Doc No. WRD-ED-0045

SOUTHERN NEVADA
WATER AUTHORITY

SNWA Monitoring, Management, and Mitigation Plan for Spring Valley, Nevada

June 2017

Suggested citation:
Southern Nevada Water Authority, 2017, SNWA Monitoring, Management, and Mitigation Plan for Spring Valley, Nevada. Southern Nevada Water Authority, Las Vegas, Nevada, Doc. No. WRD-ED-0045.

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ACRONYMS

ACEC	Area of Critical Environmental Concern
BLM	Bureau of Land Management
CPB	Corporation of the Presiding Bishop of the Church of Jesus Christ of Latter-Day Saints
DEM	Digital Elevation Model
DOI	U.S. Department of the Interior
GDP	Clark, Lincoln, and White Pine Counties Groundwater Development Project
NDOW	Nevada Department of Wildlife
NDVI	Normalized Difference Vegetation Index
NDWR	Nevada Division of Water Resources
NSE	Nevada State Engineer
POD	Point of Diversion
SALR	Seasonally Adjusted Linear Regression
SNWA	Southern Nevada Water Authority
UDWR	Utah Division of Wildlife Resources
UDWRi	Utah Division of Water Rights
UGS	Utah Geological Survey
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

ABBREVIATIONS

afa	acre-feet per annum
amsl	above mean sea level
bgs	below ground surface
cfs	cubic feet per second
ft	foot
gpm	gallons per minute

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1.0 INTRODUCTION

This document presents the Southern Nevada Water Authority (SNWA) Monitoring, Management, and Mitigation Plan (3M Plan) for Spring Valley, Nevada (Hydrographic Area 184). SNWA prepared this plan to meet conditions for SNWA groundwater permit numbers 54003-54015 inclusive, 54019, and 54020 granted by the Nevada State Engineer (NSE) in Ruling 6164 (Nevada Division of Water Resources (NDWR), 2012). These water rights are to be used for the SNWA Clark, Lincoln, and White Pine Counties Groundwater Development Project (GDP) (SNWA, 2012b).

1.1 Background

In 1989, the Las Vegas Valley Water District (LVVWD) filed 19 applications (54003 through 54021) for the appropriation of groundwater in Spring Valley. By agreement with LVVWD on December 2, 2003, SNWA assumed full interest in these applications, which were the subject of NSE Ruling 6164.

Ruling 6164 presented the decision of the NSE regarding these SNWA Spring Valley applications. Application numbers 54003 to 54015, 54019, and 54020 were granted subject to specific conditions. These conditions included, among other requirements, the implementation of a monitoring plan with a minimum of two years of biological and hydrologic baseline data collection (NDWR, 2012, at page 217).

Ruling 6164 also includes the staged development of groundwater resources associated with the SNWA GDP permits (NDWR, 2012, at pages 216-217). The three stages consist of incremental increases in pumping volume to a maximum of 61,127 acre-feet per annum (afa) over 16 years as shown on Table 1-1. The staged groundwater development approach limits SNWA GDP pumping while aquifer response data is monitored and evaluated. NSE approval is required prior to advancing to the next stage of development.

On December 13, 2013, the Seventh Judicial District Court of the State of Nevada remanded Ruling 6164 on four issues (*White Pine County and Consolidated Cases, et. al., v. Nevada State Engineer*) (Remand Order). One of the four issues was to “Define standards, thresholds or triggers so that mitigation of unreasonable effects from pumping of water are neither arbitrary nor capricious in Spring Valley, Cave Valley, Dry Lake Valley and Delamar Valley.” A second issue was “The addition of Millard and Juab counties, Utah in the mitigation plan so far as water basins in Utah are affected by pumping of water from Spring Valley Basin, Nevada” (Seventh Judicial District Court of the State of Nevada, 2013, at page 23).

In response to the Remand Order, SNWA defined unreasonable effects for the SNWA GDP, and established thresholds, triggers, and monitoring, management, and mitigation actions to avoid those unreasonable effects. Each of these elements is presented in this 3M Plan. The evidence and scientific

Table 1-1
Spring Valley Staged Groundwater Development Schedule

Stage	Incremental Volume (afa)	Total (afa)	Time Period (Years)
1[a]	38,000	38,000	0-8
2[a]	12,000	50,000	8-16
3	11,127	61,127	>16

a. To advance to the next stage, SNWA is required to pump at least 85 percent but not more than 100 percent of the total afa for a minimum of eight years. Data from those eight years of pumping and updated numerical groundwater flow modeling results will be submitted to the NSE as part of the annual monitoring report. The NSE will then make a determination as to whether SNWA can proceed to the next development stage.

rationale used to develop this 3M Plan are presented in the *Technical Analysis Report Supporting the Spring Valley and Delamar, Dry Lake, and Cave Valleys, Nevada, 3M Plans* (Marshall et al., 2017).

This 3M Plan replaces the previous hydrologic monitoring and mitigation plan (SNWA, 2011b) and biological monitoring plan (Biological Work Group, 2009) that were approved by the NSE in Ruling 6164 (NDWR, 2012, at page 217). Those previous plans include specific elements to meet requirements of a stipulated agreement between SNWA and federal agencies, and will continue to be implemented in accordance with that agreement. This 3M Plan addresses concerns stated in the Remand Order, and complies with Nevada water law pursuant to the NSE's regulatory authority. This 3M Plan may be updated or amended in accordance with any future rulings, orders, or other direction by the NSE.

1.2 Purpose and Scope

This 3M Plan identifies hydrologic and environmental monitoring activities, investigation and mitigation triggers, and management and mitigation actions to avoid unreasonable effects from SNWA GDP pumping in Spring Valley and comply with Nevada water law. Investigation and mitigation triggers, and management and mitigation actions, are described in Section 3.0. The definition of unreasonable effects, for the purposes of this 3M Plan, is as follows:

For the SNWA GDP, unreasonable effects are effects to hydrologic and environmental resources that

a. conflict with senior water rights or protectable interests in existing domestic wells;
b. jeopardize the continued existence of federally threatened and endangered species;
c. cause extirpation of native aquatic-dependent special status animal species from a hydrographic basin's groundwater discharge area;
d. cause elimination of habitat types from a hydrographic basin's groundwater discharge area;[1] or
e. cause excessive loss of shrub cover that results in extensive bare ground.

1. Mesic, shrubland, terrestrial woodland, and lake habitat types.

More detailed descriptions of these unreasonable effects, and a discussion of senior water right protection and environmental soundness under Nevada water law, are provided in the 3M Plan analysis report (Marshall et al., 2017, at Section 2.0).

This definition of unreasonable effects is in the context of the Remand Order and is specific to SNWA water rights as part of the SNWA GDP. It responds to the concerns outlined in the Remand Order and is protective of senior water rights, protectable interests in existing domestic wells, and the public interest, while allowing for reasonable lowering of the static water level as provided under Nevada water law. The definition also incorporates the NSE's interpretation of environmental soundness under Nevada water law (Marshall et al., 2017, at Section 2.1) and identifies specific unreasonable environmental effects to avoid from SNWA GDP pumping. This definition of unreasonable effects is thus in accordance with the Remand Order and Nevada water law. However, this definition may not be applicable for other water rights in other hydrographic areas in Nevada, which have different rights, resources, and conditions, and are not subject to the Remand Order.

The 3M Plan area includes Spring, northern Hamlin, and southern Snake valleys (Figure 1-1). This area was delineated in the 3M Plan analysis report based on likelihood of inter-basin flow and potential for effects from SNWA GDP pumping (Marshall et al., 2017, at Section 4.0).[1] Spring Valley was divided into Management Blocks to provide a useful structure for developing triggers and monitoring, management, and mitigation actions in the basin (Marshall et al., 2017, at Section 6.1). The Management Blocks were based on distribution of senior water rights, SNWA water rights, environmental resources, and SNWA GDP PODs (Marshall et al., 2017, at Figure 6-1). The area of focus for the adjacent basins is the inter-basin groundwater flow path from Spring Valley. As described in Ruling 6164, outflow from southern Spring Valley enters northern Hamlin Valley via the Limestone Hills, joins the north-trending flow in northern Hamlin Valley, and then enters southern Snake Valley (NDWR, 2012, at pages 81-85). Further discussion on the delineation of the 3M Plan area is provided in the 3M Plan analysis report (Marshall et al., 2017, at Section 4.0).

This 3M Plan is organized as follows: Section 1.0 presents background information about Ruling 6164 and the Remand Order, and the purpose and scope of this 3M Plan. Section 2.0 presents hydrologic and environmental monitoring activities for this 3M Plan. Section 3.0 presents the thresholds, triggers, and management and mitigation actions to avoid unreasonable effects to hydrologic and environmental resources from SNWA GDP pumping in Spring Valley. Section 4.0 discusses numerical groundwater flow modeling and other predictive tools. Section 5.0 presents SNWA reporting obligations. Section 6.0 lists references cited in this 3M Plan. Appendix A presents 3M Plan hydrologic monitoring network sites and attributes. Appendix B presents 3M Plan senior water rights and domestic wells. Appendix C presents baseline period of record hydrographs and current triggers for selected monitor wells and springs.

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1. The 3M Plan area is referred to as the "analysis area" in the 3M Plan analysis report.

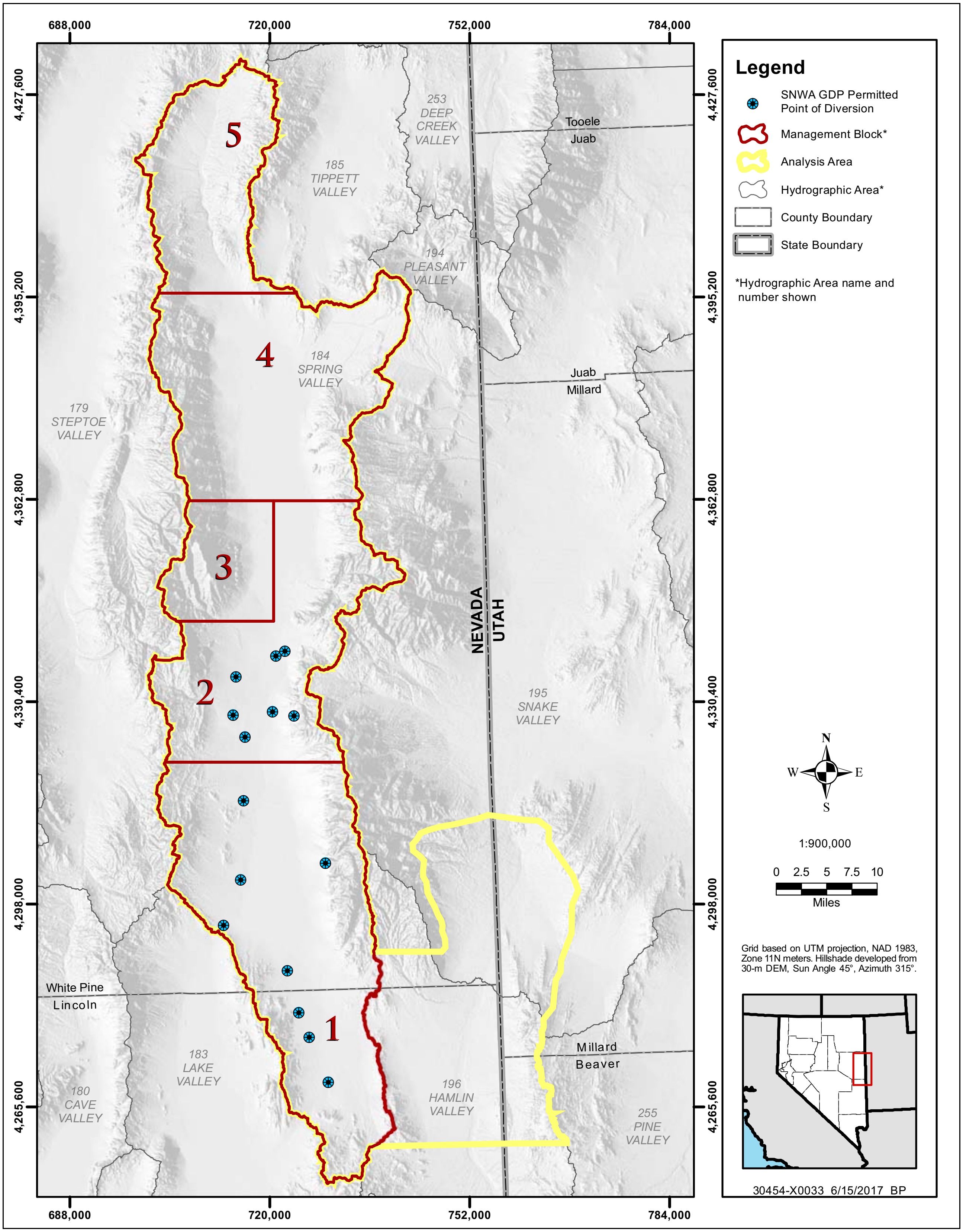

Figure 1-1
3M Plan Area for SNWA GDP Pumping in Spring Valley

2.0 Monitoring Plan

This section presents the hydrologic and environmental monitoring plan associated with SNWA GDP groundwater permits in Spring Valley. The monitoring plan provides representative hydrologic and environmental data to (1) characterize and quantify hydrologic and environmental conditions during both the baseline period prior to and during SNWA GDP pumping, (2) detect and measure drawdown propagation from GDP pumping, (3) signal activation of investigation and mitigation triggers, (4) conduct investigations, (5) calibrate and refine predictive tools, (6) determine management and mitigation actions to be implemented, (7) assess management and mitigation efficacy, and (8) identify management and mitigation modifications needed to meet goals and requirements.

Hydrologic and environmental monitoring activities for this 3M Plan are presented in Sections 2.1 and 2.2, respectively. Quality control and database management are presented in Section 2.3. As discussed in Section 1.2, Spring Valley was divided into Management Blocks in the 3M Plan analysis report to provide a useful structure for developing triggers and monitoring, management, and mitigation actions in the basin (Marshall et al., 2017, at Section 6.1). These management blocks are shown in Figure 1-1 and referred to throughout this section. Thresholds, triggers, and management and mitigation actions to avoid unreasonable effects and comply with Nevada water law are presented in Section 3.0.

2.1 Hydrologic Monitoring

This section describes the hydrologic monitoring element of the Spring Valley 3M Plan. The plan establishes and maintains a monitoring network representative of the hydrologic system to observe and document conditions during the pre-pumping baseline period and staged development operations. It also provides a structured systematic process to collect, analyze, and report data used to manage the SNWA GDP in a responsible and sustainable manner. The rationale and analyses used to develop this monitoring plan are presented in the 3M Plan analysis report (Marshall et al., 2017, at Sections 3.0, 6.2, and 7.2). Hydrologic thresholds, triggers, and management and mitigation actions are presented in Section 3.2.1.

Implementation of the hydrologic monitoring network and systematic baseline data collection began in 2006. The NSE approved the original Spring Valley 3M Plan in December 2009 (SNWA, 2009c) and a revised version in 2011 (SNWA, 2011b). As discussed in Section 1.0, the 3M Plan is revised again here to address concerns stated in the Remand Order. Hydrologic monitoring data associated with the 3M Plan are provided to the NSE electronically on a quarterly basis. Annual data reports have been provided to the NSE since 2008 (SNWA, 2008, 2009a, 2010a, 2011a, 2012a, 2013a, 2014a, 2015a, 2016a, and 2017a).

2.1.1 Hydrologic Monitoring Network

The hydrologic monitoring program includes the systematic measurement of a network of wells, piezometers, springs, streams, precipitation stations, and senior water right points of diversion (PODs). The program also includes aquifer characterization testing, water chemistry monitoring, and synoptic discharge studies of the Big Springs/Lake Creek complex. The well and spring monitoring networks associated with the Spring Valley 3M Plan are presented on Figure 2-1 and Figure 2-2, respectively. The figures also delineate the Management Blocks areas. The hydrologic monitoring network sites are listed in Table 2-1. The location and descriptive information for the monitoring sites are presented in Appendix A.

Senior water rights included in the Spring Valley 3M Plan are monitored either directly, using nearby proxy monitoring sites, or using sentinel monitor wells located between the POD and SNWA GDP production wells. The senior water rights and domestic wells included in the Spring Valley 3M Plan, monitoring strategy, and POD water resource assessment are presented in Section 2.2.

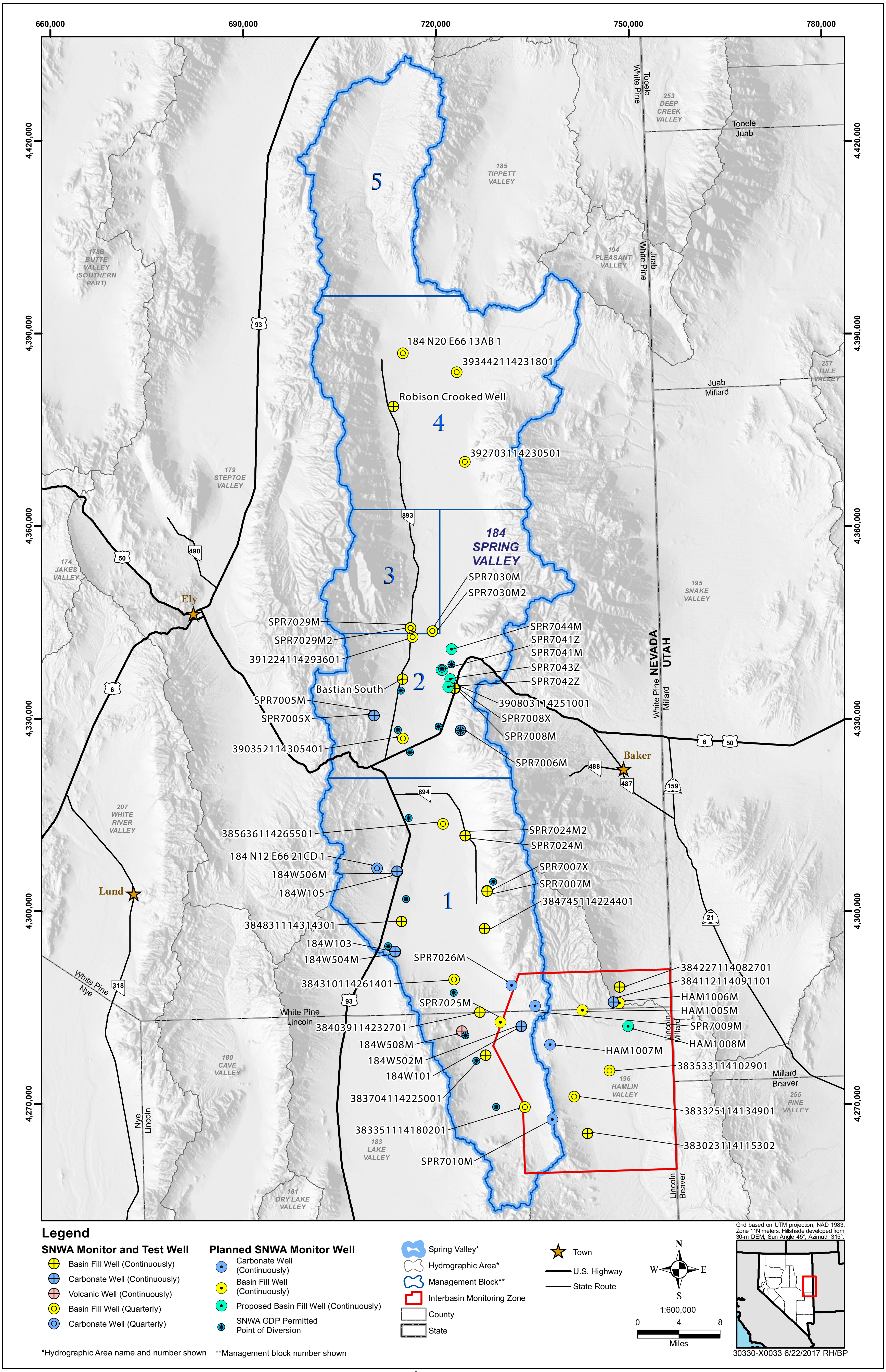

Figure 2-1
Spring Valley 3M Plan Monitor Well Network Locations

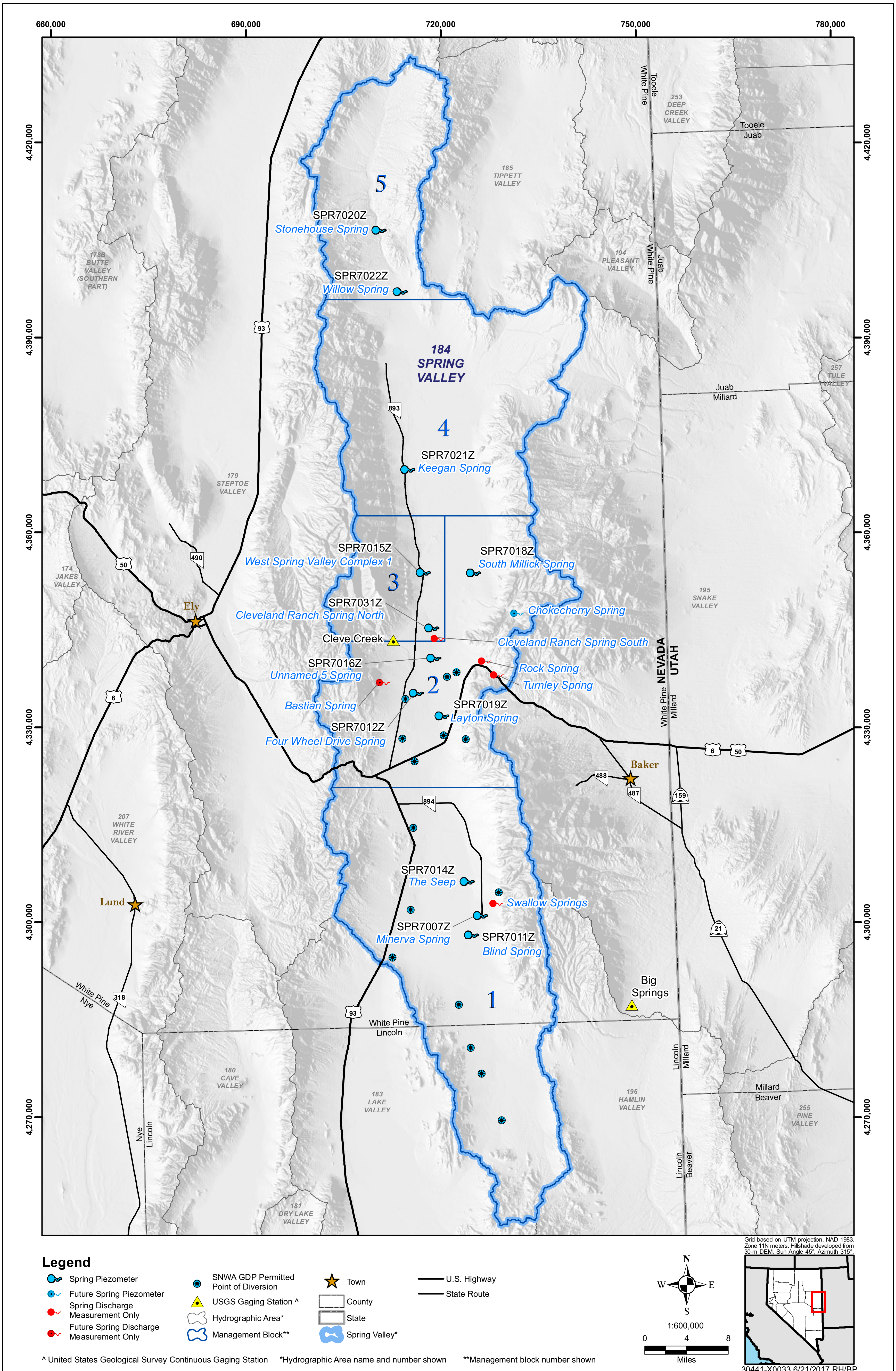

Figure 2-2
Spring Valley 3M Plan Spring and Stream Monitoring Network

Table 2-1
Spring Valley 3M Plan Hydrologic Monitoring Network
(Page 1 of 5)

