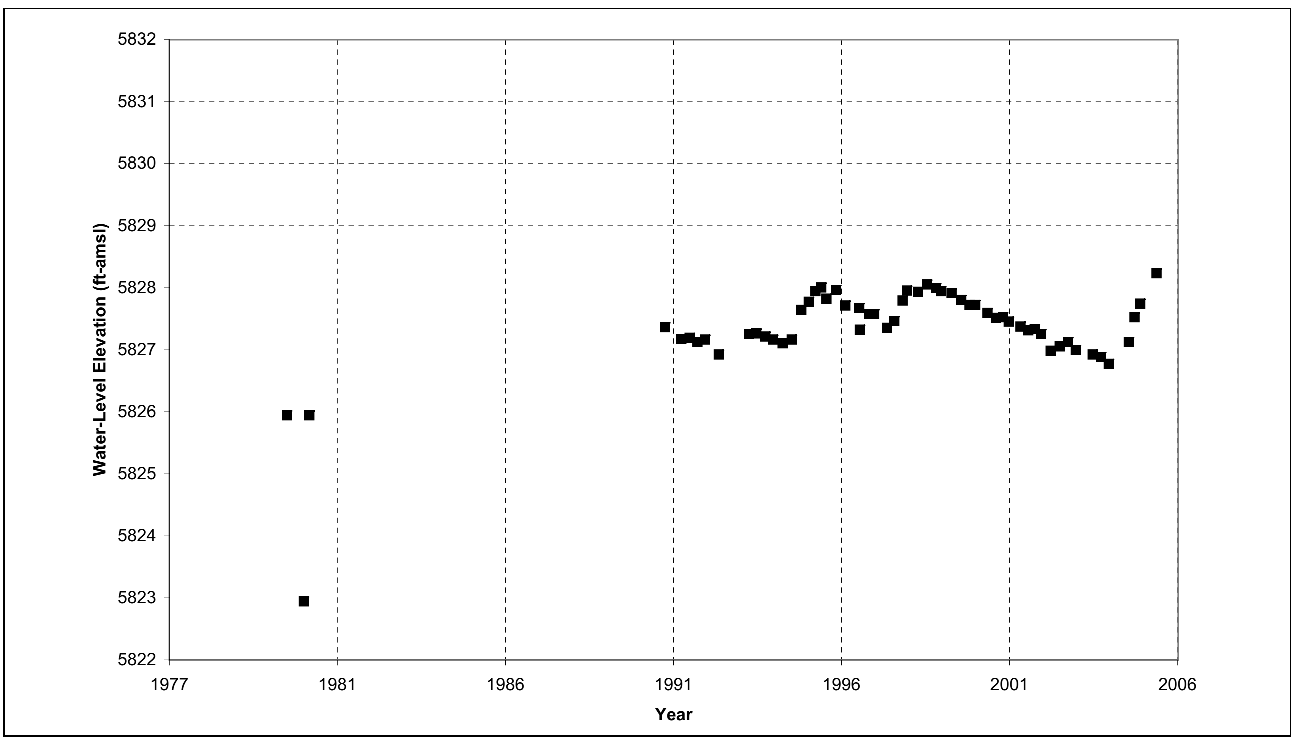

Figure D.1-2
Historical Water-Level Elevations for
Well 184 N10 E67 22AA 1 USGS-MX (Spring V Central)