Site Type/ Completion	Primary Name	Purpose/Description	Begin POR	End POR	Monitoring Frequency	Monitoring/ Reporting Agency
MANAGEMENT BLOCK 1						
Well/Basin Fill	385636114265501	Monitor aquifer conditions Near senior water rights	7/13/1998	Current	Quarterly	SNWA
Well/Basin Fill	384831114314301	Monitor aquifer conditions near POD for permit #54007 and #54008	3/8/1990	Current	Continuous	SNWA
Well/Basin Fill	384745114224401	Monitor aquifer conditions	3/8/1990	Current	Continuous	SNWA
Well/Basin Fill	384310114261401	Monitor aquifer conditions near permit #54006 POD	9/29/1991	Current	Quarterly	SNWA
Well/Basin Fill	384039114232701[b]	Monitor aquifer conditions near permit #54005 POD	11/17/2009	Current	Continuous	SNWA
Well/Basin Fill	383704114225001	Monitor aquifer conditions near permit #54004 POD	4/21/1983	Current	Continuous	SNWA
Well/Basin Fill	383351114180201	Monitor aquifer conditions near permit #54003 POD and senior water right	7/16/1996	Current	Quarterly	SNWA
Well/Basin Fill	SPR7007X	Test Well (Aquifer test performed)	3/12/2008	Current	Quarterly	SNWA
Well/Basin Fill	SPR7007M	Monitor aquifer conditions near permit #54019 POD	9/4/2007	Current	Continuous	SNWA
Well/Carbonate	184W502M	Monitor aquifer conditions	1/24/2007	Current	Continuous	SNWA
Well/Carbonate	184W101	Test well -aquifer test performed	2/27/2007	Current	Quarterly	SNWA
Well/Volcanic	184W508M	Monitor aquifer conditions near permit #54005 POD	12/19/2006	Current	Continuous	SNWA
Well/Carbonate	184W504M	Monitor aquifer conditions near permit #54007 POD	11/18/2006	Current	Continuous	SNWA
Well/Carbonate	184W103	Test well -aquifer test performed	12/6/2006	Current	Quarterly	SNWA
Well/Carbonate	184W506M	Monitor aquifer conditions	10/19/2006	Current	Continuous	SNWA
Well/Carbonate	184W105	Test Well (Aquifer test performed)	11/7/2006	Current	Quarterly	SNWA
Well/Basin Fill	SPR7024M2	Monitor vertical hydraulic gradient near Shoshone Ponds	4/6/2011	Current	Continuous	SNWA
Well/Basin Fill	SPR7024M	Monitor vertical hydraulic gradient near Shoshone Ponds	4/6/2011	Current	Continuous	SNWA
Well/Carbonate	SPR7009M[a]	Sentinel Well for Hamlin Valley	---	---	Continuous	SNWA
Well/Carbonate	SPR7010M[a]	Sentinel Well for Hamlin Valley	---	---	Continuous	SNWA
Well/Basin Fill	SPR7025M[a]	Monitor between IBMZ and closest SNWA basin fill production well	---	---	Continuous	SNWA
Well/Carbonate	SPR7026M[a]	Monitor between IBMZ and closest SNWA carbonate production well	---	---	Continuous	SNWA
Well/Carbonate	184 N12 E66 21CD 1	Dale's Seeding Well Monitor aquifer conditions in southwest Spring Valley	12/12/2006	Current	Quarterly	SNWA
Spring-Piezometer	SPR7014Z	Monitor aquifer conditions near the Seep piezometer (No discharge for extend period)	6/13/2010	Current	Continuous	SNWA
Spring-Piezometer	SPR7007Z	Monitor aquifer conditions near Minerva Spring Piezometer	3/25/2008	Current	Continuous	SNWA

Table 2-1
Spring Valley 3M Plan Hydrologic Monitoring Network
(Page 2 of 5)

Site Type/ Completion	Primary Name	Purpose/Description	Begin POR	End POR	Monitoring Frequency	Monitoring/ Reporting Agency
MANAGEMENT BLOCK 1						
Spring-Piezometer	SPR7011Z	Monitor aquifer conditions near Blind Spring Piezometer	5/24/2010	Current	Continuous	SNWA
Spring-Discharge	1846201	Measure Swallow Springs Discharge	7/28/2004	Current	Continuous	SNWA
Well/ Basin Fill	Shoshone Pond NDOW Well	Monitor artesian conditions at Shoshone Ponds	---	---	Continuous	SNWA
Four Piezometers/ Basin Fill[c]	Proposed	Monitor shallow groundwater conditions in shrubland habitat at four locations	---	---	Quarterly	SNWA
MANAGEMENT BLOCK 2						
Well/[c]	SPR7044M[a]	Sentinel monitor well for northern Spring Valley	---	---	Continuous	SNWA
Well/Carbonate	SPR7005X	Test well (aquifer test performed)	4/16/2008	Current	Quarterly	SNWA
Well/Carbonate	SPR7005M	Monitor aquifer conditions	12/18/2007	Current	Continuous	SNWA
Well/Carbonate	SPR7006M	Monitor aquifer conditions near permit #54020 POD	10/19/2007	Current	Continuous	SNWA
Well/Basin Fill	SPR7008X	Test well (aquifer test performed)	3/13/2008	Current	Quarterly	SNWA
Well/Basin Fill	SPR7008M	Monitor aquifer conditions near Swamp Cedar ACEC	9/6/2007	Current	Continuous	SNWA
Well/Basin Fill	390352114305401	Monitor aquifer conditions near permit #54010 and #54011 PODs	9/28/1991	Current	Quarterly	SNWA
Well/Basin Fill	390803114251001	Monitor aquifer conditions near Swamp Cedar ACEC	7/15/1996	Current	Continuous	SNWA
Well/Basin Fill	391224114293601[b]	Old Cleve Well (provides data south of Cleveland Ranch)	7/17/1997	5/14/2014	---	---
Spring-Discharge	1847301	Measure Rock Spring discharge (Very low spring discharge)	8/27/2007	Current	Continuous	SNWA
Spring-Discharge	1848001	Measure Turnley Spring discharge (domestic water supply- in mountain block)	10/16/2008	Current	Quarterly	SNWA
Spring-Discharge	1845702	Measure South Millick Spring Discharge	7/15/2004	Current	Quarterly	SNWA
Spring-Piezometer	SPR7018Z	Monitor aquifer conditions near South Millick Spring	6/17/2010	Current	Continuous	SNWA
Spring-Discharge	1845901	Layton Spring Discharge (Dry for extended period of time)	7/14/2004	Current	Quarterly	SNWA
Spring-Piezometer	SPR7019Z	Monitor aquifer conditions near Layton Spring	6/18/2010	Current	Continuous	SNWA
Spring-Piezometer	SPR7012Z	Monitor aquifer conditions near 4WD Spring (pool no discharge)	6/17/2010	Current	Continuous	SNWA
Spring-Piezometer	SPR7016Z	Monitor aquifer conditions near Unnamed Spring 5	6/17/2010	Current	Continuous	SNWA
Well/[c]	SPR7041M (proposed)	Swamp Cedar ACEC Deep Paired Well monitor shallow groundwater and deep aquifer conditions	---	---	Continuous	SNWA
Piezometer[c]	SPR7041Z (proposed)	Swamp Cedar ACEC Shallow Paired Piezometer Monitor shallow groundwater conditions	---	---	Continuous	SNWA

Table 2-1
Spring Valley 3M Plan Hydrologic Monitoring Network
(Page 3 of 5)

Site Type/ Completion	Primary Name	Purpose/Description	Begin POR	End POR	Monitoring Frequency	Monitoring/ Reporting Agency
MANAGEMENT BLOCK 2						
Piezometer[c]	SPR7042Z (proposed)	Swamp Cedar ACEC Shallow Piezometer southeast Monitor shallow groundwater conditions	---	---	Continuous	SNWA
Piezometer[c]	SPR7043Z (proposed)	Swamp Cedar ACEC Shallow Piezometer east-southeast Monitor shallow groundwater conditions	---	---	Continuous	SNWA
Two Piezometers/ Basin Fill[c]	Proposed	Monitor shallow groundwater conditions in shrubland habitat	---	---	Quarterly	SNWA
Well/Basin Fill	Bastian South	Deep well monitors aquifer conditions south of Cleveland Ranch	4/30/2008	Current	Continuous	SNWA
Spring - Discharge	Bastian Spring[a]	Measure spring discharge in the Schell Creek mountain block at Bastian Spring	---	---	Continuous	SNWA
Spring -Piezometer	Chokecherry Spring[a]	Monitor shallow groundwater near Chokecherry Spring	---	---	Quarterly	SNWA
Spring - Discharge	Chokecherry Spring[a]	Measure spring discharge in the Snake Range mountain block at Chokecherry Spring	---	---	Quarterly	SNWA
MANAGEMENT BLOCK 3						
Well/Basin Fill	SPR7029M2	Sentinel monitor well for northern Spring Valley	5/17/2011	Current	Quarterly	SNWA
Well/Basin Fill	SPR7029M	Sentinel monitor well for northern Spring Valley	6/14/2011	Current	Quarterly	SNWA
Well/Basin Fill	SPR7030M	Sentinel monitor well for northern Spring Valley	5/10/2011	Current	Quarterly	SNWA
Well/Basin Fill	SPR7030M2	Sentinel Monitor Well for northern Spring Valley	5/10/2011	Current	Quarterly	SNWA
Spring-Discharge	1848401	Measure Cleveland Ranch Spring North discharge	11/2/2010	Current	Quarterly	SNWA
Spring-Discharge	1848501	Measure Cleveland Ranch Spring South discharge	11/3/2010	Current	Continuous	SNWA
Stream-Discharge	1841611	Cleve Creek Gaging Station to measure stream flow	10/20/1959	Current	Continuous	USGS
Stream-Discharge	proposed	Three gaging stations on Cleve Creek and Summer/Winter Ditches at Cleveland Ranch	--	--	Continuous	---
Spring-Piezometer	SPR7015Z	Monitor aquifer conditions near West Spring Valley Complex	6/14/2010	Current	Continuous	SNWA
Spring-Piezometer	SPR7031Z	Monitor shallow groundwater conditions near North Cleveland Ranch Spring	5/24/2011	Current	Quarterly	SNWA

Table 2-1
Spring Valley 3M Plan Hydrologic Monitoring Network
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Site Type/ Completion	Primary Name	Purpose/Description	Begin POR	End POR	Monitoring Frequency	Monitoring/ Reporting Agency
MANAGEMENT BLOCK 4						
Well/Basin Fill	184 N20 E66 13AB 1	Monitor aquifer conditions	8/15/2006	Current	Quarterly	SNWA
Well/Basin Fill	393442114231801	Monitor aquifer conditions	7/15/1996	Current	Quarterly	SNWA
Well/Basin Fill	392703114230501	Monitor aquifer conditions	7/15/1996	Current	Quarterly	SNWA
Well/Basin Fill	Robison Crooked Well	Monitor aquifer condition	9/6/2007	Current	Continuous	SNWA
Spring-Discharge	1847101	Measure Keegan Spring discharge	8/29/2007	Current	Quarterly	SNWA
Spring-Piezometer	SPR7021Z	Monitor aquifer conditions near Keegan Spring	6/14/2010	Current	Continuous	SNWA
MANAGEMENT BLOCK 5						
Spring-Discharge	1845501	Measure Willow Spring discharge	7/14/2004	Current	Quarterly	SNWA
Spring-Piezometer	SPR7020Z	Monitor aquifer conditions near Stonehouse Spring	6/14/2010	Current	Continuous	SNWA
Spring-Piezometer	SPR7022Z	Monitor aquifer conditions near Willow Spring	6/14/2010	Current	Continuous	SNWA
NORTHERN HAMLIN AND SOUTHERN SNAKE VALLEYS						
Well/Basin Fill	HAM1005M[a]	Inter-basin Monitoring Zone aquifer conditions	---	---	Continuous	SNWA
Well/Basin Fill	HAM1006M[a]	Inter-basin Monitoring Zone aquifer conditions	---	---	Continuous	SNWA
Well/Carbonate	HAM1007M[a]	Sentinel Well for Hamlin Valley and monitor senior water rights	---	---	Continuous	SNWA
Well/Basin Fill	HAM1008M[a]	Proposed well - mitigation trigger site for Snake Valley	---	---	---	SNWA
Well/Basin Fill	383023114115302	Monitor aquifer conditions near senior water rights	8/19/1992	Current	Continuous	SNWA
Well/Basin Fill	383325114134901	Monitor aquifer conditions at senior water right	8/2/2005	Current	Quarterly	SNWA
Well/Basin Fill	384227114082701	Monitor aquifer conditions near Big Springs	9/28/1991	9/16/2014	---	---
Well/Basin Fill	383533114102901[b]	Monitor aquifer conditions at senior water right	8/14/2006	5/13/2014	---	---
Well/Carbonate	384112114091101	Monitor aquifer conditions near Big Springs	9/9/2010	Current	Continuous	SNWA
Stream-Discharge	1951901	Big Springs Gaging Station	6/22/2004	Current	Continuous	USGS

Table 2-1
Spring Valley 3M Plan Hydrologic Monitoring Network
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Site Type/ Completion	Primary Name	Purpose/Description	Begin POR	End POR	Monitoring Frequency	Monitoring/ Reporting Agency
REGIONAL PRECIPITATON STATIONS						
Precipitation	Schellborne	Measurement record includes over 60 years of water year data near Management Block 5	1954	Current	Periodic	NDWR
Precipitation	Mount Wilson	Measurement record includes over 60 years of water year data near Management Block 1	1954	Current	Periodic	NDWR
Precipitation	McGill	Measurement record includes over 100 years of monthly data	1892	Current	Continuous	WRCC
Precipitation	Ely WBO	Measurement record includes over 90 years of monthly data	1888	Current	Continuous	WRCC
Precipitation	Great Basin NP	Measurement record includes over 80 years of monthly data	1948	Current	Continuous	WRCC
Precipitation	Bird Creek	High elevation precipitation gage near Management Block 4	2011	Current	Continuous	NRCS (Snotel)
Precipitation	Berry Creek	High elevation precipitation gage near Management Block 3	1980	Current	Continuous	NRCS (Snotel)
Precipitation	Kalamazoo	High elevation precipitation gage near Management Block 4	2011	Current	Continuous	NRCS (Snotel)
Precipitation	Cave Mountain	High elevation precipitation gage near Management Block 2	2011	Current	Continuous	NRCS (Snotel)
Precipitation	Takka Wiiya	High elevation precipitation gage near Management Block 4	2013	Current	Continuous	NRCS (Snotel)
Precipitation	Silver Creek Nv	High elevation precipitation gage near Management Block 2	2011	Current	Continuous	NRCS (Snotel)
Precipitation	Wheeler Peak	High elevation precipitation gage near Management Blocks 1 & 2	2010	Current	Continuous	NRCS (Snotel)
Precipitation	PSPR7008	Near Swamp Cedar ACEC and inside Management Block 2	2017	Current	Continuous	SNWA
Precipitation	P1840602	Mid-elevation precipitation gage inside Management Block 4	2007	Current	Continuous	SNWA
Precipitation	P1841701	Mid-elevation precipitation gage inside Management Block 2	2009	Current	Continuous	SNWA
Precipitation	P1841901	Mid-elevation precipitation gage inside Management Block 4	2009	Current	Continuous	SNWA
Precipitation	P1846201	Mid-elevation precipitation gage inside Management Block 1	2010	Current	Continuous	SNWA

[a]Planned SNWA monitoring site
[b]Wells temporarily suspended from monitoring with consensus from NSE due to stable water levels over the baseline period. Monitoring will be resumed prior to SNWA GDP pumping.
[c]Location to be determined
[d]If access permission is denied, Shoshone Well #2 will be used as a proxy monitoring well.
Reporting agency: NDWR - Nevada Division of Water Resources; WRCC - Western Regional Climate Center; NRCS - Natural Resources Conservation Service; USGS - U.S. Geological Survey.
IBMZ = Inter-basin Monitoring Zone.
POR = Period of Record.

2.1.2 Senior Water Rights and Domestic Wells

SNWA performed queries of the NDWR on-line water rights database for all active water rights, NDWR on-line well log data base for domestic wells in Spring, Hamlin, and Snake valleys, Nevada, and the Utah Division of Water Rights on-line water right point of diversion database for all active water rights in Hamlin and Snake Valley, Utah. Active water rights are those that are not in application status, but it includes vested claims. Based on the query, active water rights in the valleys that have status of certificated, decreed, permitted, reserved, or vested were identified. The data set was adjusted by removing water rights that are located outside the 3M Plan area, in the basin mountain block, have priority dates junior to the SNWA GDP permits, reservoir rights, and those owned by SNWA. Additional information on the senior water rights data set is located in Marshall et al. (2017 at Section 6.2).

2.1.2.1 Senior Water Rights

In Spring Valley, 134 senior water rights were identified using the analysis criteria described above. Within the analysis area of Hamlin and Snake valleys, Nevada, there are 10 and 19 senior water rights, respectively, which meet the analysis criteria. In the Utah portion of Snake Valley, there are 31 approved and perfected water rights that meet the criteria. There are no senior water rights outside the mountain block in the Hamlin Valley, Utah analysis area.

Individual senior water rights for each Spring Valley management block and the Hamlin and Snake valley analysis area are listed in Tables B-1 to B-7. The tables include information on water right status, source, manner of use, priority date, diversion rate, annual duty, ownership, distance to the closest SNWA GDP POD, Digital Elevation Model (DEM) elevation, and management category. The water right PODs locations are presented graphically for each management block and for Hamlin and Snake valleys in Section 2.1.3.

2.1.2.2 Domestic Wells

A total of 18 non-SNWA domestic wells were identified in Spring Valley using available well logs. Two domestic wells located within the analysis area in Snake Valley were also identified. The wells are listed by basin and management block in Table B-8. A water resource assessment, as described in Section 2.1.2.4, of the domestic wells within 10 miles of the closest SNWA GDP PODs will be performed at least three years prior to initiation of SNWA GDP pumping to confirm the existence and condition of the wells.

2.1.2.3 Senior Water Right Management Categories

Individual senior water rights listed in Appendix B have been classified into groundwater management categories to reflect the strategy and approach for monitoring, management, and mitigation. The management categories are described in Table 2-2 and illustrated in plan and profile view on Figures 2-3 and 2-4, respectively. The management categories align with the use of staged development of the Spring Valley SNWA GDP water rights, with more emphasis initially focused on senior water rights located near the SNWA GDP PODs. A more detailed discussion of the management categories is provided in the 3M Plan analysis report (Marshall et al., 2017, at Section 3.2.5).

Management Category A is assigned to senior water rights within 3 miles of an SNWA GDP POD. Category A senior water rights will be monitored either directly at the POD or at a proxy monitoring site if there are multiple water rights grouped together or if a more reliable representative measurement can be collected at the proxy site.

Management Category B is assigned to senior water rights between 3 and 10 miles of an SNWA GDP POD. Category B sites will be monitored either directly at the senior water right POD, at a proxy monitor well in the vicinity of the senior rights, or at an intermediate monitor well which can detect propagation of drawdown between the group of senior rights and an SNWA GDP POD.

Senior water rights assigned Management Categories A and B will have a baseline water resource assessment performed, as described in the 3M Plan analysis report (Marshall et al., 2017, at Section 3.2.7), at least three years prior to SNWA GDP pumping. The assessment will document the characteristics, condition, and production capacity of the senior water right POD. The baseline assessment is in addition to long term baseline measurements of water levels or spring/stream discharge at the water right PODs or proxy monitoring locations.

Management Category C consists of senior water rights within the same basin as but located over 10 miles from the closest SNWA GDP POD (for example, water rights located in northern Spring Valley). Management Category D is assigned to senior water rights located in an adjacent basin (Hamlin and Snake valleys). Management Categories C and D rely on an intermediate well between the senior water right and SNWA GDP POD that is designated as a sentinel monitor well (as described in Marshall et al., 2017, at Section 3.2.2) near the basin boundary or edge of SNWA GDP production area to detect and measure propagation of drawdown.

Management Category E is assigned to senior water rights that are not in hydraulic connection with the producing aquifer in which SNWA GDP production wells will be installed. This categorization is based upon previous hearing testimony, the hydrogeologic setting of the site, and the difference in spring or stream elevation compared to the SNWA GDP POD water level.

2.1.2.4 Water Resource Assessment

A baseline assessment will be performed by SNWA at least three years prior to GDP pumping at each senior water right POD and domestic well included in the 3M Plan that is located within 10 miles of the closest SNWA GDP POD, with permission of the owner. The 10 mile extent provides an initial assessment area beyond which effects are not expected during initial development time frames. The 10 mile limit will be extended as a management action if monitoring network observations indicate potential for drawdown effects from the SNWA GDP PODs to extend beyond 10 miles to more distant senior water rights. The assessment will document the characteristics, condition, and production capacity of the senior water right POD. The baseline assessment is in addition to long term baseline measurements of water levels or spring/stream flow at the water right PODs or proxy monitoring locations.

Table 2-2
Management Strategy Category Summary[a]
(Page 1 of 2)

Category	Description	Monitoring Strategy	Management Strategy
A	Senior water right <3 miles from closest SNWA GDP POD	- Perform water resource assessment at least three years prior to SNWA GDP pumping with owner permission -Direct monitoring at senior water right site or proxy monitoring site at least quarterly	-Investigation trigger at senior water right site or proxy monitoring location is below the 99.7 percent lower control limit for six continuous months using the seasonally adjusted linear regression (SALR) method -Mitigation trigger set at senior water right site -Preemptive mitigation preparation
B	Senior water right 3 to 10 miles from closest SNWA GDP POD	- Perform water resource assessment at least three years prior to SNWA GDP pumping with owner permission -Direct monitoring at senior water right site or proxy monitoring site at least quarterly -Monitoring at intermediate monitor well, if available	-Investigation trigger at senior water right site or proxy monitoring location is below the 99.7 percent lower control limit for six continuous months using the SALR method -Mitigation trigger set at senior water right site -Preemptive mitigation preparation
C	Distant senior water right site >10 miles from closest SNWA GDP POD, and is within the same basin	-Monitoring at sentinel well and senior water right or nearby proxy site	-Investigation trigger is activated if water level in sentinel or intermediate well is below the 99.7 percent lower control limit for six continuous months using the SALR method -Refine predictive tools with aquifer response data to estimate drawdown at other more distant monitor wells -Identify and implement management actions if needed -Mitigation trigger set at senior water right site

Table 2-2
Management Strategy Category Summary[a]
(Page 2 of 2)

Category	Description	Monitoring Strategy	Management Strategy
D	Senior water right site located in a hydrographic area adjacent to SNWA GDP basins	-Monitoring at sentinel well near basin boundary -Monitoring at multiple monitor wells at different distances between senior water right site and SNWA GDP POD -Monitoring at senior water right site or proxy site	-Investigation trigger at senior water right site or proxy monitoring location is below the 99.7 percent lower control limit for six continuous months using the SALR method -Refine predictive tools with aquifer response data to estimate drawdown at other monitor wells and at senior water right site to determine if amount of drawdown in sentinel or other monitoring wells is significant compared to senior water right site -Identify and implement management actions if needed -Mitigation trigger set at senior water right site
E	Senior water right site not in hydraulic connection with SNWA GDP producing aquifer in which SNWA GDP production wells will be installed	-Effects from SNWA GDP pumping are unlikely -Monitoring at intermediate, sentinel well, and/or area proxy well for verification	Effects from SNWA GDP pumping are unlikely

a. The assigned category for each senior water right in the analysis area is presented in the individual basin senior water right summary tables in Appendix B.

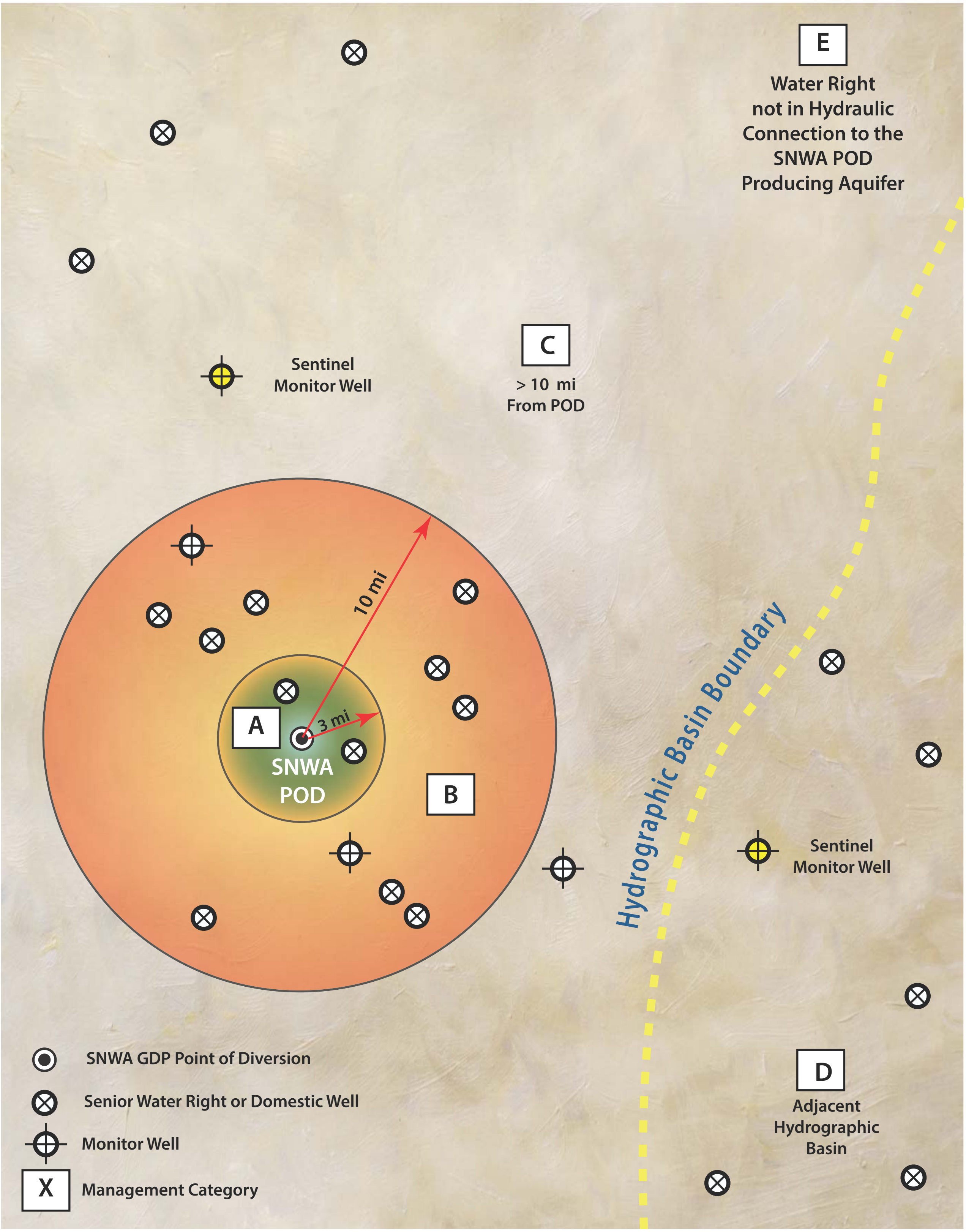

Figure 2-3
Plan View Illustration of Management Strategy Categories

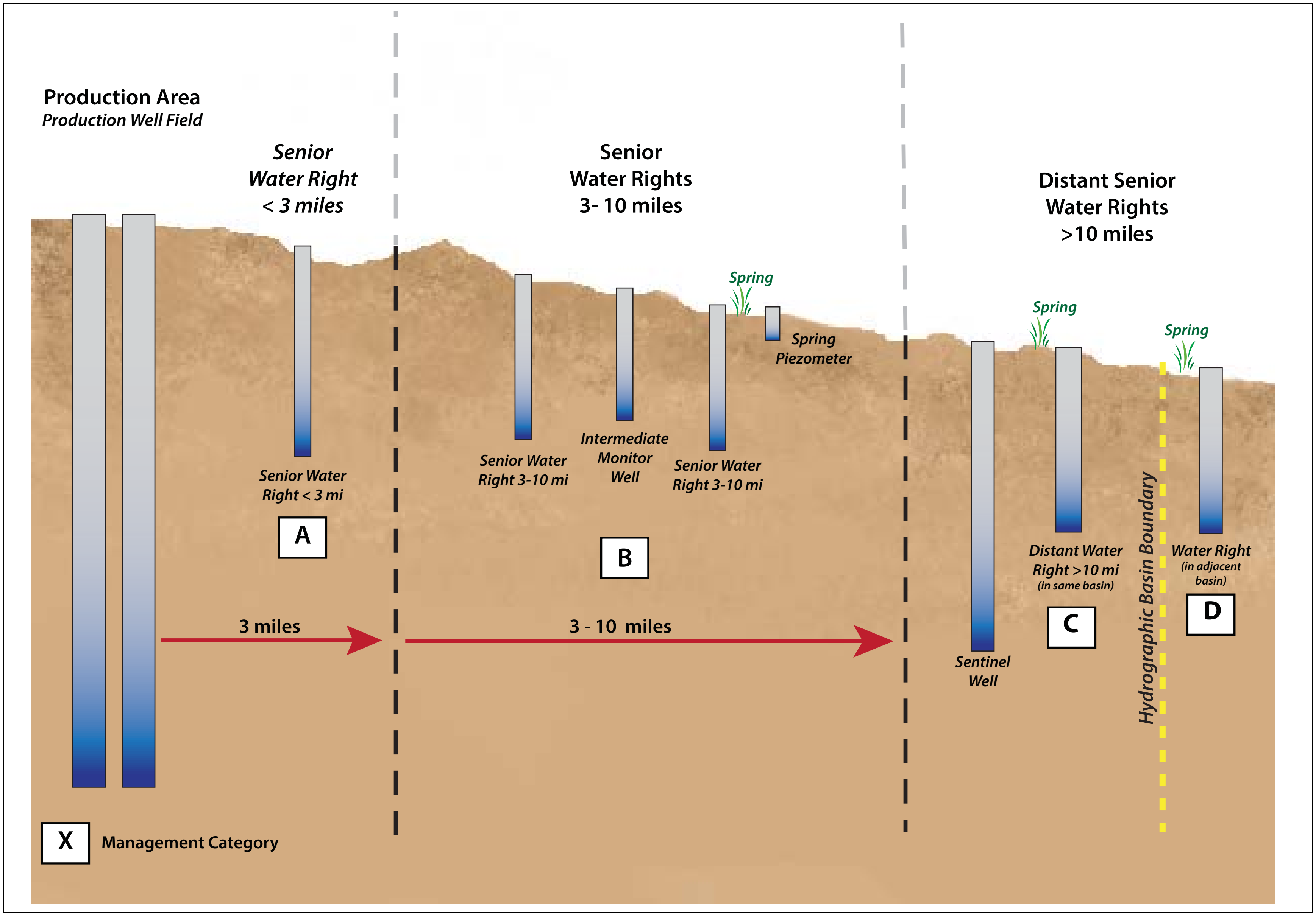

Figure 2-4
Profile Illustration of Management Strategy Categories

Wells associated with senior underground water rights will be inventoried and assessed, with permission of the owner, by SNWA prior to SNWA GDP pumping. The purpose of the assessment is to document the condition of the well. The results of the well assessment will be used to verify the potential for impacts from SNWA GDP pumping and confirm investigation and mitigation triggers. The well assessment includes the following activities performed by SNWA:

- Review of available driller completion reports providing information on well construction, depth, lithology, and production data at time of well installation.
- Perform a downhole video log, if the well is accessible, to verify the construction log, document pump setting, screen or perforation interval, well depth, and condition of the well and pump.
- Perform a well step-drawdown test (step test) using the current pump to document existing pump capacity, static and pumping water levels, well performance, and specific capacity at various pumping rates. A temporary test pump will be used with the owner’s permission if there is no existing pump in the well or if the current pump is not functioning.
- Determine the potential for the well to be redeveloped in order to increase well efficiency.
- Determine the potential for the pump to be lowered in the well.
- Prepare a short technical memo documenting the findings.

The wells will be grouped into two categories: (1) the well discharge rate is above the water right diversion rate; and (2) the well discharge rate is at or below the water right diversion rate. If no data is available the well production capacity will be assumed to produce at the water right diversion rate.

An assessment of spring and stream water rights located in the assessment area will be performed by SNWA to document hydraulic characteristics, conditions, and production capacity and flow variability. Baseline spring flow data will be collected for individual springs, or at an assigned proxy spring or monitoring well site which is representative of the spring POD site. The assessment will include documentation of the springhead and any observed or documented modifications. Spring and stream sites will be grouped into categories where: (1) the spring or stream flow rate is consistently above the water right diversion rate; (2) the spring or stream flow rate is consistently at or below the water right diversion rate; and (3) springs which have intermittent flow or are usually dry.

A spring which has non-measurable intermittent flow or that is dry over extended periods of time will be studied as a special case using nearby shallow piezometers, if present, or visual observations. The spring conditions will be compared to water levels and regional precipitation conditions to determine the conditions under which the spring normally flows. After SNWA GDP pumping begins, the spring will be monitored to determine if there is a change in the observed spring flow compared what has been observed under similar baseline regional hydrologic conditions.

2.1.3 Spring Valley

As described in Section 1.2, Spring Valley is divided into five management blocks to provide a useful structure for developing triggers and monitoring, management, and mitigation actions in the basin. The monitoring wells, piezometers, springs, streams, and senior water right PODs presented in this section are organized by Management Block. The other hydrologic monitoring program components, including precipitation, aquifer characterization, synoptic discharge studies, and water chemistry, are presented in separate sections below.

The environmental resources for which monitoring is established in Spring Valley to ensure avoidance of unreasonable effects include one federally-endangered species, one native aquatic-dependent special status animal species, and three habitat types (mesic, shrubland, and terrestrial woodland habitats). The monitoring for each of these resources is described below. This information is organized by environmental resources, with reference to the Management Blocks discussed in Section 1.2 (shown in Figure 1-1). The triggers and management and mitigation activities for these environmental resources are presented in Section 3.3.2.

2.1.3.1 Management Block 1

Management Block 1 consists of the southern portion of Spring Valley which contains the SNWA GDP PODs associated with permit numbers 54003 through 54009 and 54019. The SNWA GDP POD locations, senior water rights, and 3M Plan hydrologic monitoring network in Management Block 1 are shown on Figure 2-5. The majority of existing water rights on the valley floor and alluvial fan in Management Block 1 are owned by SNWA (Marshall et al., 2017, at Section 6.1). There are no non-SNWA owned domestic wells in this management block.

The hydrologic monitoring sites for Management Block 1 are listed in Table 2-1. Individual senior water rights meeting the analysis criteria are listed in Table B-1 including information on water right status, source, manner of use, priority date, diversion rate, annual duty, ownership, distance to the closest SNWA GDP POD, DEM elevation, and management category. Monitoring associated with each senior water right is presented in Table 2-3.

Nine of the certificated underground rights and one reserved water right listed in Table B-1 are assigned Management Category A (as described on Table 2-2) because they are located within 3 miles of the nearest SNWA GDP POD. The closest of these senior water rights are permit numbers 8076 and R05273 which are located over a mile from the SNWA GDP POD for permit number 54009. One other certificated underground right in this management block is assigned Management Category B because it is located between 3 and 10 miles of the nearest SNWA GDP POD permit number 27768. This senior water right is associated with the Shoshone Ponds and is discussed in detail in Marshall et al. (2017 at Section 6.3.1.3) and summarized in Section 2.2.1.1.

One of the reserved spring water rights R05274 and the stream vested claim V01026, located approximately 5 and 6 miles from the nearest SNWA GDP POD, are assigned Management Category E because these sites are not in hydraulic connection with the producing aquifer in which SNWA GDP production wells will be installed. This is due to the location, hydrogeologic setting, and

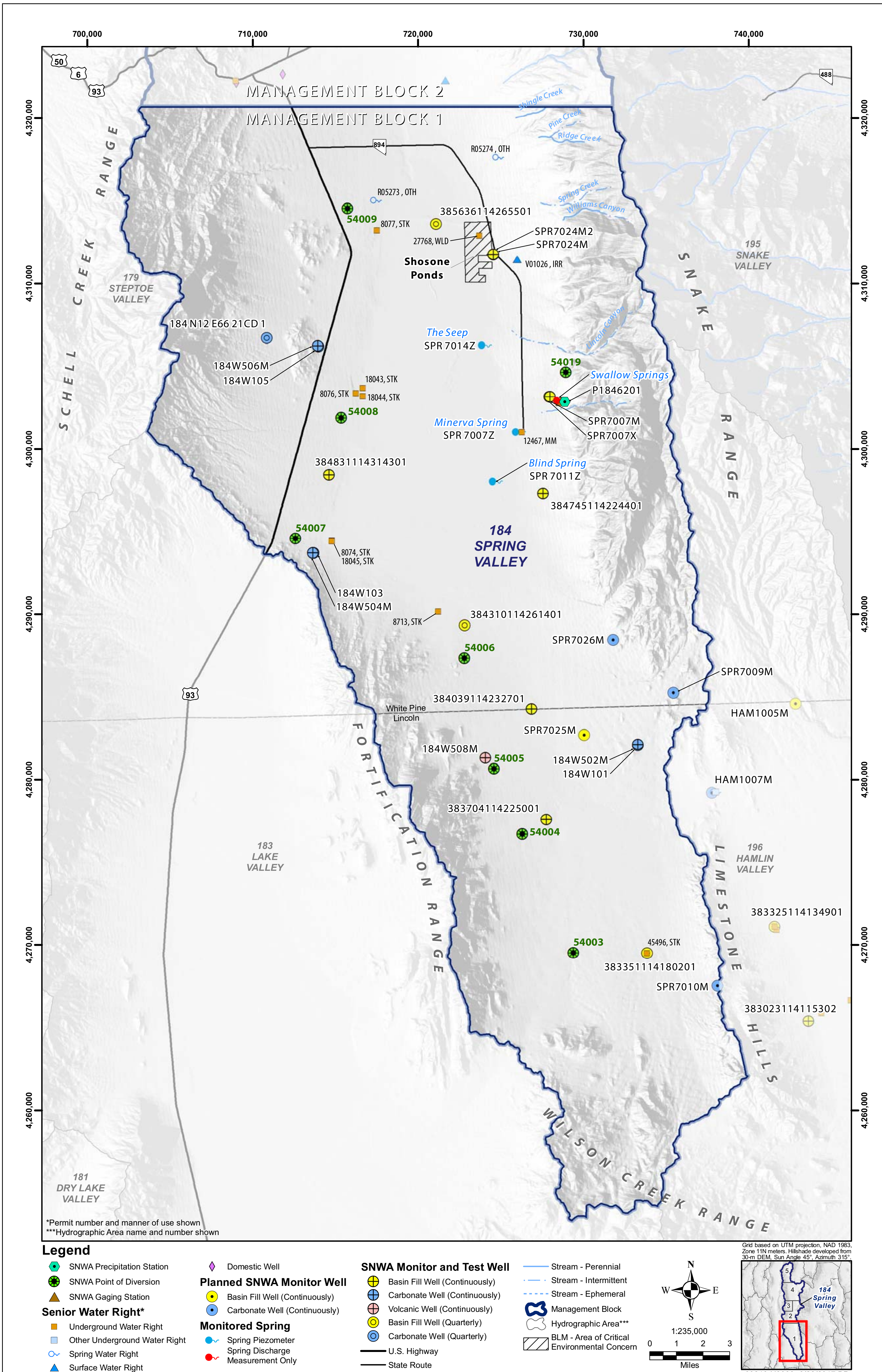

Figure 2-5
Management Block 1 GDP PODs, Senior Water Rights, and Hydrologic Monitoring Network

Table 2-3
Spring Valley Management Block 1 Senior Water Right PODs - Monitoring Sites

Senior Water Right	Associated Monitoring Site	Notes
Management Block 1		
8074, 18045	Directly at one POD - Well	Stock water two PODs grouped at same location
8076, 18043,18044	Directly at one POD - Well	Stock water three PODs grouped at same location
8077	Directly at POD - Well	Stock water
8713	Directly at POD - Well	Stock water
12467	SPR7013Z	Milling and mining - may not be active
27768	Directly at POD - Well	Flowing artesian well at Shoshone NDOW Well. If not accessible, substitute BLM well Shoshone Well #2.
45496	383351114180201	Stock water
R05273	Directly at POD - Spring	Reserved right
----	Four piezometers	Shrubland monitoring

elevation difference between the water rights and the SNWA GDP PODs; therefore, effects from SNWA GDP pumping are unlikely.

The monitoring strategy for senior water rights assigned Management Categories A and B consists of the following:

- Perform a water resource assessment, as described in Section 2.1.2.4, on the ten wells and one spring listed in Table B-1 at least three years prior to SNWA GDP pumping.

- Measure static water level at the ten wells listed in Table B-1 on a quarterly basis beginning at least three years prior to SNWA GDP pumping if physically accessible and permission is granted by the owner. The time period will provide three measurements each season to provide a baseline for comparison with monitor wells in the network with longer term baseline records.

- Directly monitor spring flow at water right R05273 if discharge is measurable. If not measurable, document conditions of the spring compared to any observed changes in the groundwater level at the well associated with underground stock water right 8077.

- Measure all monitoring network well and spring locations as described in the 3M Plan to document hydrologic and aquifer conditions.

Three additional piezometers will be installed in shrubland habitat within the groundwater discharge area. These additional monitoring sites will expand the hydrologic monitoring network to monitor shallow groundwater conditions in shrubland habitat not associated with springs or streams. The piezometers will be drilled to a depth of up to 50 feet (ft), depending upon hydrogeologic conditions encountered, and located based on the final shrubland monitoring design, as discussed in Section 2.2.1.3. These piezometers will be installed and monitored at least five years prior to SNWA GDP groundwater withdrawal from Spring Valley to coincide with shrubland habitat monitoring (Section 2.2.1.3).

2.1.3.2 Management Block 2

Management Block 2 consists of the central portion of Spring Valley which contains the SNWA GDP PODs associated with permit numbers 54010 through 54015 and 54020. The SNWA GDP PODs, senior water rights, and 3M Plan hydrologic monitoring network in Management Block 2 are shown on Figure 2-6. A combination of SNWA-owned and privately-owned existing water rights occur on the valley floor and alluvial fan of Management Block 2 (Marshall et al., 2017, at Section 6.1). This management block includes Shoshone Ponds and the Bureau of Land Management (BLM)-designated Swamp Cedar Area of Critical and Environmental Concern (ACEC), which are focal areas in the environmental monitoring plan (Section 2.2.1.4).

The hydrologic monitoring sites for Management Block 2 are listed in Table 2-1. Individual senior water rights meeting the analysis criteria are listed in Table B-2 including information on water right status, source, manner of use, priority date, diversion rate, annual duty, ownership, distance to the closest SNWA GDP POD, DEM elevation, and management category. Monitoring associated with each senior water right meeting the analysis criteria is presented in Table 2-4.

The distances between the 40 senior water rights and vested claims within Management Block 2 in hydraulic connection with the producing aquifer in which SNWA GDP production wells will be installed and the SNWA GDP PODs range from 0.8 to 10.8 miles. Twenty seven of these senior water rights consisting of seven underground certificated, eight spring (one of which is certificated and seven reserved), and 12 spring vested claims listed on Table 2-4 are assigned Management Category A because they are located within 3 miles of the nearest SNWA GDP POD.

Ten senior water rights located between 3 and 10 miles of the nearest SNWA GDP POD and are assigned Management Category B (as described on Table 2-2). These consist of one underground certificated, three spring certificated, one stream certificated, one spring reserved, and four vested spring claims. There are three senior water rights located over 10 miles from the nearest SNWA GDP POD consisting of two certificated spring and one permitted underground water right assigned Management Category C.

The monitoring strategy for senior water rights assigned Management Categories A and B consists of the following:

- Perform a water resource assessment, as described in Section 2.1.2.4 at least three years prior to SNWA GDP pumping.

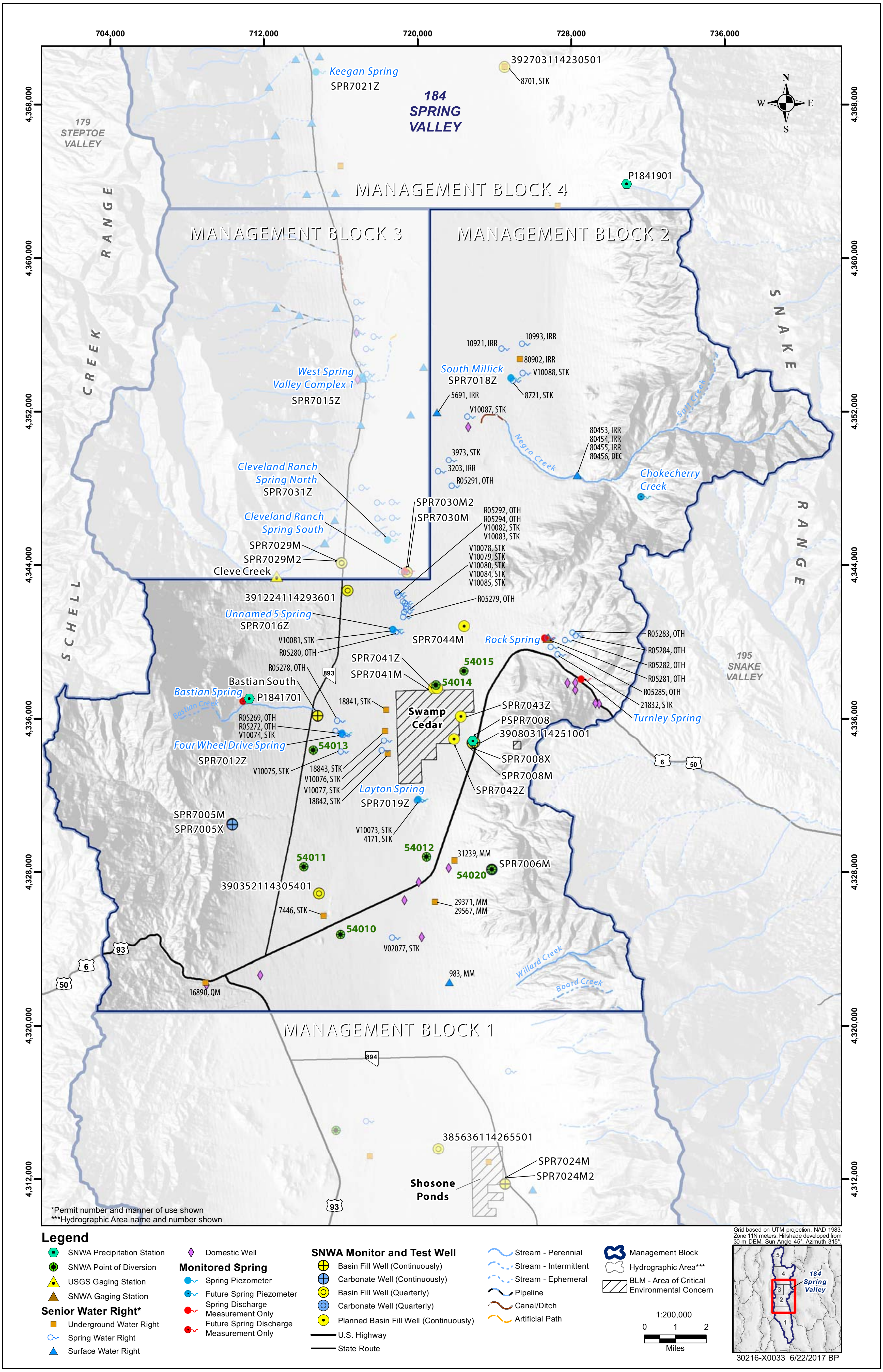

Figure 2-6
Management Block 2 GDP PODs, Senior Water Rights, and Hydrologic Monitoring Network

- Monitoring each senior water right directly at the POD or at a nearby proxy well as described in Table 2-4.

- Measuring static water level at wells on a quarterly basis beginning at least three years prior to SNWA GDP pumping, if physically accessible and permission is granted by the owner.

- Measuring spring discharge at the springs on a quarterly basis beginning at least three years prior to SNWA GDP pumping, if the springs can be accurately measured, are physically accessible, and have permission granted by the land owner. The measurements will be compared to water levels at nearby proxy monitor wells listed in Table 2-4 to determine if the wells can provide more accurate data on aquifer conditions and spring discharge for those senior spring water rights.