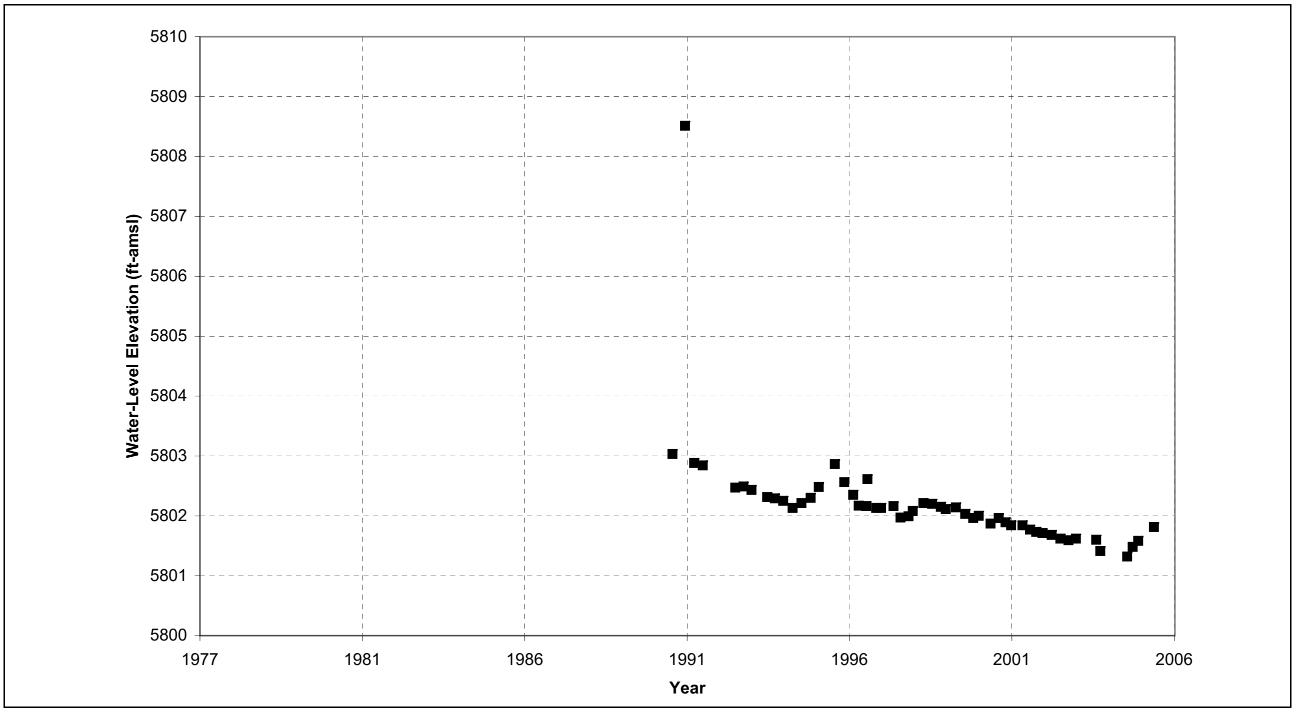

Figure D.1-3
Historical Water-Level Elevations for
Well 184 N13 E67 18DCAB1 Majorwoods Windmill