- Five monitor wells and one gaging station located in the vicinity of these senior water rights which will be monitored continuously and may be used as a proxy for groundwater conditions associated with senior water rights as listed in Table 2-4.

Monitor well SPR7044M will be installed one mile north of the northern most SNWA GDP production well at least three years prior to SNWA GDP pumping. This well is designated as a sentinel well to detect and measure drawdown propagating in the direction of the distant water rights assigned Management Category C. The designation and purpose of sentinel wells is further described in the 3M Plan analysis report (Marshall et al., 2017, at Section 3.2.2).

Unreasonable effects at senior water rights assigned Management Category E are unlikely because these rights are not in hydraulic connection with the producing aquifer in which SNWA GDP production wells will be installed. Continuous gaging stations at Rock Spring (operating), Chokecherry Spring (planned), Bastian Creek Spring (planned), and periodic physical measurements at Turnley Spring will document aquifer conditions in the mountain block and verify that no impacts occur. A supplemental gaging station operated by SNWA on Bastian Creek will also be used to document hydrologic conditions in the area.

Hydrologic monitoring associated with the Swamp Cedar ACEC includes three planned shallow piezometers (SPR7041Z, SPR7042Z, and SPR7043Z), and one deep monitor well (SPR7041M). SPR7041M and SPR7041Z will be drilled in close proximity to each other to evaluate the vertical hydraulic gradient and relationship between shallow groundwater and the deeper aquifer underlying the Swamp Cedar ACEC area. SPR7041Z will be drilled to a depth of approximately 20 to 30 ft, depending upon hydrogeologic conditions encountered, and SPR7041M will be drilled to below a clay layer which was observed in nearby well SPR7008M or 300 ft. SPR7042Z and SPR7043Z will compliment SPR7041Z to better understand the shallow groundwater conditions within the upper root zone of the swamp cedars. These additional monitoring sites will expand the current two monitor wells (SPR7008M and 390803114251001), one test well (SPR7008X) and a precipitation station (PSPR7008) in the vicinity of the ACEC to evaluate the relationship between precipitation, shallow groundwater, and the underlying producing aquifer in which SNWA GDP production wells will be installed. This additional monitoring will begin at least five years prior to SNWA GDP groundwater withdrawal from Spring Valley to coincide with terrestrial woodland habitat monitoring (Section 2.2.1.4).

Table 2-4
Spring Valley Management Block 2 Monitoring Program

Senior Water Right/Monitoring Area	Associated Monitor Well
V10078-V10085, R05279-R05280, R05292, R05294	Continuous water level at Unnamed 5 Spring Piezometer (SPR7016Z)
V10074-V10075, R05269, R05272, R05278	Four Wheel Drive Spring Piezometer (SPR7012Z) and Bastian South Well
18841-18843, V10076-V10077, V02077, 16890, 31239, 29567, 29371, 7446	Direct monitoring at water right site
4171, V10073	Layton Spring Piezometer (SPR7019Z)
3203,3973, 5691, R05291, V10087	Sentinel Monitor Wells SPR7030M, SPR7030M2, and SPR7044M (planned well)
8721, 80902,10993, 10921, V10088	South Millick piezometer (SPR7018Z) and Sentinel Monitor Wells SPR7030M, SPR7030M2, and SPR7044M (planned well)
Aquifer Conditions in Management Block	SPR7005M, SPR7008M, and 390803114251001
Swamp Cedar ACEC (See Section 2.2.1.4)	SPR7041M, SPR7041Z, SPR7042Z, and SPR7043Z (proposed wells)
Shrubland Piezometer (See Section 2.2.1.3)	To be determined (proposed wells)
21832, R05281-R05285 (mountain block)	Springs not in hydraulic connection with producing aquifer for SNWA GDP permits. Rock Spring gaging station and Turnley Spring for measurement verification
983, 80453-80456	Streams not in hydraulic connection with producing aquifer for SNWA GDP permits.

Two additional piezometers will be installed in shrubland habitat within the groundwater discharge area. These additional monitoring sites will expand the hydrologic monitoring network to monitor shallow groundwater conditions in shrubland habitat not associated with springs or streams. The piezometers will be drilled to a depth of up to 50 ft, depending upon hydrogeologic conditions encountered, and located based on the final shrubland monitoring design, as discussed in Section 2.2.1.3. These piezometers will be installed and monitored at least five years prior to SNWA GDP groundwater withdrawal from Spring Valley to coincide with shrubland habitat monitoring.

2.1.3.3 Management Block 3

Management Block 3 is located in west-central Spring Valley and contains Cleveland Ranch. The northernmost SNWA GDP POD is approximately three and a half miles south of the management block. The SNWA GDP PODs, senior water rights, and 3M Plan hydrologic monitoring network in Management Block 3 are shown on Figure 2-7. The majority of existing water rights on the valley floor and alluvial fan of Management Block 3 are privately owned, with existing water rights in the north owned by SNWA (Marshall et al., 2017, at Section 6.1). This management block is a focal area in the environmental monitoring plan (Section 2.2.1.4). Background information and hydrogeologic setting is presented in the 3M Plan analysis report (Marshall et al., 2017, at Section 6.2.3).

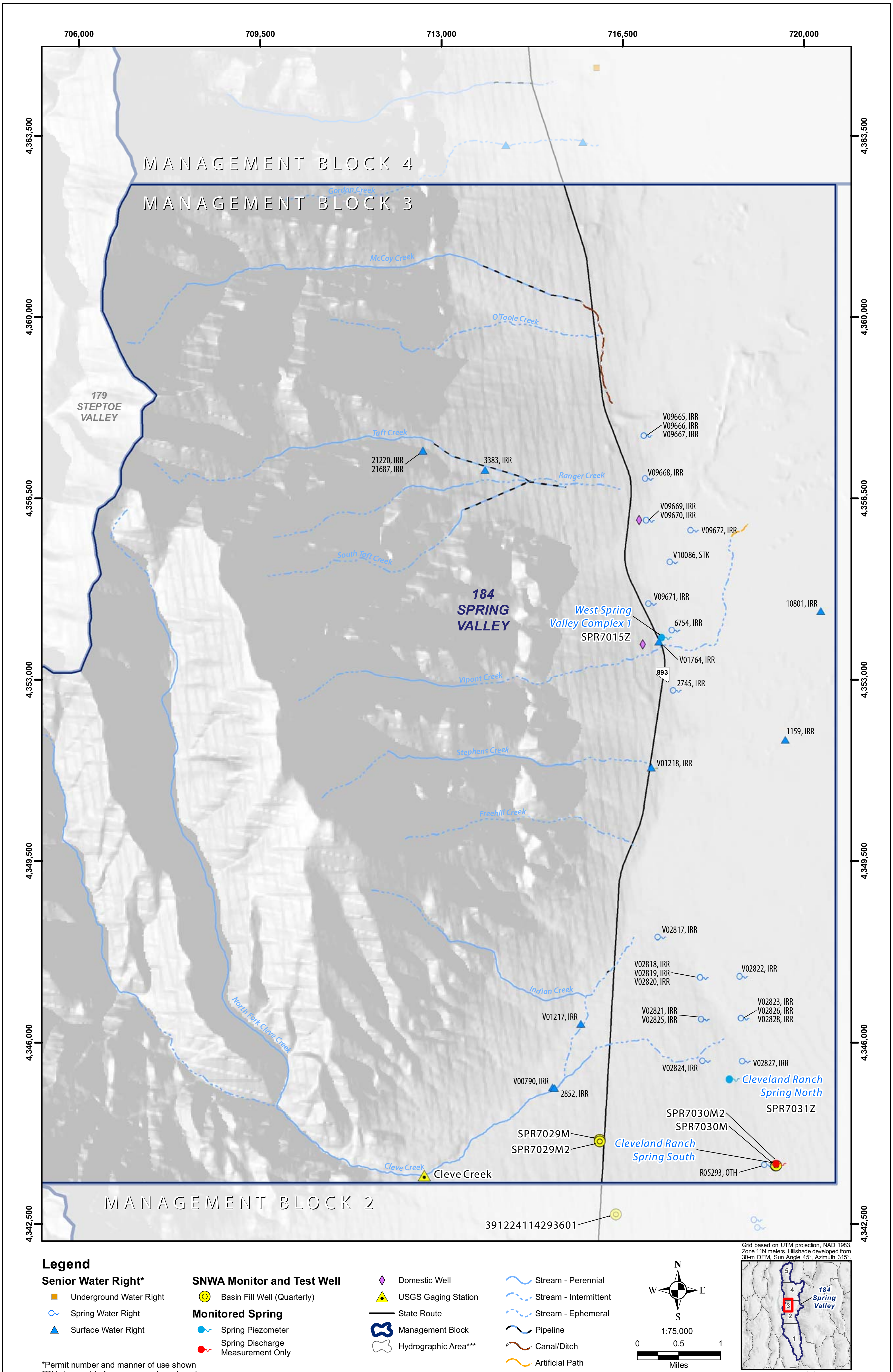

Figure 2-7
Management Block 3 Senior Water Rights and Hydrologic Monitoring Network

The hydrologic monitoring sites for Management Block 3 are listed in Table 2-1. Individual senior water rights meeting the analysis criteria are listed in Table B-3 including information on water-right status, source, manner of use, priority date, diversion rate, annual duty, ownership, distance to the closest SNWA GDP POD, DEM elevation, and management category. Monitoring associated with each senior water right meeting the analysis criteria is presented in Table 2-5.

One reserved and one certificated senior spring water right, two certificated stream water rights and 12 spring vested claims listed in Table B-3 are assigned Management Category B (as described in Table 2-2) because they are located between 3 and 10 miles of the nearest SNWA GDP POD. One certificated spring water right and nine spring vested claims are assigned Management Category C because they are located greater than 10 miles from the nearest SNWA GDP POD. Eight other stream water rights are assigned Management Category E because the streams at the POD locations are not in hydraulic connection with the producing aquifer in which SNWA GDP production wells will be installed because of location and hydrogeologic setting.

The monitoring strategy for Management Block 3 includes using five sentinel monitor wells, as explained in Marshall et al. (2017 at Section 3.2.1), near the southern end of Cleveland Ranch along with other monitoring sites to track hydrologic conditions and detect change, if any. The sentinel wells are located between the SNWA GDP PODs and the more distant senior water rights to detect and measure propagation of drawdown. The sentinel wells are a key component of the monitoring and management strategy to avoid activating mitigation triggers at senior water rights.

The monitoring and management strategy for Management Block 3 includes using four sentinel monitor wells near the southern end of Cleveland Ranch and one planned sentinel well (SPR7044M) southeast of Cleveland Ranch. The sentinel wells along with other monitoring sites between Management Block 3 and the SNWA GDP PODs document aquifer conditions and detect changes in water levels which may indicate propagation of drawdown. Four of the designated sentinel monitor wells (SPR7029M, SPR7029M2, SPR7030M, and SPR7030M2) are paired at two sites. One set of wells are completed in coarse grained sediments located on the alluvial fan while the other wells are completed at the toe of the alluvial fan near the Cleveland Ranch South Spring. The paired wells are completed at different depths to evaluate variations in vertical hydraulic gradient.

The Cleveland Ranch South Spring discharge is also monitored with a permanent flume. Another permanent flume and shallow piezometer (SPR7031Z), located in southern Cleveland Ranch within an area of diffuse springs, measures discharge and shallow groundwater level to evaluate the relationship between the diffuse spring discharge and groundwater level. Monitoring locations in the vicinity of Cleveland Ranch are shown on Figure 2-8 and Figure 2-9.

Ruling 6164 denied SNWA application numbers 54016, 54017, 54018, and 54021 located on the Cleve Creek alluvial fan upgradient of numerous CPB water rights (NSE 2012a, at page 216). By eliminating these PODs, the NSE has provided a buffer between permitted SNWA GDP POD locations and Cleveland Ranch.

In addition to the sentinel monitor wells and monitoring on Cleveland Ranch presented above, additional groundwater monitoring in Management Block 2, to the south of Management Block 3, will detect and measure changes in water level between Cleveland Ranch and SNWA GDP PODs.

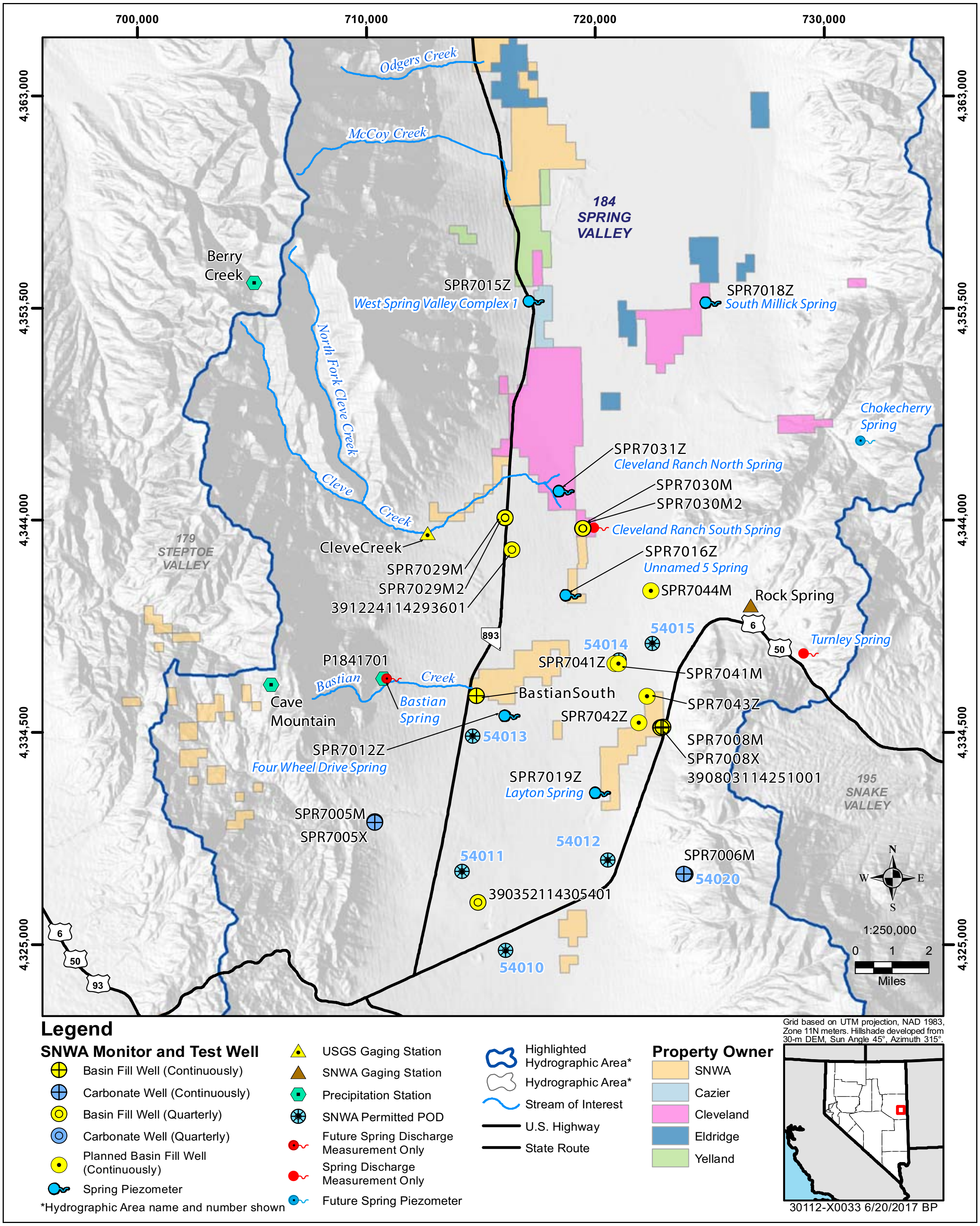

Figure 2-8
Cleveland Ranch/McCoy Creek Area with SNWA GDP PODs and Hydrologic Monitoring Locations

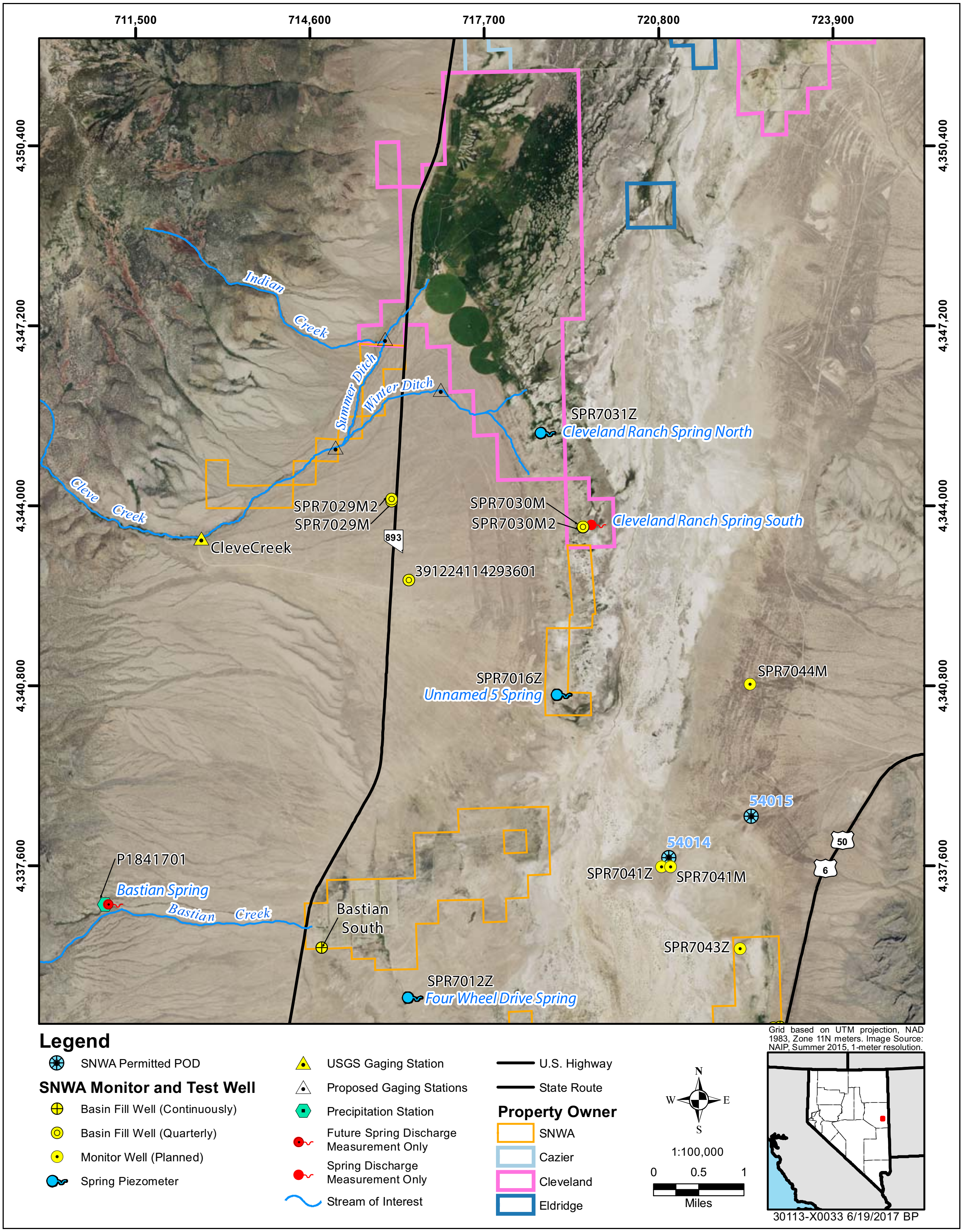

Figure 2-9
Cleveland Ranch Area Hydrologic Monitoring Locations

These sites include monitor wells 391224114293601, SPR7016Z, SPR7012Z, and South Bastian Well.

Cleve Creek and the diversion ditches west of the ranch are losing reaches and would not be effected by SNWA GDP pumping due to depth of groundwater underlying the ditches as observed in monitor well SPR7029M. The Cleveland Ranch has extensive irrigation operations which influence groundwater conditions on the ranch. Irrigation practices may effect the discharge from the sub-irrigated meadows at diffuse spring locations on the ranch. These practices include diversion of Cleve Creek into the winter and summer ditches, distribution of water, and application rates at different locations on the ranch.

It is important to measure and monitor irrigation practices to determine the effects on spring discharge variability in comparison with hydrologic baseline data prior to and during SNWA GDP pumping. Surface water gaging stations are proposed to be constructed and operated at the following three locations as shown on Figure 2-9: (1) upstream of the diversion splitter with the winter ditch, (2) downstream on the summer ditch, and (3) on the winter ditch at the ranch boundary. Regional baseline hydrologic data and aerial imagery on and away from the ranch will be compared to irrigation diversions between the summer and winter ditches of Cleve Creek to characterize influence of irrigation practices on spring discharge.

The hydrologic monitoring strategy associated with Management Block 3 consists of the following:

- Perform a water resource assessment for senior water rights assigned Management Category B in Table B-3, as described in Section 2.1.2.4, at least three years prior to SNWA GDP pumping.

- Designating existing SNWA monitor wells SPR7029M, SPR7029M2, SPR7030M, SPR7030M2 and planned monitor well SPR7044M as sentinel wells to identify and measure northern propagation of drawdown from SNWA GDP pumping to the south.

- Performing additional monitoring south of Cleveland Ranch in Management Block 2 to detect and measure potential changes in groundwater levels between Cleveland Ranch and SNWA GDP PODs, including monitor wells 391224114293601, SPR7016Z, SPR7012Z, and South Bastian Well.

- Measuring static water level or spring discharge on Cleveland Ranch at piezometer SPR7031Z, north Cleveland Ranch Spring, and south Cleveland Ranch flumes.

- Monitoring stream flow at U.S. Geological Survey (USGS) Cleve Creek gaging station as a reference site to compare groundwater levels and spring discharge.

- Monitoring SPR7015Z at the West Springs Complex located north of Cleveland Ranch for aquifer conditions.

- Installing and operating additional surface water gaging stations on Cleve Creek in the following three locations as shown on Figure 2-9: upstream of the diversion splitter with the winter ditch; downstream of the summer ditch; and on the winter ditch at the ranch.

Table 2-5
Spring Valley Management Block 3 Monitoring Program

Senior Water Right/ Monitoring Area	Monitor Well or Spring
Monitoring between Cleveland Ranch and SNWA GDP PODS	391224114293601, SPR7016Z, SPR7012Z, and Bastian South Well
Sentinel monitor wells between Cleveland Ranch and SNWA GDP PODS	SPR7029M, SPR7029M2, SPR7030M, SPR7030M2, and SPR7044M (planned well)
Additional current monitoring on Cleveland Ranch	Cleveland Ranch Spring South, SPR 7031Z, and Cleveland Ranch Spring North
Additional gaging station on Cleve Creek	Upstream of the diversion splitter with the winter ditch, downstream of the summer ditch, and on the winter ditch at the ranch

2.1.3.4 Management Block 4

Management Block 4 is located in north-central Spring Valley, over 15 miles from the northernmost permitted Spring Valley GDP POD. A combination of SNWA-owned and privately-owned existing water rights occur on the valley floor and alluvial fan of Management Block 4 (Marshall et al., 2017, at Section 6.1). The SNWA GDP PODs, senior water rights, and 3M Plan hydrologic monitoring network in Management Block 4 are shown on Figure 2-10.

The hydrologic monitoring sites for Management Block 4 are listed in Table 2-1. Individual senior water rights meeting the analysis criteria are listed in Table B-4, including information on water right status, source, manner of use, priority date, diversion rate, annual duty, ownership, distance to the closest SNWA GDP POD, DEM elevation, and management category.

The monitoring strategy for Management Block 4 is summarized in Table 2-6. The senior water rights in Management Block 4 are assigned either Management Category C or E. Management Category C contains senior rights greater than 10 miles from SNWA GDP PODs. Unreasonable effects at senior water rights assigned Management Category E are unlikely because these rights are not in hydraulic connection with the producing aquifer in which SNWA GDP production wells will be installed.

The monitoring strategy includes five sentinel monitor wells, which will provide water level data to track any northern propagation of groundwater drawdown and avoid activating a mitigation trigger in Management Block 4. The sentinel wells include four SNWA monitor wells (SPR7029M, SPR7029M2, SPR7030M, SPR7030M2) located at the south end of Cleveland Ranch, and SPR7044M, a planned monitor well that will be located one mile north of the northern most SNWA GDP production well on the east side of the valley. These sentinel monitoring locations will be used to detect and measure changes in water level which may indicate propagation of drawdown into

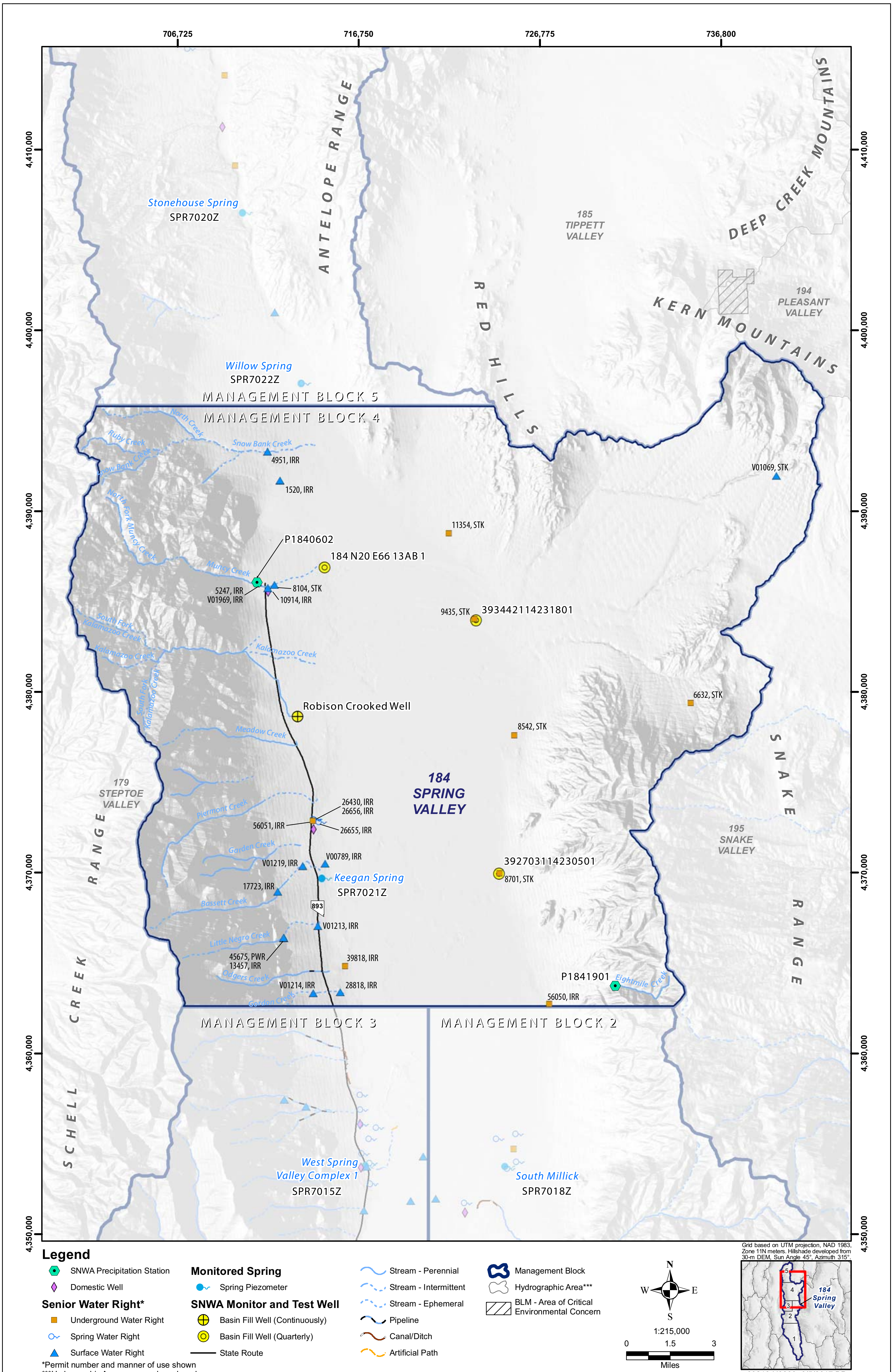

Figure 2-10
Management Block 4 Senior Water Rights and Hydrologic Monitoring Network

Management Block 4. Additional monitoring of aquifer conditions in Management Block 4 includes four monitoring wells and one spring piezometer at Keegan Spring. The four wells are N20E6613AB1, 393442114231801, 39270311430501, and Robison Crooked Well.

Additional piezometers will be installed in shrubland habitat if shrubland monitoring is implemented in Management Block 4, as discussed in Section 2.2.1.3. The additional monitoring sites would expand the hydrologic monitoring network to monitor shallow groundwater conditions in shrubland habitat not associated with springs or streams. The piezometers would be drilled to a depth of up to 50 ft, depending upon hydrogeologic conditions encountered, and located based on the shrubland monitoring design, as discussed in Section 2.2.1.3.

Table 2-6
Spring Valley Management Block 4 Program Monitoring

Senior Water Right	Monitor Well
All Senior Rights in Block 4	Sentinel Monitor wells SPR7029M, SPR7029M2, SPR7030M, SPR7030M2, and SPR7044M (planned well)
All Senior Rights in Block 4	Four monitor wells and one piezometer providing monitoring of aquifer conditions in Management Block 4 184 N20 E66 13AB 1, 393442114231801, 39270311430501, Robison Crooked Well, and Keegan Spring piezometer (SPR7021Z)

2.1.3.5 Management Block 5

Management Block 5 is located in northern Spring Valley, over 35 miles from the northernmost permitted Spring Valley GDP POD. A combination of SNWA-owned and privately-owned existing water rights occur on the valley floor and alluvial fan of Management Block 4 (Marshall et al., 2017, at Section 6.1). The SNWA GDP PODs, senior water rights, and 3M Plan hydrologic monitoring network in Management Block 5 are shown on Figure 2-11.

The hydrologic monitoring sites for Management Block 5 are listed in Table 2-1. Individual senior water rights are listed in Table B-5, which includes information on water right status, source, manner of use, priority date, diversion rate, annual duty, ownership, distance to the closest SNWA GDP POD, DEM elevation, and management category.

The distance between the SNWA GDP PODs and senior water rights locations that are in hydraulic connection to the producing aquifer ranges from approximately 36 to 50 miles and are assigned Management Category C. Senior water rights not in hydraulic connection with the producing aquifer in which SNWA GDP production wells will be installed are assigned Management Category E due to their location and hydrogeologic setting.

The monitoring strategy for Management Block 5 is summarized in Table 2-7. Similar to Management Block 4, four sentinel monitor wells, consisting of SNWA monitor wells (SPR7029M, SPR7029M2, SPR7030M, SPR7030M2) located south of Cleveland Ranch and one planned well located one mile north of the northern most production well on the east side of the valley (SPR7044M), are used to detect significant changes in water level which may indicate propagation of

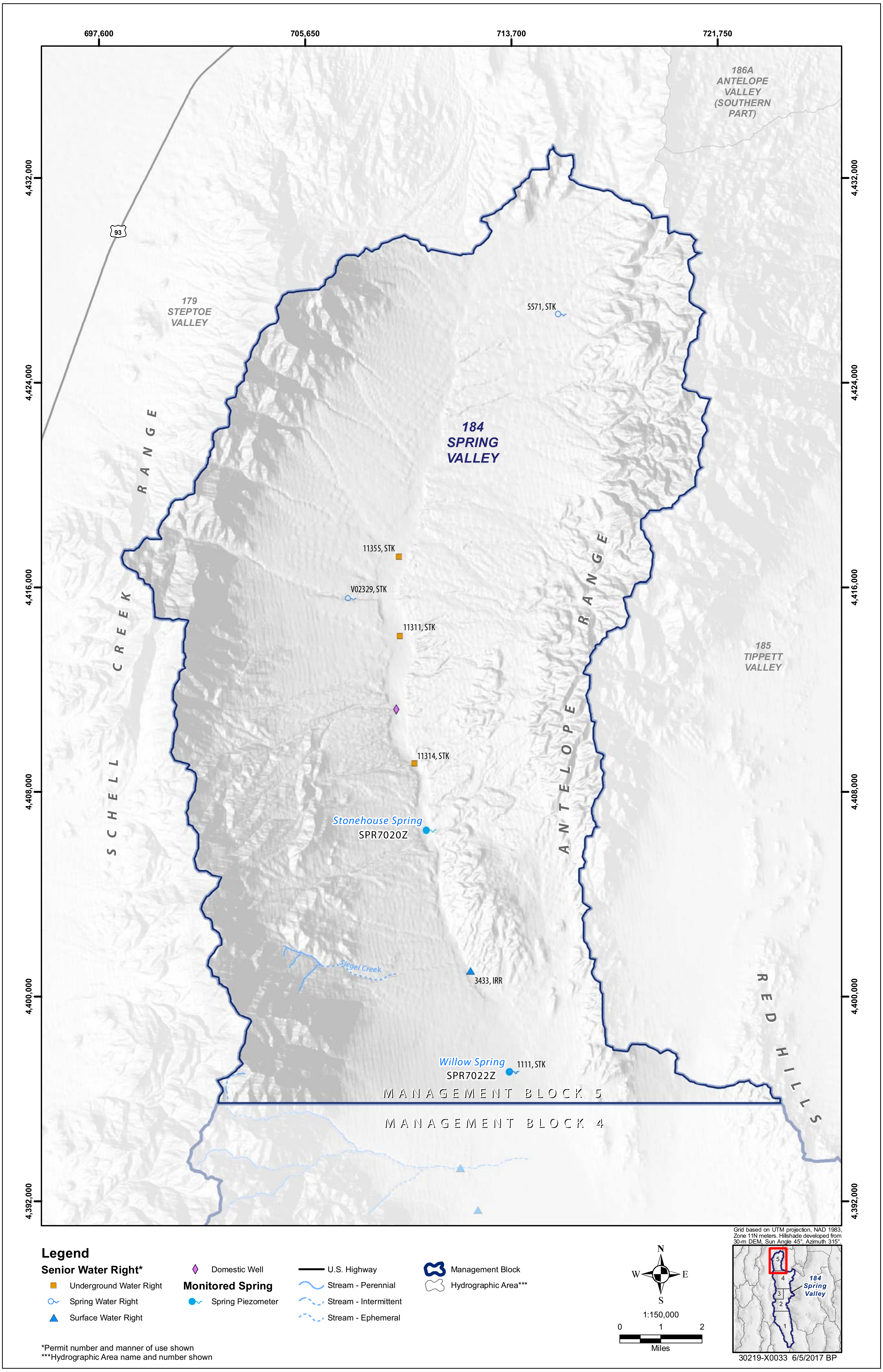

Figure 2-11
Management Block 5 Senior Water Rights and Hydrologic Monitoring Network

drawdown into Management Blocks 3, 4, and 5. The large distance and multiple monitoring wells between Management Block 5 and the SNWA PODs provide a large buffer.

Additional monitoring of aquifer conditions in Management Block 5 includes two shallow piezometers at Willow and Stonehouse springs and spring discharge monitoring at Willow Spring (Table 2-7).

Table 2-7
Spring Valley Management Block 5 Program Monitoring

Senior Water Right	Monitor Well
All Senior Rights in Block 5	Sentinel Monitor wells SPR7029M, SPR7029M2, SPR7030M, SPR7030M2, and SPR7044M (planned well)
1111	Willow Spring piezometer (SPR7022Z) and discharge monitoring
Aquifer conditions in Management Block 5	Stonehouse Spring piezometer (SPR7020Z)

2.1.3.6 Northern Hamlin and Southern Snake Valleys

The monitoring sites associated with northern Hamlin and southern Snake valleys are listed in Table 2-1 and shown on Figure 2-12. The hydrogeologic setting of the area is presented in (Marshall et al., 2017, at Section 7.2.3). The senior water rights meeting the analysis criteria in Hamlin and Snake valleys are assigned Management Category D, as described in Table 2-2 because they are located in an adjacent basin to SNWA GDP pumping. The monitoring and management strategy for this category consists of using sentinel monitor wells, located between the SNWA GDP PODs and the more distant senior water rights to detect and measure propagation of drawdown. The sentinel wells are a key component of the monitoring and management strategy to avoid unreasonable effects to senior water rights in Hamlin and Snake valleys.

Inter-basin groundwater flow between Spring and Hamlin valleys is limited to the carbonate aquifer below the Limestone Hills due to the low hydraulic conductivity of the Snake Range to the north and the Indian Peak Caldera Complex to the south as described in Rowley et al. (2011). Three planned wells (SPR7009M, HAM1007M, and SPR7010M) are designated as sentinel monitor wells, and will be installed at least three years prior to SNWA GDP pumping along the Limestone Hills in the carbonate aquifer near the Spring Valley and Hamlin Valley hydrographic boundary as shown on Figure 2-12.These sentinel monitor wells will be effective at detecting and measuring propagation of drawdown because they are located in the groundwater flow path between the SNWA GDP PODs and Hamlin Valley.

There are seven senior water rights or vested claims in Hamlin Valley located approximately 7.75 to 11.5 miles from the closest SNWA GDP POD. These senior water rights will be monitored at four assigned wells, as listed in Table 2-8, which are located at the senior water right POD or in close proximity to the senior water right POD. The remaining three senior water rights in Hamlin Valley are located greater than 15 miles from the closest SNWA GDP POD and are managed similar to the distant senior water rights located in Snake Valley.

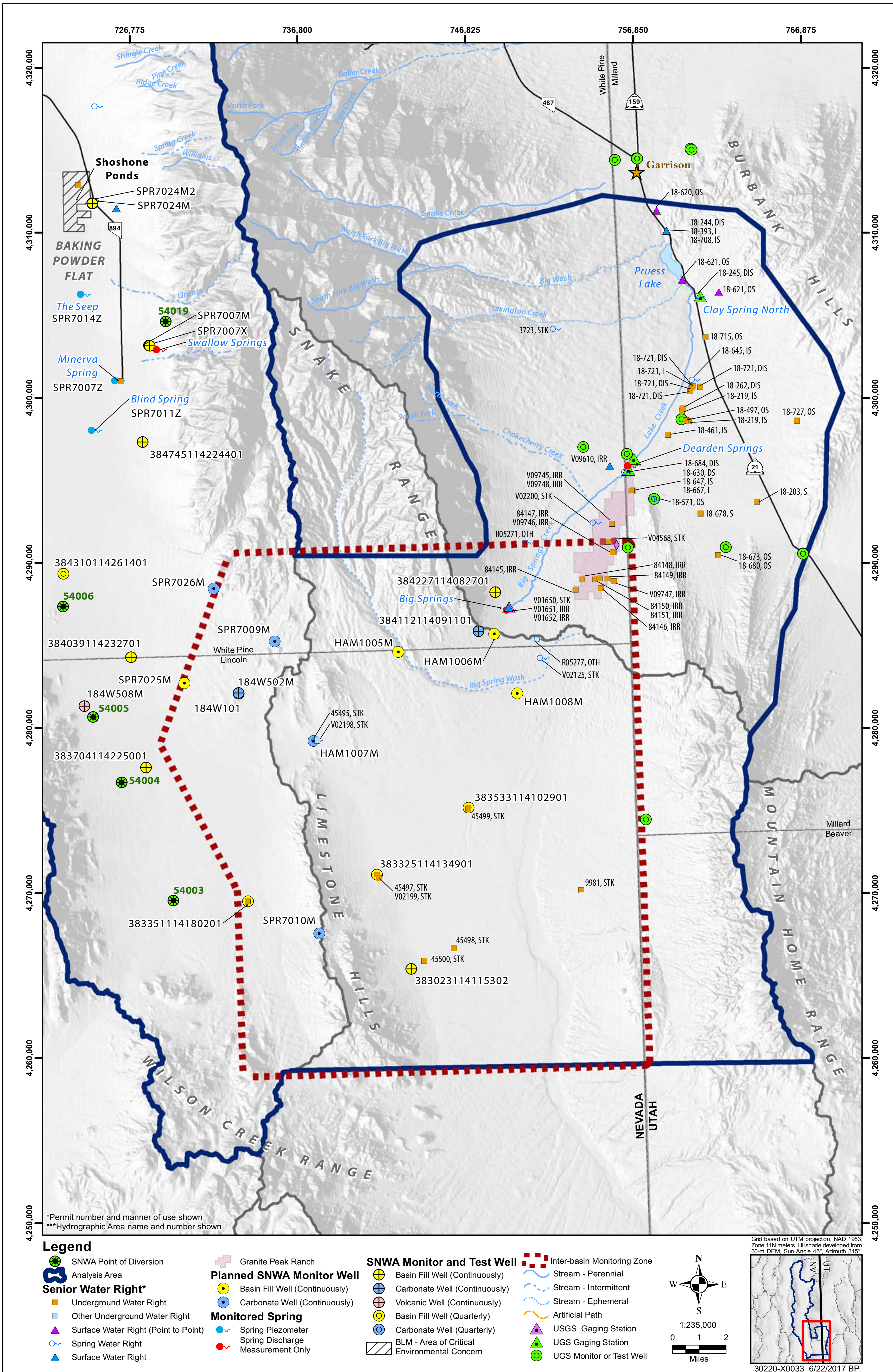

Figure 2-12
SNWA GDP PODs, Senior Water Rights, and Hydrologic Monitoring Network - Northern Hamlin and Southern Snake Valleys

Table 2-8
Hamlin and Snake Valleys Senior Water Right PODs - Monitoring Sites

Senior Water Right	Monitoring Site
Hamlin Valley	
45495 (Spring), V02198 (OGW)	Sentinel Monitor Wells (SPR7009M, SPR7010M, and HAM1007M)
45497 (UG), V02199 (UG)	Sentinel Monitor Wells (SPR7009M, SPR7010M, and HAM1007M) and Well 383325114134901
45498 (UG), 45500 (UG)	Sentinel Monitor Wells (SPR7009M, SPR7010M, and HAM1007M) and Well 383023114115302
45499 (UG)	Sentinel Monitor Wells (SPR7009M,SPR7010M, and HAM1007M) and Well 383533114102901
R05277 and V02125	Sentinel Monitor Wells (SPR7009M,SPR7010M, and HAM1007M) and HAM1008M
Snake Valley	
All senior water rights in Snake Valley	Sentinel Monitor Wells (SPR7009M,SPR7010M, and HAM1007M) and HAM1008M

A special inter-basin monitoring zone (IBMZ) was established in the previous Spring Valley 3M Plan (SNWA, 2009a) to focus on the hydrologic relationship between Spring, Hamlin, and Snake valleys. The boundary of the monitoring zone is highlighted on Figure 2-12.

The monitoring network includes:

- Fourteen monitor wells that are either existing or committed to be constructed associated with the IBMZ. The committed monitoring wells are seven monitor wells which will be installed at least three years prior to SNWA GDP pumping, including two near-zone wells to be constructed between the two closest SNWA GDP production wells and the IBMZ. Right-of-way access has been approved from BLM for five of the committed planned wells. The remaining two near-zone wells will be sited after the SNWA GDP production well configuration is determined.

- Continuous gaging stations at two spring orifices at Big Springs. These locations are currently monitored by USGS through a joint funding agreement with SNWA and NSE.

- Four gaging stations operated by Utah Geological Survey (UGS). One gage is located upstream of Dearden Springs, two are located downstream of Dearden Springs at the West and East Middle Ditches and one gage is at Clay Spring North.

- A groundwater monitoring network along the Nevada - Utah state line in Snake Valley. This network was installed and is maintained by UGS (UGS, 2017).

One additional downgradient monitor well (HAM1008M) is proposed in Hamlin Valley south of the Snake Valley hydrographic basin boundary to provide a mitigation trigger location for Snake Valley.

Additional piezometers will be installed in shrubland habitat in northern Hamlin and southern Snake valleys if shrubland monitoring is implemented in those regions, as discussed in Section 2.2.2.2. The additional monitoring sites would expand the hydrologic monitoring network to monitor shallow groundwater conditions in shrubland habitat not associated with springs or streams. The piezometers would be drilled to a depth of up to 50 ft (depending upon hydrogeologic conditions encountered) and located based on the shrubland monitoring design, as discussed in Section 2.2.2.2.

2.1.4 Precipitation Stations

Data is obtained from operating regional precipitation stations in the vicinity of Spring Valley with established historical records. The stations will continue to be part of the 3M plan monitoring network as long as they are operated by the current entities that operate them. Five additional SNWA precipitation stations are spatially distributed within Spring Valley as part of the 3M Plan hydrologic monitoring network, including one near the Swamp Cedar ACEC (PSPR7008). The current precipitation stations are listed in Table 2-1 and presented on Figure 2-13.

The SNWA precipitation stations are currently equipped with the OTT Pluvio^2 weighing rain gage, which is an all-weather precipitation gage that uses weight-base technology to measure rainfall, snow, and hail. The high resolution electronic weighing system allows for liquid and solid precipitation to be measured immediately with no time delay for melting solid precipitation. The OTT Pluvio^2 weighing rain gage complies with World Meteorological Organization NO. 8 guidelines for automatic recording precipitation gages (Nemeth, 2008).

2.1.5 Aquifer Characterization

Aquifer characterization will be performed using constant-rate pumping tests to evaluate aquifer parameters, such as transmissivity, hydraulic conductivity, storage coefficient, and specific yield. The tests may also identify boundary conditions, provide information on aquifer heterogeneity, and evaluate long-term sustainable pumping rates. In fracture-flow systems, depending upon conditions, the tests may estimate fracture and matrix properties. Aquifer testing results would be used to assess well performance, provide aquifer property data for the groundwater flow model, and evaluate long-term pumping effects.

Well performance step tests and 72- to 120-hour constant-rate tests have been performed on the six Spring Valley SNWA test wells (184W101, 184W103, 184W105, SPR7005X, SPR7007X, and SPR7008X). Geologic analysis reports for each site, presenting drilling and downhole geophysical data, lithologic descriptions, and structural evaluation were submitted to the NSE. Hydrologic analysis reports for each site, including hydrologic data, well performance and aquifer test analysis, and water chemistry results, were submitted to the NSE. The results are also summarized in the 2008

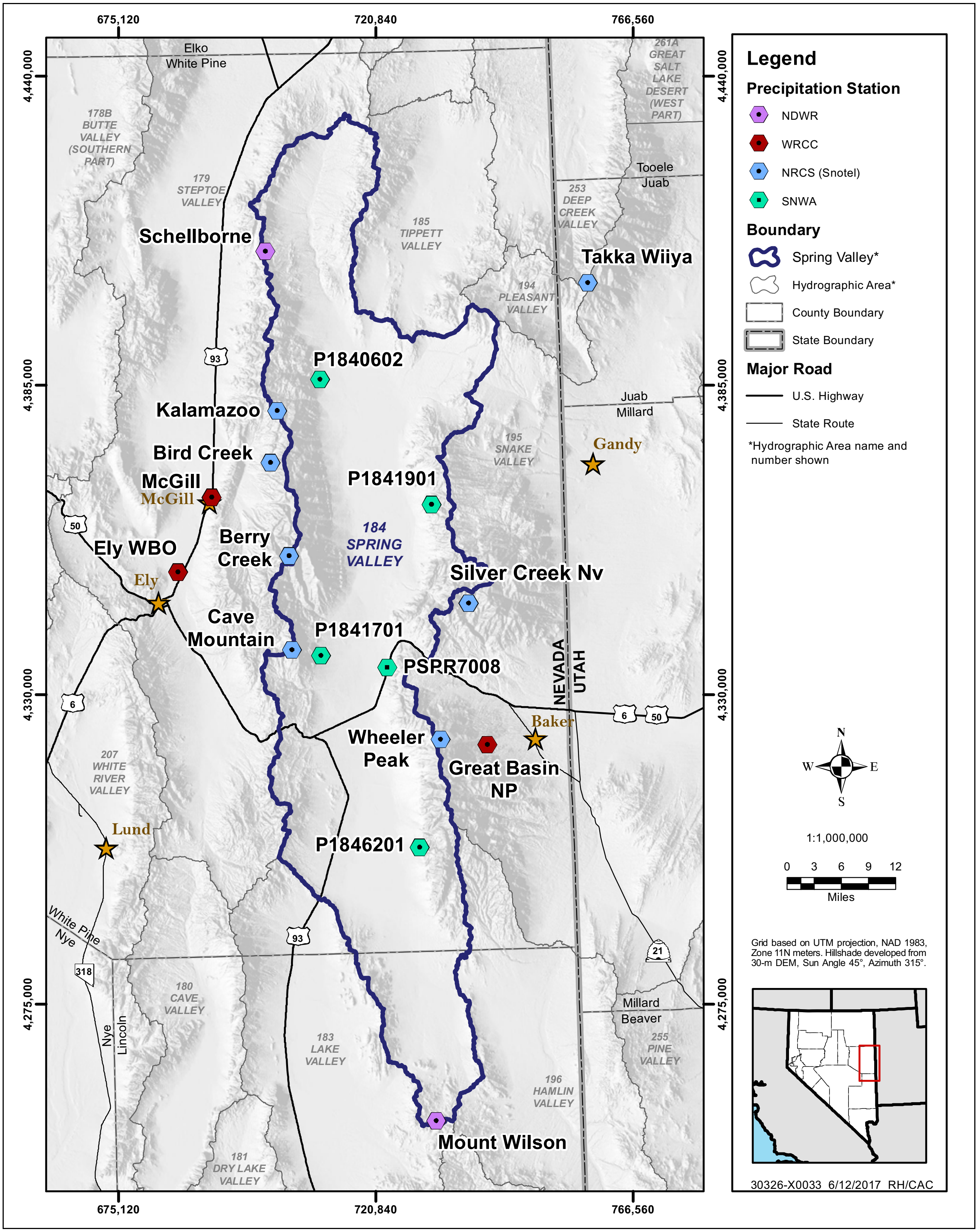

Figure 2-13
Spring Valley Precipitation Station Locations

and 2009 Annual Spring Valley Data Reports (SNWA 2008; 2009a). Similar reports will be prepared after completion of each SNWA GDP production well.