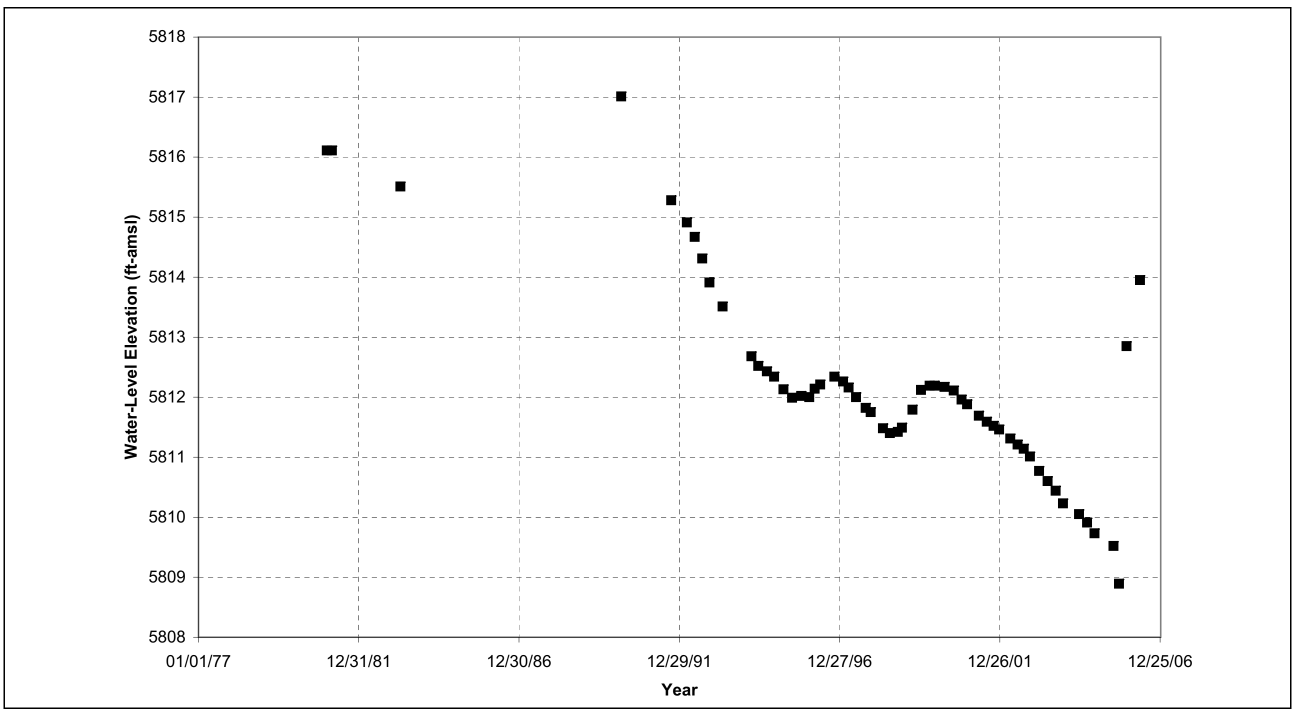

Figure D.1-4
Historical Water-Level Elevations for
Well 184 N11 E68 19DCDC1 USGS-MX (Spring Valley)