Two separate constant-rate aquifer tests will be performed by pumping the closest SNWA basin-fill and carbonate aquifer production wells (SPR7025M and SPR7026M) to the IBMZ boundary.

2.1.6 Big Springs - Lake Creek Synoptic Discharge Study

A synoptic discharge study was performed by SNWA with support from NSE, UGS, and U.S. Department of Interior (DOI) staff during irrigation and non-irrigation periods for the Big Springs Creek and Lake Creek surface water system from Big Springs to Pruess Lake (Big Springs/Lake Creek Complex) during the spring and fall of 2014 (SNWA, 2015c). Two sets of measurements will be repeated every five years following the start of SNWA GDP pumping in Spring Valley unless the schedule is modified by the NSE. The purpose of the study is to evaluate surface water - groundwater interactions along the creek. The Big Springs/Lake Creek Complex study area is presented on Figure 2-14.

The UGS operates three continuous gaging stations on Lake Creek near Stateline Spring to provide gain/loss data over segments of the creek and one station at North Clay Spring. Data available from the UGS will be utilized in the studies and will provide, along with the Big Springs gages, additional continuous data on the Big Springs/Lake Creek Complex.

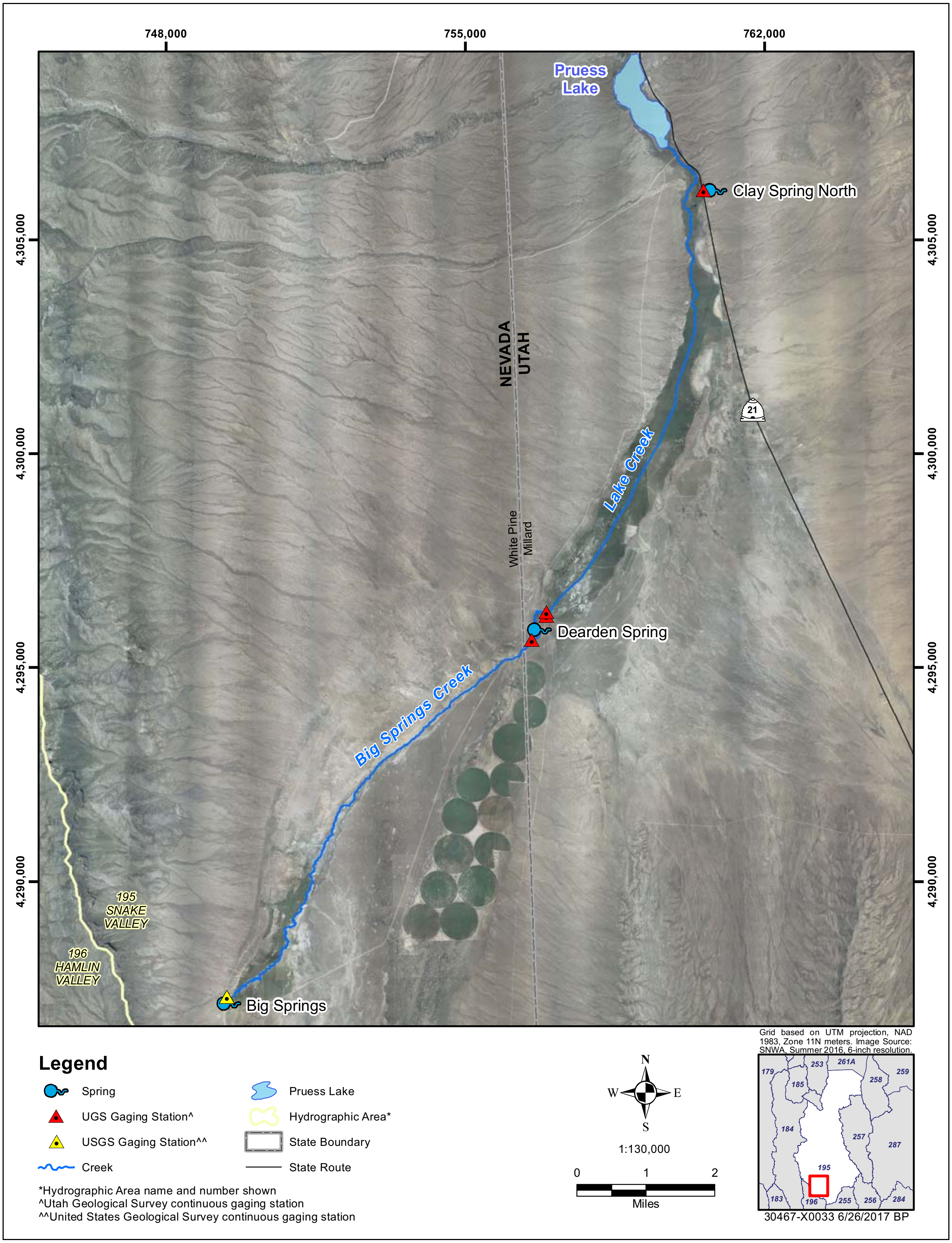

Figure 2-14
Big Springs Synoptic-Discharge Measurement Study Area, Snake Valley

2.1.7 Water Chemistry

Monitoring of groundwater and surface water chemistry is performed to establish baseline conditions. Chemical analyses of selected parameters will be performed on three rounds of samples collected from wells, piezometers, and spring and stream sites approved by NSE. The program will consist of three sampling events. The initial round of sampling at 35 locations was completed in late 2010 and 2011. These sample locations are presented in Figure 2-15. The five new IBMZ monitor wells will be sampled after installation. The second and third rounds of the water chemistry program will be completed after installation and sampling of the five IBMZ monitor wells. The second and third rounds will consist of 40 locations which include the five new IBMZ wells and 35 initial round locations. SNWA will collect and analyze water chemistry for the parameters listed in Table 2-9. Water chemistry laboratory reports will be made available to the NSE within 90 calendar days of receipt or within an alternative time frame required by the NSE. Results will also be reported in the annual data report.

Table 2-9
Water Chemistry Parameters

Field Parameters	Major Ions	Isotopes	Metals
Water temperature Air temperature pH Electrical conductivity Dissolved oxygen	TDS Calcium Sodium Potassium Chloride Bromide Fluoride Nitrate Phosphate Sulfate Carbonate alkalinity Alkalinity Silica Magnesium	Oxygen-18 Deuterium Tritium Carbon-14 Carbon-13 Strontium-87	Arsenic Barium Cadmium Chromium Lead Mercury Selenium Silver Manganese Aluminum Iron

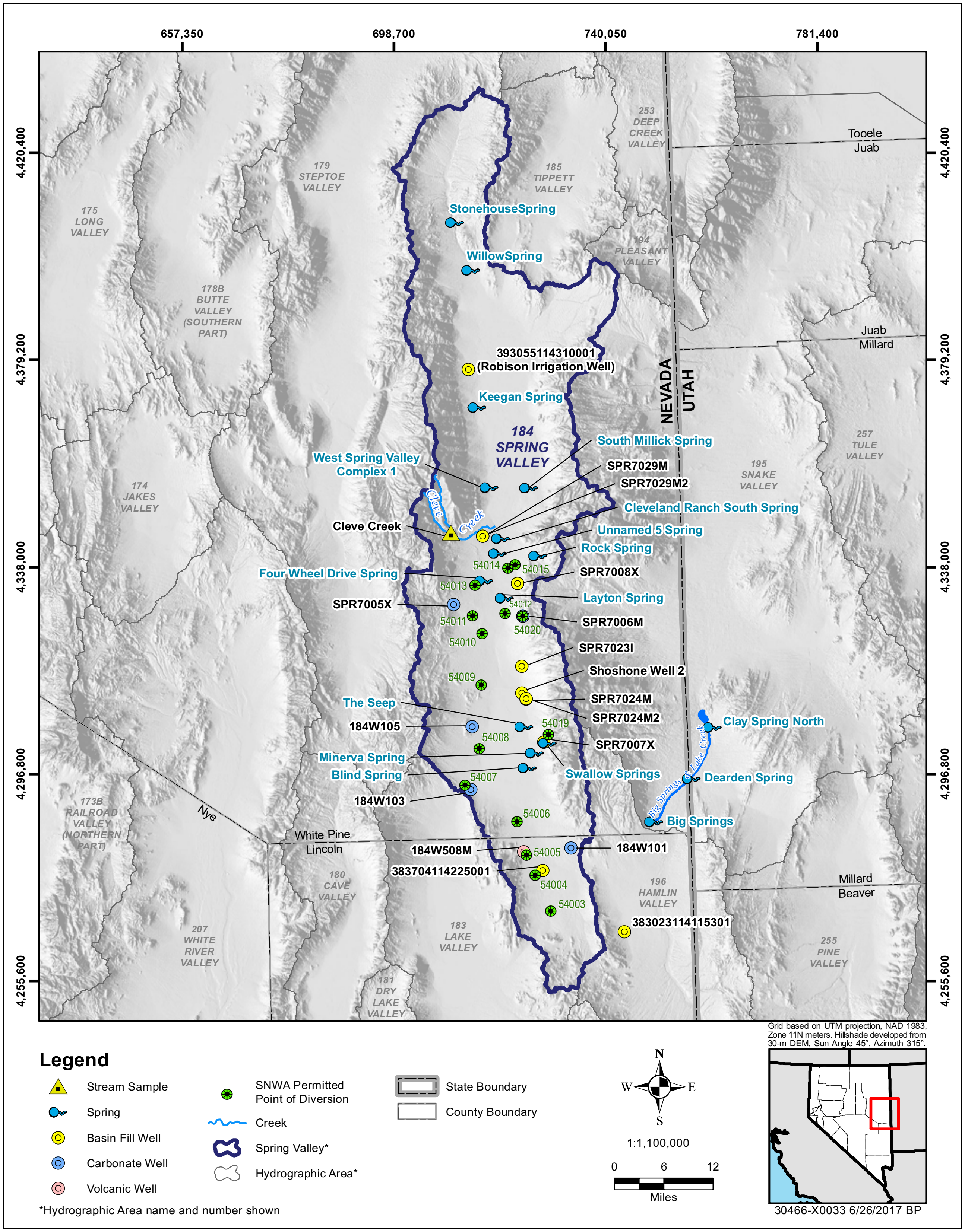

Figure 2-15
Spring Valley Monitoring Plan Water Chemistry Program Sample Locations

2.2 Environmental Monitoring

This section describes the environmental monitoring element for the Spring Valley 3M Plan. The rationale and analyses used to develop this monitoring plan are presented in the 3M Plan analysis report (Marshall et al., 2017, at Sections 3, 6.3, and 7.3). Thresholds, triggers, and management and mitigation actions are presented in Section 3.0.

Environmental monitoring and studies in support of the SNWA GDP water rights in Spring Valley began in 2009. These efforts were associated with the previous biological monitoring plan (Biological Work Group, 2009) that was approved by the NSE in Ruling 6164 (NDWR, 2012, at page 217). Annual reports regarding these efforts were submitted to the NSE (SNWA 2010b, 2011c, 2013b, 2014b, 2015b, 2016c, and 2017b). As discussed in Section 1.1, this 3M Plan replaces that previous biological monitoring plan, which includes specific elements to meet requirements of a stipulated agreement between SNWA and federal agencies, and which will continue to be implemented in accordance with that agreement. This 3M Plan addresses concerns stated in the Remand Order, and complies with Nevada water law pursuant to the NSE's regulatory authority.

The hydrologic monitoring network presented in Section 2.1 provides a major element of the environmental monitoring plan. Key habitat components monitored under the hydrologic monitoring network include groundwater level, spring discharge, stream flows, and precipitation. Given the number and spatial distribution of hydrologic monitoring sites and senior water rights, and the general co-location of senior water rights with environmental resources, the hydrologic monitoring network provides extensive information about environmental conditions in Spring, northern Hamlin, and southern Snake valleys. Additional environmental monitoring is presented below.

2.2.1 Spring Valley

The environmental resources for which monitoring is established in Spring Valley to ensure avoidance of unreasonable effects include one federally listed species, one native aquatic-dependent special status animal species, and three habitat types. Monitoring for each of these resources is described below. This information is organized by environmental resources, with reference to the Management Blocks discussed in Section 1.2 (shown in Figure 1-1). Thresholds, triggers, and management and mitigation actions for these environmental resources are presented in Section 3.3.2.

2.2.1.1 Federally Listed Species

Federally listed species: Pahrump poolfish (*Empetrichthys latos*).[1]

In Spring Valley, Pahrump poolfish occur at Shoshone Ponds in Management Block 1 (Figure 2-16) (see discussion in Marshall et al., 2017, at Section 6.3.1).

Monitoring activities: SNWA supports the Nevada Department of Wildlife Resources (NDOW) with its annual Pahrump poolfish survey at Shoshone Ponds, which documents the Pahrump poolfish

1. A description of the species’ status is provided in the 3M Plan analysis report (Marshall et al., 2017, at Section 5.3).

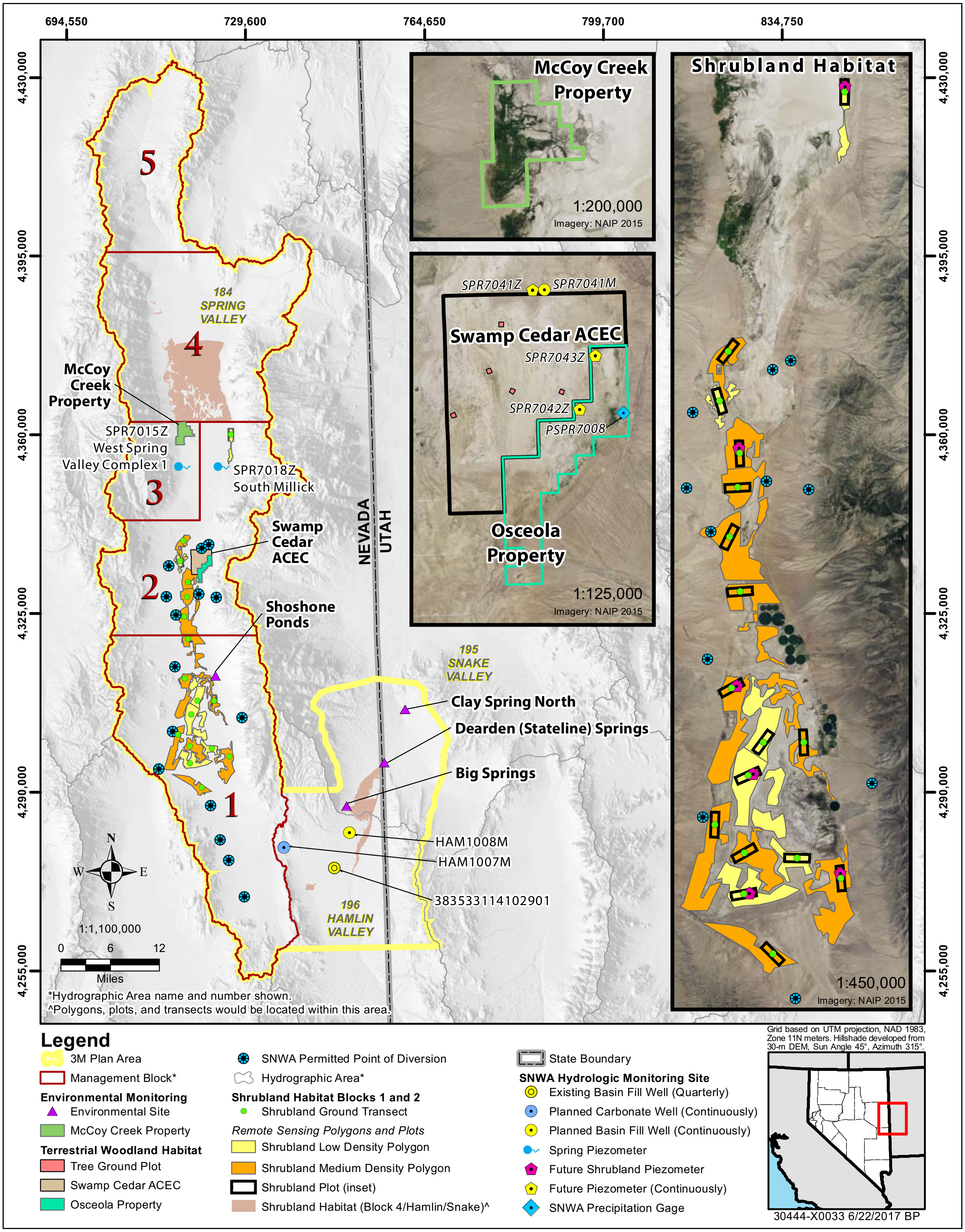

Figure 2-16
Environmental Monitoring Sites in Spring, Hamlin, and Snake Valleys

population and its natural fluctuations.[1] SNWA's support ensures that the surveys are conducted on an annual basis. SNWA also participates on the Pahrump Poolfish Recovery Implementation Team. These efforts begin five years prior to SNWA GDP groundwater withdrawal from Spring Valley, and continue as long as SNWA pumps groundwater under the Spring Valley GDP permits.

Hydrologic monitoring is conducted at the Shoshone NDOW Well (the POD for the senior underground water right, Permit Number 27768), and at monitor wells between Shoshone Ponds and SNWA GDP PODs (Section 2.1.3.1). Changes in artesian flows at the Shoshone NDOW Well are used to trigger investigation, management, and mitigation actions for the senior water right, and management and mitigation actions for Pahrump poolfish (Section 3.3.2.1).

2.2.1.2 Native Aquatic-Dependent Special Status Animal Species and Mesic Habitat

Native aquatic-dependent special status animal species: Northern leopard frog (*Rana pipiens*).[2]

Habitat type: Mesic habitat has a moderate or well-balanced supply of moisture. In the Spring Valley groundwater discharge area, mesic habitat is composed of spring, seep, pond, wetland/meadow, marsh, and stream components that are often intermixed to form complexes.[2]

Monitoring for northern leopard frogs and mesic habitat focuses on Management Block 3, including the SNWA Robison Ranch McCoy Creek Property (hereafter referred to as McCoy Creek Property) (Figure 2-16) (see discussion in Section 3.3.2.2 and Marshall et al., 2017, at Section 6.3.2.1).

Monitoring activities: Northern leopard frog and mesic habitat data are collected to verify their continued status on the McCoy Creek Property. Data are collected on an annual basis for at least five years prior to SNWA GDP groundwater withdrawal from Spring Valley, and annual data collection continues as long as SNWA pumps groundwater under the Spring Valley GDP permits.

- Northern leopard frog egg mass surveys are conducted to verify continued presence and breeding of the species on the McCoy Creek Property. Surveys conducted between 2009 and 2013 identified general breeding areas on the property, with the largest concentrations of egg masses and most reliable breeding habitat in the pools and ponds in the northern and southern portions of the property (SNWA, 2016b). Monitored areas are based on ground conditions documented by a field reconnaissance prior to initiating egg mass monitoring.

- The extent of mesic habitat on the McCoy Creek Property is mapped using satellite or aerial imagery. Springtime images are used to coincide with the northern leopard frog egg mass surveys.

Hydrologic monitoring is conducted at senior water rights that support northern leopard frogs and mesic habitat, sentinel wells for Management Block 3, and other monitor wells between Management

1. The fish surveys are part of NDOW's regular monitoring efforts for native fish populations under the Nevada State's Native Aquatic Species Program.
2. Descriptions of mesic habitat and the species' status are provided in the 3M Plan analysis report (Marshall et al., 2017, at Sections 5.2 and 5.3).

Block 3 and SNWA GDP PODs (Section 2.1.3.3). Changes in water levels at the sentinel wells are used to trigger investigation, monitoring, and management actions for the senior water rights in Management Block 3, and management actions for northern leopard frogs and mesic habitat. Changes in senior water right spring flows in Management Block 3 are used to trigger mitigation actions for senior water rights, northern leopard frogs, and mesic habitat (Section 3.3.2.2).

2.2.1.3 Shrubland Habitat

Shrubland habitat type: The majority of the Spring Valley groundwater discharge area is composed of shrubland habitat (Marshall et al., 2017, at Section 6.3.3.1).[1]

Monitoring for shrubland habitat focuses on the groundwater discharge area of Management Blocks 1 and 2 (Figure 2-16) (see discussion in Section 3.3.2.3 and Marshall et al., 2017, at Section 6.3.3.1). Monitoring for shrubland habitat is also conducted in Management Block 4 if a hydrologic investigation trigger is activated, as specified below.

Monitoring activities: Shrubland habitat vegetation data are collected in Management Blocks 1 and 2 to verify that vegetation cover remains at or above the threshold (see discussion in Section 3.3.2.3 and Marshall et al., 2017, at Section 6.3.3). Data are collected on an annual basis for at least five years prior to SNWA GDP groundwater withdrawal from Spring Valley, and annual data collection continues as long as SNWA pumps groundwater under the Spring Valley GDP permits.

The sample design consists of remote sensing polygons and plots, ground vegetation transects, and piezometers located in shrubland habitat (Figure 2-16). The development of these monitoring elements are discussed in detail in the 3M Plan analysis report (Marshall et al., 2017, at Section 6.3.3 and Appendix D, D.1.1).

- Remote sensing polygons are delineated within medium-density and low-density shrubland habitat.
- Remote sensing plots are located within the polygons using a proportionate stratified random design.
- One ground vegetation transect is located in the center of each remote sensing plot.
- Six piezometers (four in Management Block 1, two in Management Block 2) are spatially distributed across the medium-density shrubland and low-density shrubland remote sensing plots. Their location also takes into account the hydrologic monitoring network.
- These polygon, plot, transect, and piezometer configurations are confirmed by a ground-truthing exercise and remote sensing analysis prior to initiating shrubland habitat monitoring.

1. A description of shrubland habitat is provided in the 3M Plan analysis report (Marshall et al., 2017, at Section 5.2).

Remote sensing is one of the methods used to monitor shrubland habitat and trigger investigation, management, and mitigation actions. Remotely sensed landscape-scale data are effective for analyzing and managing this expansive shrubland habitat.

- Normalized Difference Vegetation Index (NDVI, a proxy for vegetation cover) and precipitation data are generated for the remote sensing polygons. NDVI data are derived from July-September Landsat satellite image data, and precipitation data are derived for the water year (October - September) from a spatial weather dataset (gridMET).[1] NDVI and precipitation data are derived for the longest baseline period possible, taking into account the need to cross-calibrate the Landsat imagery data. Landsat data are cross-calibrated, NDVI and precipitation computed, and NDVI and precipitation zonal statistics generated using the methods in the 3M Plan analysis report (Marshall et al., 2017, at Appendix D, D.1.2.1 and D.1.2.2).

- Mean annual NDVI and mean annual precipitation are calculated for each habitat group (medium-density shrubland, low-density shrubland) using the methods in the 3M Plan analysis report (Marshall et al., 2017, at Appendix D, D.1.3).

- Mean annual NDVI and mean annual precipitation are used to calculate baseline prediction intervals for each habitat group (medium-density shrubland, low-density shrubland) prior to SNWA GDP groundwater withdrawal from Spring Valley. The prediction intervals are calculated by performing a linear least squares regression with a 95 percent confidence level, as described in the 3M Plan analysis report (Marshall et al., 2017, at Appendix D, D.1.3). The 1985-2015 baseline prediction intervals are shown in Figure 3-7.

- Once SNWA GDP pumping begins, mean annual NDVI is plotted against mean annual precipitation for each habitat group (medium-density shrubland, low-density shrubland). These data points are overlaid on the baseline prediction intervals and compared to the lower control limits, which are used to trigger investigation, management, and mitigation actions (Section 3.3.2.3).

- The same computational methods are applied to the remote sensing plots. The plots provide additional opportunities for statistical analysis during investigations.

Ground vegetation transect surveys is the other method used to monitor shrubland habitat and trigger investigation, management, and mitigation actions. Remotely sensed data and ground vegetation data are used in a complimentary manner to provide information about landscape-scale shrubland habitat changes and the nature of those changes.

- Ground vegetation transects are established at least five years prior to SNWA GDP groundwater withdrawal from Spring Valley. Each transect is 50 meters long, consistent with SNWA rangeland monitoring transects. Transects are not placed near dirt roads or water sources, or in inclusions or burn sites.

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1. For example, the water year for 1985 spans October 1984 - September 1985..

- Transect data are collected during summer (August) to coincide with the remotely sensed NDVI data.

- Data collection methods are based on methods that SNWA uses for rangeland monitoring in Spring Valley, and are consistent with federal agency methods in the region. Cover and composition data are collected along the transects using the line-point intercept method. Data are collected at each 0.5 meter mark, totaling 100 points per transect. Multiple-level (vertical strata) plant data are collected at each point (hence, percent live cover can total greater than 100%). Level of hit is recorded to provide information on succession and germination. Shrubs and trees are recorded to species. Because annual herbaceous plants and the upper parts of perennial herbaceous plants are typically dead in the summer, making species identification more difficult, herbaceous plants are recorded to life form (grass, forb). However, if a hit is on a plant that is on the Nevada State noxious weed list or is known to be highly invasive in the region, the species and status are noted. A hit on a dead shrub or tree is recorded as dead shrub or dead tree. Branches that appear dead but are on live shrubs and trees are considered live hits and recorded to species. Standing dead herbaceous vegetation that was alive during that growing season are considered live hits and recorded to life form (grass, forb). Ground cover data are also recorded (bare soil, litter woody litter, live plant cover, rock, cobble, and gravel). Level of hit is recorded for the ground cover, so that bare ground under a plant is distinguishable from bare ground (first hit). Gap-intercept data are collected using the canopy-gap and basal-gap method. Qualitative observations are made regarding bare ground, erosion, weed infestation, and herbivory. A photograph is taken at the beginning transect point, looking down the transect line with field tape stretched begin to end, following protocol to ensure repeatability.

- Mean annual percent live shrub cover and mean annual precipitation are calculated for each habitat group (medium-density shrubland, low-density shrubland). Mean annual percent live shrub cover is calculated using the ground vegetation transect data, and mean annual precipitation is calculated as described above using the remote sensing polygons where the transects are located.

- Mean annual percent live shrub cover and mean annual precipitation are used to calculate baseline prediction intervals for each habitat group (medium-density shrubland, low-density shrubland) prior to SNWA GDP groundwater withdrawal from Spring Valley. The prediction intervals are calculated by performing a linear least squares regression with a 95 percent confidence level, as described in the 3M Plan analysis report (Marshall et al., 2017, at Appendix D, D.1.3).

- Once SNWA GDP pumping begins, mean annual percent live shrub cover is plotted against mean annual precipitation for each habitat group (medium-density shrubland, low-density shrubland). These data points are overlaid on the baseline prediction intervals and compared to the lower control limits, which are used to trigger investigation, management, and mitigation actions (Section 3.3.2.3).

- Other transect data are used to understand the nature of vegetation changes during investigations.

The six additional piezometers expand the hydrologic monitoring network within shrubland habitat, and provide additional information for investigations. The piezometers are installed up to 50 ft deep, depending on hydrogeologic conditions encountered, to span the plant rooting zone.[1] Hydrologic monitoring at the piezometers and across the hydrologic monitoring network in Management Blocks 1 and 2 is discussed in Sections 2.1.3.1 and 2.1.3.2.

Monitoring for shrubland habitat is conducted in Management Block 4 if the hydrologic investigation trigger at the West Spring Valley Complex 1 piezometer or the South Millick Spring piezometer (Figure 2-16) is activated due to SNWA GDP pumping as described in Section 3.3.1. The shrubland habitat monitoring methods are the same as those used for Management Blocks 1 and 2, and as described in the 3M Plan analysis report (Marshall et al., 2017, at Section 6.3 and Appendix D, D.1). The configuration of remote sensing polygons and plots, ground vegetation transects, and shrubland piezometers are informed by conducting a ground-truthing exercise and remote sensing analysis prior to initiating shrubland habitat monitoring in Management Block 4. Mean annual NDVI and mean annual percent live shrub cover are plotted against the mean annual precipitation for each habitat group (medium-density shrubland, low-density shrubland) as described above. These data points are overlaid on the baseline prediction intervals calculated prior to SNWA GDP groundwater withdrawal for Management Blocks 1 and 2. Alternatively, if the NSE approves, the data may be overlaid on baseline prediction intervals calculated specifically for Management Block 4 using monitoring data acquired prior to drawdown propagation reaching Management Block 4. The data points are compared to the 95 percent lower control limits of the prediction intervals, which are used to trigger investigation, management, and mitigation actions (Section 3.3.2.3).

2.2.1.4 Terrestrial Woodland Habitat

Terrestrial woodland habitat: Terrestrial woodland habitat in the Spring Valley groundwater discharge area is referred to as Swamp Cedars. Swamp Cedars is a name with historical and cultural significance, but biologically speaking the habitat is not a true swamp, and the trees are Rocky Mountain juniper (*Juniperus scopulorum*), with Utah juniper (*Juniperus osteosperma*) mixed in at places.[2]

Monitoring for terrestrial woodland habitat focuses on the Swamp Cedar ACEC in Management Block 2 (Figure 2-16) (see discussion in Section 3.3.2.4 and Marshall et al., 2017, at Section 6.3.4.1). Monitoring for terrestrial woodland habitat is also conducted on the SNWA El Tejón Ranch Osceola Property (hereafter referred to as Osceola Property) if mitigation is implemented on the property (see Section 3.3.2.4).

Monitoring activities: Terrestrial woodland habitat vegetation data are collected to verify that a viable tree population is maintained in the Swamp Cedar ACEC, and that tree cover area remains at or above the threshold (see discussion in Section 3.3.2.4 and Marshall et al., 2017, at Section 6.3.4). Data are collected on an annual basis for at least five years prior to SNWA GDP groundwater withdrawal from

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1. Maximum rooting depth of facultative phreatophytes in the region is approximately 50 ft (BLM, 2012, at page 3.5-13; McLendon, 2011).
2. A description of terrestrial woodland habitat is provided in the 3M Plan analysis report (Marshall et al., 2017, at Section 5.2).

Spring Valley, and annual data collection continues as long as SNWA pumps groundwater under the Spring Valley GDP permits.

The sample design consists of the entire population of trees in the Swamp Cedar ACEC, ground tree plots, piezometers, a well, and a precipitation station (Figure 2-16). The sample design also includes remote sensing sample areas to calculate baseline percent range in cover, as discussed below. The development of these monitoring elements are discussed in detail in the 3M Plan analysis report (Marshall et al., 2017, at Section 6.3.4 and Appendix D, D.2.2).

- Trees in the Swamp Cedar ACEC are delineated on an annual basis.
- Ground tree plots are located in medium-density and low-density vegetation areas within the Swamp Cedar ACEC terrestrial woodland habitat using a proportionate stratified random design.
- Remote sensing sample areas are also stratified across the medium-density and low-density vegetation areas (see Marshall et al., 2017, at Figure D-3 in Appendix D, D.2.2.2). They are located where tree cover area is relatively high, and include large trees or clumps of trees, as well as a variety of tree sizes.[1]
- Three piezometers, a deeper nested well, and a precipitation station are distributed adjacent to the ACEC. Their location takes into account groundwater recharge from the Snake Range, the closest SNWA GDP POD, and the hydrologic monitoring network.
- These plot, sample area, piezometer, and well configurations are confirmed by a ground-truthing exercise and remote sensing analysis prior to initiating terrestrial woodland habitat monitoring.

Remote sensing is used to monitor the tree population within the Swamp Cedar ACEC and trigger investigation, management, and mitigation actions.

- Tree cover area in the Swamp Cedar ACEC is quantified using high-resolution imagery of at least 0.5-m resolution that provides standardized measurements over time. Annual acquisition of this imagery begins at least five years prior to SNWA GDP groundwater withdrawal from Spring Valley, and continues as long as SNWA pumps groundwater under the Spring Valley GDP permits. The imagery is acquired in the summertime (primarily August); if weather conditions prevent imagery acquisition in August, the imagery is acquired in September.
- The range of NDVI data indicative of juniper trees in the ACEC is determined from the imagery data. That range of NDVI is converted to vector polygons that encompass trees and tree clusters. The data are manually "cleaned" of false positives (i.e., polygons that are void of

1. To ensure that the data reflect changes in tree cover and not simply changes in shrub or grass cover, small remote sensing sample areas (60 m x 60 m, or 2 x 2 Landsat pixels) are located in areas where tree cover area is relatively high. To avoid sampling bias, the sample areas include areas with large trees or clumps of trees, as well as areas with a variety of tree sizes (Marshall et al., 2017, at Appendix D, D.2.2.2).

trees are deleted) using the methods in the 3M Plan analysis report (Marshall et al., 2017, at Appendix D, D.2.2.1).

- Annual tree cover area is calculated by summing the tree polygon areas across the entire Swamp Cedar ACEC.

- Annual tree cover area is used to compute the baseline maximum tree cover area prior to SNWA GDP groundwater withdrawal from Spring Valley.

- Annual tree cover area continues to be calculated as long as SNWA pumps groundwater under the Spring Valley GDP permits.

- To calculate the baseline percent range in cover, historical NDVI data are generated for the remote sensing sample areas. As described in the 3M Plan analysis report, NDVI is a proxy for vegetation cover (Marshall et al., 2017, at Appendix D, D.1.2.1).

- The historical NDVI data are derived from July-September Landsat satellite image data, using the same methods as those described for shrubland habitat (see Section 2.2.1.3 and Marshall et al., 2017, at Appendix D, D.1.2.1 and D.1.2.2).[1] NDVI zonal statistics are generated for the remote sensing sample areas for the longest baseline period possible. Only baseline data are needed for this calculation.

- Mean annual NDVI is calculated across the remote sensing sample areas using the methods described in the 3M Plan analysis report (Marshall et al., 2017, at Appendix D, D.2.2.2).

- Mean annual NDVI is used to calculate the baseline percent range in cover prior to SNWA GDP groundwater withdrawal from Spring Valley. The calculation methods are described in the 3M Plan analysis report (Marshall et al., 2017, at Appendix D, D.2.2.2). The baseline percent range in cover from 1985-2015 is 25% (see Marshall et al., 2017, at Section 6.3.4.2).

- Once SNWA GDP pumping begins, the annual tree cover area is compared to the baseline maximum tree cover area, taking into account the baseline percent range in cover (as described in Section 3.3.2.4). These data are used to trigger investigation, management, and mitigation actions.

Ground tree plots are also used to monitor the terrestrial woodland habitat in the Swamp Cedar ACEC.

- Ground tree plots are established at least five years prior to SNWA GDP groundwater withdrawal from Spring Valley. Each plot is 100 m x 100 m.

1. As discussed in the 3M Plan analysis report, given the long life span, slow growth rate and variable recruitment of the Rocky Mountain juniper species, the long record of data provided by Landsat imagery is optimal for this analysis (Marshall et al., 2017, at Section 6.3.4.2).

- Ground tree data are collected during summer (primarily August) to coincide with the remotely sensed tree cover area data. If weather and wet soil conditions prevent access in August, the data are collected in September.[1]

- Annual data collection includes presence of seedlings (< 0.1 m), number of saplings (0.1 m - 1 m), and number of mature trees (>1 m) within each plot.[2] A photograph is taken at the center of each plot, following protocol to ensure repeatability. Every five years, sapling height is also measured.

- These data are used to track tree population dynamics such as survivorship and recruitment, and to understand the nature of tree population changes during investigations.

Monitoring for terrestrial woodland habitat is conducted in the SNWA Osceola Property if mitigation is implemented on the property as described in Section 3.3.2.4, in order to ensure mitigation success. The methods are the same as those described above for the Swamp Cedar ACEC.

The shallow piezometers, deeper nested well, and precipitation station intensify the hydrologic monitoring network around the Swamp Cedar ACEC. They are used to evaluate the relationship between the junipers, precipitation, shallow groundwater, and underlying producing aquifer in which SNWA GDP production wells are installed, and provide information during investigations. Hydrologic monitoring at the piezometers, well, and precipitation station and across the hydrologic monitoring network in Management Block 2 is discussed in Section 2.1.3.2.

2.2.2 Northern Hamlin and Southern Snake Valleys

The environmental resources for which monitoring is established in northern Hamlin and southern Snake valleys to ensure avoidance of unreasonable effects include one native aquatic-dependent special status animal species, and one habitat type (shrubland habitat). Monitoring for these resources is described below. Thresholds, triggers and management and mitigation actions for these environmental resources are presented in Section 3.4.2.

2.2.2.1 Native Aquatic-dependent Special Status Animal Species

Native aquatic-dependent special status animal species: Longitudinal gland pyrg (*Pyrgulopsis anguina*).

The longitudinal gland pyrg may be endemic to southern Snake Valley, and is only known to occur at Dearden (Stateline) Springs, Big Springs, and Clay Spring North (Figure 2-16) (see discussion in Marshall et al., 2017, at Section 7.3).[3]

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1. Traversing the ACEC becomes difficult when the soils are moist under the surface.
2. The age classes are based on information about growth and reproduction for the species. In the southwestern U.S., average annual growth rate for Rocky Mountain juniper during the first 40 years is 0.1 m per year, and seed production begins under favorable conditions when plants are approximately 10 years old (approximately 1.0 m tall) (Noble, 1990).
3. A description of the species' status is provided in the 3M Plan analysis report (Marshall et al., 2017, at Section 5.3)

Monitoring activities: Monitoring for longitudinal gland pyrg is conducted if the hydrologic investigation trigger at the Hamlin Valley monitor well 383533114102901 (Figure 2-16) is activated as result of SNWA GDP pumping as described in Section 3.4.1. Presence/absence data on the longitudinal gland pyrg are collected at Dearden (Stateline) Springs, Big Springs, and Clay Spring North to verify the continued existence of the species at these sites. Data are collected on an annual basis as long as the investigation trigger is activated at monitor well 383533114102901, the hydrologic mitigation trigger is activated at monitor well HAM1008M (Figure 2-16) as described in Section 3.4.1, or as long as mitigation actions for the longitudinal gland pyrg are being conducted for the GDP.

Hydrologic monitoring is conducted at monitor wells 383533114102901 and HAM1008M, and other sentinel and intermediate wells between southern Snake Valley and SNWA GDP PODs in Spring Valley (Section 2.1.3.6). Changes in water levels at sentinel wells and select monitor wells are used to trigger hydrologic investigation and management actions for senior water rights. Changes in water levels at monitor well HAM1008M are used to trigger mitigation actions for senior water rights and the longitudinal gland pyrg (Section 3.4.2.1).

2.2.2.2 Shrubland Habitat

Habitat type: The majority of the groundwater discharge areas in northern Hamlin and southern Snake valleys is composed of shrubland habitat (Marshall et al., 2017, at Section 7.3).[1]

Monitoring for shrubland habitat focuses on the groundwater discharge areas in northern Hamlin Valley and in southern Snake Valley, Nevada, east of Big Springs Creek (Figure 2-16) (see discussion in Marshall et al., 2017, at Section 7.3).[2]

Monitoring activities: Shrubland habitat vegetation data are collected to verify that vegetation cover remains at or above the threshold (as discussed in Section 3.4.2.2 and Marshall et al., 2017, at Sections 6.3.3 and 7.3).

Monitoring for shrubland habitat is conducted in northern Hamlin Valley if the hydrologic investigation trigger at the sentinel well HAM1007M (Figure 2-16) is activated as result of SNWA GDP pumping as described in Section 3.4.1. Data are collected on an annual basis as long as the investigation trigger is activated at sentinel well HAM1007M, or as long as mitigation actions for Hamlin Valley shrubland habitat is being conducted for the GDP.

Monitoring for shrubland habitat is conducted in southern Snake Valley, Nevada, east of Big Springs Creek, if the hydrologic investigation trigger at the sentinel well HAM1008M (Figure 2-16) is activated as result of SNWA GDP pumping as described in Section 3.4.1. Data are collected on an annual basis as long as the investigation trigger is activated at sentinel well HAM1008M, or as long as mitigation actions for Snake Valley shrubland habitat is being conducted for the GDP.

1. A description of shrubland habitat is provided in the 3M Plan analysis report (Marshall et al., 2017, at Section 5.2).
2. No shrubland monitoring is needed west of Big Springs Creek/Lake Creek in Nevada or east of Big Springs Creek/Lake Creek in Utah, as described in the 3M Plan analysis report (Marshall et al., 2017, at Section 7.2.3).

The sample design consists of remote sensing polygons and plots, ground vegetation transects, and piezometers located in shrubland habitat (see shrubland habitat in Figure 2-16). These monitoring elements are developed using the same methods as used in Spring Valley, as described in the 3M Plan analysis report (Marshall et al., 2017, at Sections 6.3.3 and 7.3 and Appendix D, D.1.1).

- Remote sensing polygons are delineated within medium-density and low-density shrubland habitat (if both are present in adequate acreages).
- Remote sensing plots are located within the polygons using a proportionate stratified random design.
- One ground vegetation transect is located in the center of each remote sensing plot.
- One or two piezometers are spatially distributed across medium-density shrubland and low-density shrubland remote sensing plots in each basin. The locations also take into account the hydrologic monitoring network.
- The configurations of remote sensing polygons and plots, ground vegetation transects, and shrubland piezometers are informed by conducting a ground-truthing exercise and remote sensing analysis prior to initiating shrubland habitat monitoring in each basin.

Remote sensing is one of the methods used to monitor shrubland habitat and trigger investigation, management, and mitigation actions. The methods are the same as those used in Spring Valley (Section 2.2.1.3), and as described in the 3M Plan analysis report (Marshall et al., 2017, at Sections 6.3.3 and 7.3 and Appendix D, D.1).

- Normalized Difference Vegetation Index (NDVI, a proxy for vegetation cover) and precipitation data are generated for the remote sensing polygons. NDVI data are derived from July-September Landsat satellite image data, and precipitation data are derived for the water year (October - September) from a spatial weather dataset (gridMET). Landsat data are cross-calibrated, NDVI and precipitation computed, and NDVI and precipitation zonal statistics generated using the methods in the 3M Plan analysis report (Marshall et al., 2017, at Appendix D, D.1.2.1 and D.1.2.2).
- Mean annual NDVI and mean annual precipitation are calculated for each habitat group (medium-density shrubland, low-density shrubland) using the methods in the 3M Plan analysis report (Marshall et al., 2017, at Appendix D, D.1.3).
- Mean annual NDVI is plotted against mean annual precipitation for each habitat group (medium-density shrubland, low-density shrubland). These data points are overlaid on the baseline prediction intervals calculated prior to SNWA GDP groundwater withdrawal for Spring Valley Management Blocks 1 and 2 (Section 2.2.1.3). The prediction intervals are calculated by performing a linear least squares regression with a 95 percent confidence level, as described in the 3M Plan analysis report (Marshall et al., 2017, at Appendix D, D.1.3). The 1985-2015 baseline prediction intervals for Spring Valley Management Blocks 1 and 2 are shown in Figure 3-7 (Section 3.3.2.3). Alternatively, if the NSE approves, the data may be

overlaid on baseline prediction intervals calculated specifically for northern Hamlin or southern Snake valley using monitoring data acquired prior to drawdown propagation reaching each basin. The data points are compared to the lower control limits of the prediction intervals, which are used to trigger investigation, management, and mitigation actions (Section 3.4.2.2).

- The same computational methods are applied to the remote sensing plots. The plots provide additional opportunities for statistical analysis during investigations.

Ground vegetation transect surveys is the other method used to monitor shrubland habitat and trigger investigation, management, and mitigation actions. Remotely sensed data and ground vegetation data are used in a complimentary manner to provide information about landscape-scale shrubland habitat changes and the nature of those changes. The methods are the same as those used in Spring Valley (Section 2.2.1.3).

- Ground vegetation transects are 50 meters long, consistent with SNWA rangeland monitoring transects and the Spring Valley shrubland habitat transects in this 3M Plan (Section 2.2.1.3). Transects are not placed near dirt roads or water sources, or in inclusions or burn sites.

- Transect data are collected during summer (August) to coincide with the remotely sensed NDVI data.

- Cover and composition data are collected along the transects using the line-point intercept method. Gap-intercept data are collected using the canopy-gap and basal-gap method. Qualitative observations are made regarding bare ground, erosion, weed infestation and herbivory, and a photograph is taken at the beginning transect point looking down the transect line. These methods are described in detail in Section 2.2.1.3.

- Mean annual percent live shrub cover and mean annual precipitation are calculated for each habitat group (medium-density shrubland, low-density shrubland). Mean annual percent live shrub cover is calculated using the ground vegetation transect data, and mean annual precipitation is calculated as described above using the remote sensing polygons where the transects are located.

- Mean annual percent live shrub cover is plotted against mean annual precipitation for each habitat group (medium-density shrubland, low-density shrubland). These data points are overlaid on the baseline prediction intervals calculated prior to SNWA GDP groundwater withdrawal for Spring Valley Management Blocks 1 and 2 (Section 2.2.1.3). The prediction intervals are calculated by performing a linear least squares regression with a 95 percent confidence level, as described in the 3M Plan analysis report (Marshall et al., 2017, at Appendix D, D.1.3). Alternatively, if the NSE approves, the data may be overlaid on baseline prediction intervals calculated specifically for northern Hamlin or southern Snake valley using monitoring data acquired prior to drawdown propagation reaching each basin. The data points are compared to the lower control limits of the prediction intervals, which are used to trigger investigation, management, and mitigation actions (Section 3.4.2.2).

- Other transect data are used to understand the nature of vegetation changes during investigations.

The piezometers expand the hydrologic monitoring network within shrubland habitat, and provide additional information for investigations. The piezometers are installed up to 50 ft deep, depending on hydrogeologic conditions encountered, to span the plant rooting zone.[1] The hydrologic monitoring network is discussed in Section 2.1.3.6.

2.3 Quality Control and Database Management

All data collection and processing is performed following SNWA procedures. Applicable standards from organizations, such as the American Society for Testing and Materials, the U.S. Environmental Protection Agency, and the USGS, for each element of the program are incorporated as appropriate. A quality assurance/quality control (QA/QC) program will be followed, which includes the following elements: (1) identification of QA/QC procedure and direct organizational responsibilities; (2) staff training; (3) project work plans and reviews; (4) instrumentation deployment, maintenance, and calibration with the use of industry-recognizable standards and traceable to the National Institute of Standards and Technology when appropriate; (5) data collection protocols and documentation; (6) sample collection, chain of custody, and laboratory-analysis procedures; (7) data processing and review procedures; and (8) data storage.

All data collected pursuant to this 3M Plan will be processed according to the applicable SNWA procedure(s) and stored in an appropriate computerized database and/or physical file. Database quality will be maintained by verifying database input against original data files. Internal cross-checks of new data in the database will be performed at the time of entry to identify anomalous new or existing data. Original data will be maintained in paper or electronic archives to ensure integrity and traceability. Data reviews will be performed to verify that data are collected and entered into the database properly and accurately.