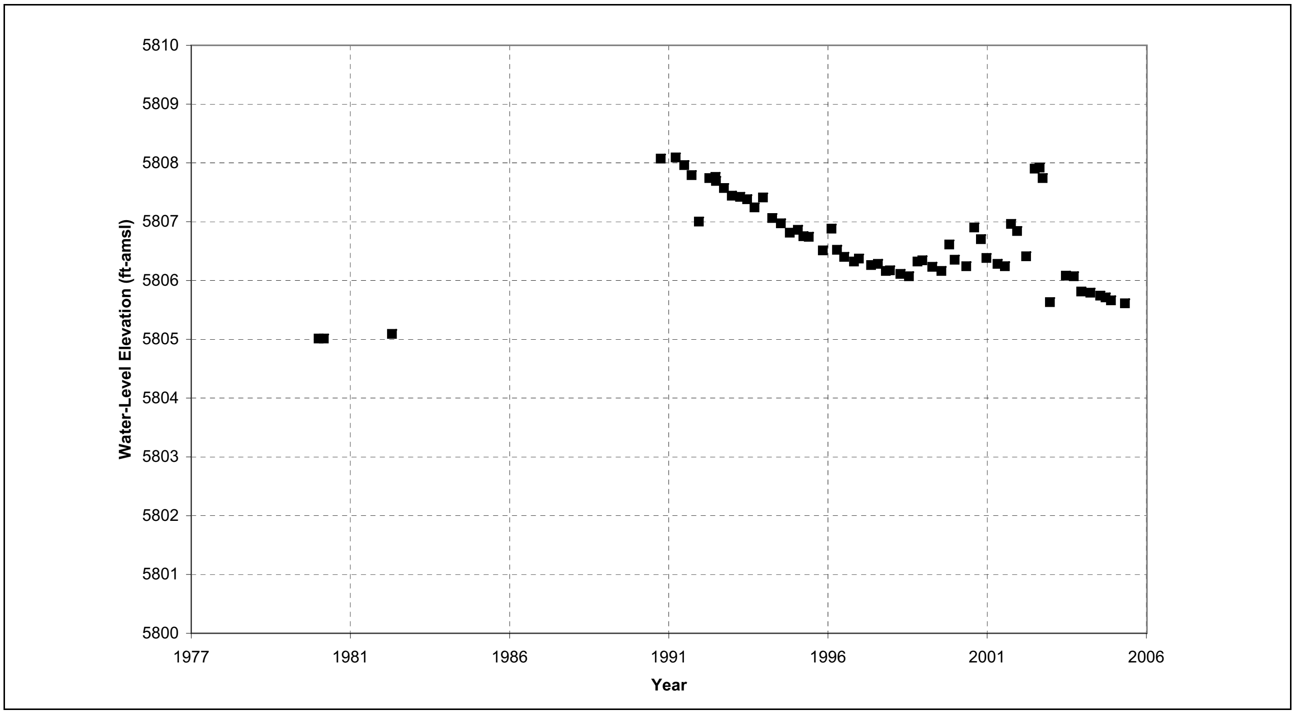

Figure D.1-5
Historical Water-Level Elevations for Well 184 N14 E66 24BDDD1 (Spring Valley N.)

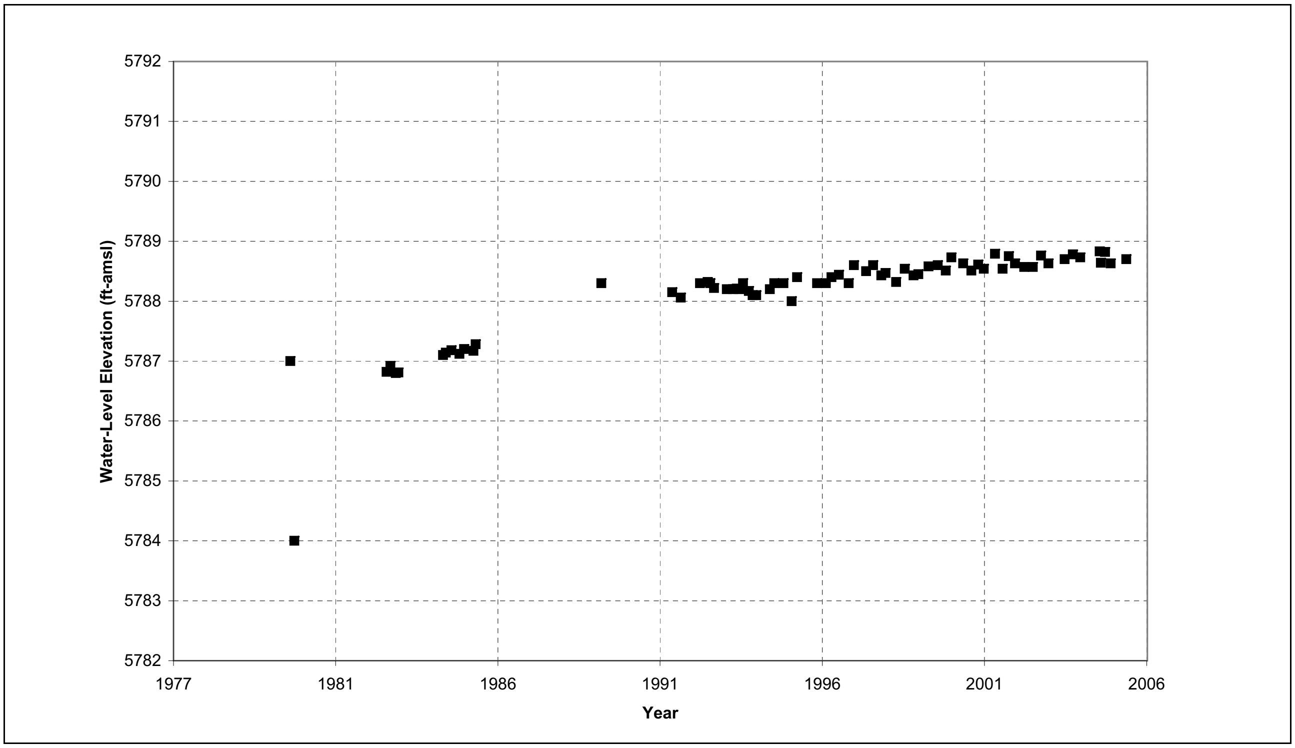

Figure D.1-6
Historical Water-Level Elevations for
Well 184 N09 E68 30AAAB1 USGS-MX (Spring Valley S.)

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