1. Maximum rooting depth of facultative phreatophytes in the region is approximately 50 ft (BLM, 2012, at page 3.5-13; McLendon, 2011).

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3.0 Management and Mitigation Plan

This section presents the management and mitigation plan to avoid unreasonable effects to hydrologic and environmental resources from SNWA GDP pumping in Spring Valley. The 3M Plan management and mitigation element of the 3M Plan provide: (1) quantitative triggers that determine when mitigation actions will be implemented for senior water rights and environmental resources; (2) quantitative triggers that determine when investigation actions will be implemented where applicable, and an approach to investigate changes in hydrologic and environmental conditions and inform management and mitigation actions; (3) specific management and mitigation actions for senior water rights and environmental resources; and (4) a process for assessing efficacy of mitigation actions to ensure that unreasonable effects are avoided or eliminated and that the SNWA GDP complies with the Remand Order and Nevada water law.

3.1 Conceptual Approach and Systematic Process

A conceptual approach and systematic process were used to identify objective thresholds, quantitative investigation and mitigation triggers, and monitoring, management, and mitigation actions in this 3M Plan. The conceptual approach and systematic process are described in detail in the 3M Plan analysis report (Marshall et al., 2017, at Section 3.0), and summarized below.

A threshold is defined in this 3M Plan as a condition of a hydrologic or environmental resource that, when crossed, requires a mitigation action that will avoid unreasonable effects. As discussed in the 3M Plan analysis report, the crossing of a threshold is detected by using quantitative mitigation triggers (Marshall et al., 2017, at Section 3.1.1) (Figure 3-1). The thresholds in this 3M Plan were determined by analyzing baseline data and considering resource sensitivity and unreasonable effects. To reduce risk, the thresholds were established at levels that provide buffers from unreasonable effects. For example, thresholds for senior water rights were established above permitted diversion rates when conditions allowed. By establishing thresholds in this manner, time and resources will be available to implement mitigation actions and avoid unreasonable effects.

A trigger, as defined in this 3M Plan, is a quantitative hydrologic or environmental parameter value that prompts action. As described in the 3M Plan analysis report, two types of triggers are employed: investigation triggers and mitigation triggers (Marshall et al., 2017, at Section 3.1.2) (Figure 3-1). Investigation triggers are established above thresholds levels and prompt investigation actions. Based on investigation findings, preemptive management actions may be implemented to avoid or minimize the risk of activating mitigation triggers. Mitigation triggers are established at threshold levels, and prompt mitigation actions to avoid unreasonable effects and comply with Nevada water law.

The investigation and mitigation triggers for hydrologic resources are (1) a quantitative fixed trigger which is related to a specific value, such as water level or a specific permitted water right diversion

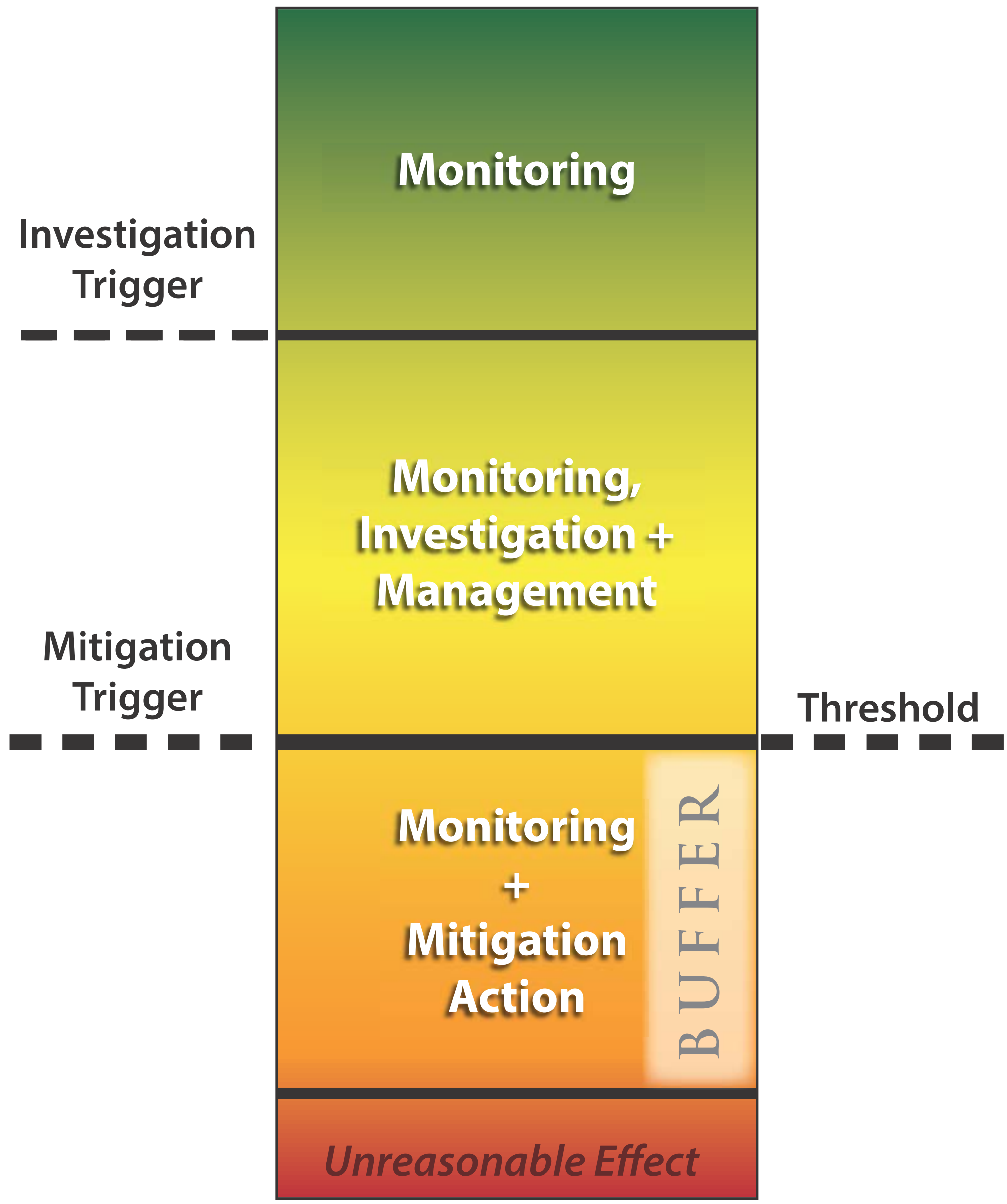

Figure 3-1
Threshold, Trigger, and Monitoring, Management, and Mitigation Approach

rate, or (2) a quantitative trigger linked to the behavior of the baseline data record. Quantitative fixed triggers do not adjust for trends or reoccurring patterns, such as seasonality, in the baseline data set. Quantitative triggers linked to the behavior of the baseline dataset can account for trends and seasonal variability, and are more responsive in accounting for variation in natural hydrologic conditions. The investigation and mitigation triggers for environmental resources are (1) a hydrologic trigger as discussed above, or (2) a quantitative environmental trigger linked to the behavior of the baseline data record.

Activation of triggers can prompt three types of actions, as discussed in the 3M Plan analysis report (Marshall et al., 2017, at Section 3.1.4) and shown in Figure 3-1: investigation actions, management actions, and mitigation actions:

- Investigation actions are prompted by investigation triggers and can also be requested by the NSE. The purpose of conducting investigations is to determine cause, condition, and significance of observed changes, and inform management and mitigation actions. Investigation actions focus on data analyses, refinement of predictive tools, and may incorporate additional data collection efforts. For example, investigation actions that result from activating an investigation trigger might involve analyses of groundwater level and discharge data, SNWA GDP pumping data, and precipitation data to understand groundwater levels in the context of regional patterns. A critical aspect of investigation actions is to determine the cause and significance of water level changes at the trigger location, and identify prudent preemptive management actions.

- Preemptive, discretionary management actions may be prompted by investigation findings, and will be employed as best management practices for the SNWA GDP. The purpose of implementing preemptive management actions is to avoid or minimize the risk of activating mitigation triggers, and support responsible groundwater development. Management actions that are known to be effective and are available to SNWA are identified in this 3M Plan. Specific implementation of individual management actions will depend on the resource and situation. For example, if an investigation trigger is activated at an intermediate monitor well, management actions might involve reducing pumping rates at specific locations to reduce drawdown propagation toward a resource.

- Mitigation actions are prompted by mitigation triggers. Mitigation actions may also be implemented preemptively if data trends indicate that the activation of a mitigation trigger is imminent. In some cases, mitigation may be conducted prior to SNWA GDP pumping (e.g., for resources close to pumping locations with a potential high risk of impact, or for highly sensitive resources). The purpose of implementing mitigation actions is to avoid unreasonable effects and comply with Nevada water law. Mitigation actions that are known to be effective and are available to SNWA are identified in this 3M Plan. Specific implementation of individual mitigation actions will depend on the resource and situation. For example, if a mitigation trigger is activated at a flowing artesian well with a senior water right, a pump may be installed to ensure continued access to the permitted water for the legally-approved beneficial use.

3.2 Approach for Senior Water Rights and Environmental Resources

Section 3.2.1 presents the approach to avoid conflicts with senior water rights, including details regarding thresholds, triggers, and actions for underground and spring/stream water rights. This approach is then applied to senior water rights within the 3M Plan area in Sections 3.3.1 and 3.4.1. Section 3.2.2 summarizes the approach to avoid unreasonable effects to environmental resources. Details regarding thresholds, triggers, and actions for environmental resources within the 3M Plan area are presented in Sections 3.3.2 and 3.4.2.

3.2.1 Avoiding or Eliminating Conflicts with Senior Water Rights

This 3M Plan uses monitoring activities, management tools, investigation and mitigation triggers, and management and mitigation actions to avoid or eliminate conflicts with existing water rights. As described in Section 1.2, unreasonable effects include conflicts with senior water rights or protectable interests in existing domestic wells.

3.2.1.1 Investigation Triggers

Quantitative triggers have been set for resources. Investigation triggers for senior water rights are an SNWA management tool to evaluate observed changes in trigger parameter values, and preemptively implement discretionary management actions to avoid or minimize the risk of activating mitigation triggers. The investigation triggers are activated if trigger parameter values are outside the normal range of the historical baseline, as specified below. When an investigation trigger is activated, SNWA will conduct an investigation and submit the findings to the NSE (see investigation in Section 3.2.1.2, and reporting in Section 5.2). The purpose of the investigation is to determine the cause, condition, and significance of the observed changes in relation to potential future effects on senior water rights, and to inform potential management actions.

Investigation triggers are specific and quantified and are set at different types of locations to assist in managing SNWA GDP pumping in order to avoid mitigation triggers and unreasonable effects. Specific investigation triggers associated with the senior water rights are presented in this section and in the 3M Plan analysis report (Marshall et al., 2017 and Sections 6.0 and 7.0).The types of locations where an investigation trigger may be assigned in the 3M Plan are presented below:

- A specific senior water right.
- A specific spring or well which acts as a proxy for multiple senior water rights in the vicinity of that location.
- An intermediate monitor well, piezometer, or spring location between an individual or group of senior water rights and SNWA GDP PODs. The intermediate location acts as an early warning to detect the presence and amount of change in water level or spring discharge prior to being observed at a measurable level at a distant senior water right.

- A sentinel monitor well, which is located on the outside fringe of SNWA GDP pumping areas, to detect the presence and amount of drawdown propagating from the pumping areas. An example of sentinel wells is the designated monitor wells located along the hydrographic boundary between Spring and Hamlin valleys. The sentinel wells provide data to determine if management actions are needed or if additional monitoring should be expanded a greater distance away from the pumping area in order to protect more distant senior water rights.

The measured parameters associated with a designated investigation trigger depend upon the location and type of site. The measured parameters may include groundwater level, well production rate, spring flow, or stream flow.

The activation conditions assigned to a specific investigation trigger location are dependent on the length, quality, and characteristics of the baseline record. The primary investigation trigger is a decrease in the measured parameter (such as water level or spring flow) that is collected after SNWA GDP pumping begins, which for six continuous months is below the 99.7 percent lower control limit using the seasonally adjusted linear regression (SALR) method for the baseline data collected prior to SNWA GDP pumping.

The SNWA GDP 3M Plan uses the SALR method to identify a lower control limit for the baseline dataset. A linear regression is a simple method that can be used to construct a model to fit time-series data (Chandler and Scott, 2011). The method uses ordinary least-squares, which calculates a best-fit line for the observed data by minimizing the sum of the squares of the vertical deviations from each data point to the line. “Linear least squares regression is by far the most widely used modeling method. It is what most people mean when they say they have used "regression", "linear regression" or "least squares" to fit a model to their data” (NIST/SEMATECH, 2017).

Evaluating hydrologic time-series data using a multiple linear regression model provides the ability to assess the trend of the data over a period of time and captures the aggregate effects of the natural and human induced processes on the baseline measurement data. The SALR method also evaluates recurring seasonal variability in the record. A description of the SALR method is presented in the 3M Plan analysis report (Marshall et al., 2017, in Appendix A). An example demonstrating the activation of an investigation trigger is presented below.

The example shown in Figure 3-2, uses the SALR method applied to a hypothetical baseline dataset which exhibits a strong reoccurring seasonal behavior. The example illustrates the activation of an investigation trigger for the hypothetical dataset. An artificial water-level record was constructed for the period 2006 through 2026 to demonstrate hypothetical hydrologic conditions over an assumed 20 year baseline monitoring period at the hydrologic monitoring location.

As shown in Figure 3-2, SNWA GDP pumping is hypothetically assumed to begin in early 2026, from which point the artificial record is extended to demonstrate a decline in water-level for the purpose of illustrating the timing of an investigative trigger. The investigative trigger established for this hypothetical example is a decrease in groundwater level below the 99.7 percent lower control limit for a continuously period of six months. A close-up of the plot, presented in Figure 3-3, shows the water level crossing the 99.7 percent lower control limit during the third quarter of 2026 and remaining for six continuous months at which point the investigative trigger would be activated.

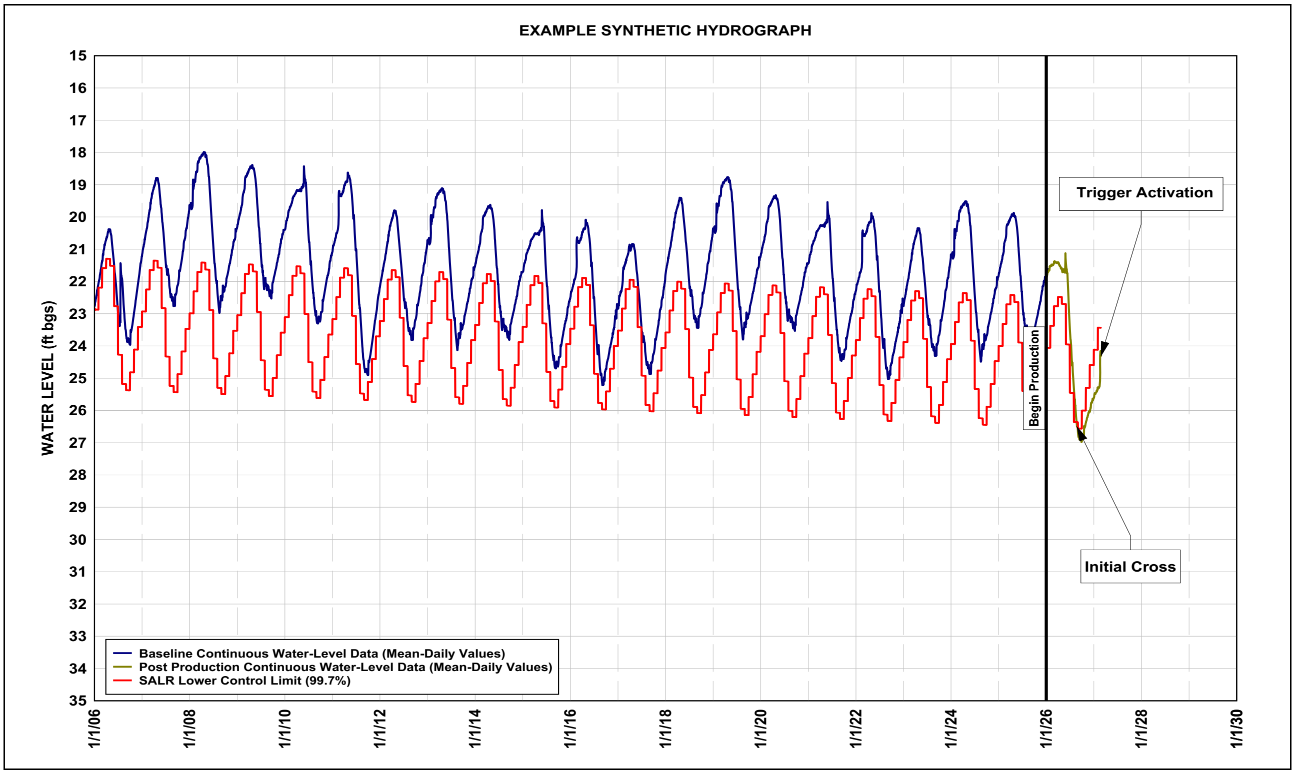

Figure 3-2
Example of Trigger Activation - Strong Seasonality

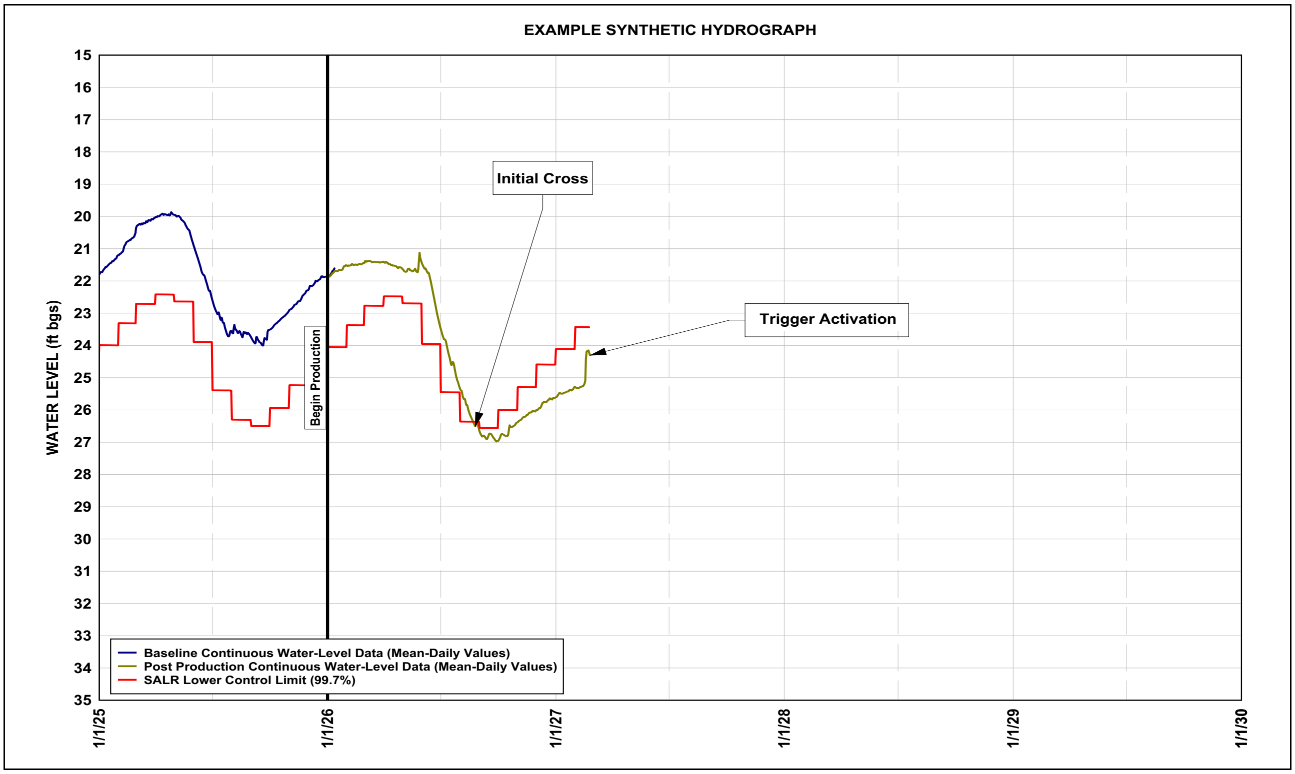

Figure 3-3
Example of Trigger Activation - Close up of Figure 3-2 Example

Baseline period of record hydrographs and the current triggers based on the 99.7 percent lower control limit derived using the SALR method for all installed sentinel and network monitor wells are presented in Appendix C.

3.2.1.2 Investigation Methodology

Investigations are conducted when an investigation trigger is activated, or at the request of the NSE (Section 3.2.1.1). The purpose of conducting investigations is to determine cause, condition, and significance of observed changes, and inform management and mitigation actions. SNWA will also perform regular internal technical reviews of data for the improvement and optimization of project operation and management which will follow a similar investigation methodology.

The investigation methodology includes the following components:

- Assemble and document information on the current and historical conditions in the investigation area including: SNWA pumping locations, rates, and duration; physical attributes of water right POD; monitoring system and instrumentation; hydrologic data; historical water and land use in the area; other non-SNWA pumping; changes in irrigation activities; and other factors which may influence the investigation area.

- Evaluate the hydrogeologic conditions at the site including source aquifer, recharge location, water chemistry, and effects from local conditions or activities. The investigation evaluates the likelihood and degree of hydrologic connection between the site and the producing aquifer in which SNWA GDP production wells will be installed.

- Compare investigation area data with SNWA GDP pumping activities and background hydrologic information. Evaluate the variability in water level in the wells or spring discharge compared to historical regional hydrologic conditions including regional and local precipitation, barometric pressure, stream flow, spring flow, land use, and irrigation practices. Compare hydrologic conditions at the site to area reference index sites, if available, which behaved in a similar manner to the site of investigation over time.

- Review the quality control / quality assurance and calibration data documentation associated with the monitoring instrumentation and measurements.

- Quantify the amount of drawdown in wells between the site and production locations and compare with SNWA GDP pumping rates, duration, and schedule.

- Identify other pumping or natural stress which may influence the site.

- Utilize management tools such as the USGS SeriesSEE (Halford et al., 2012) analysis package to identify and detrend influences such as precipitation, barometric pressure, and tidal effects on historical time series data sets associated with the senior water right or monitoring locations. SeriesSEE can be used to compare water level or spring flow at the site to multiple regional reference locations outside the SNWA GDP pumping area in order to detect divergence from those reference sites. It is used to help filter regional influences from pumping effects.

- Compare the drawdown estimated by analytical solutions and the numerical groundwater flow model (Section 4.0) for the documented SNWA GDP pumping rate, distribution, and duration history to the change in water level observed at the site and area monitoring locations.

- If the investigation trigger is associated with an underground water right, evaluate the well efficiency and performance to pre-SNWA GDP pumping conditions.

- Prepare a technical memorandum of findings from the investigation (Section 5.2).

- Additional investigation actions for environmental resources are described in Section 3.3.

3.2.1.3 Management Actions and Tools

Preemptive management actions may be taken to avoid reaching a mitigation trigger and causing unreasonable effects. Management actions may be implemented based on investigation findings that result from the activation of investigation triggers. SNWA may also develop and implement management actions for the ongoing improvement and optimization of SNWA GDP operations. The specific management actions are dependent upon the risk of impact, significance of the change (in water level, production rate, spring flow, or stream flow), potential of the mitigation trigger being reached at a senior water right, and sensitivity of the resource.

Examples of management actions which may be used include, but are not limited to, the following:

- Additional data collection and evaluation including expanded monitoring activities such as installation of additional monitoring wells or spring monitoring sites.

- Increase measurement frequency or install higher resolution monitoring instrumentation.

- Expand use of management predictive tools such as analytical methods and numerical groundwater flow models to analyze the significance and relationship of drawdown at the investigation trigger location, and projected drawdown.

- Develop higher resolution local flow models (child models) if sufficient data exists within the regional groundwater flow model to provide a tool for analysis in the specific area of interest.

- Establish a new or refined quantitative investigation trigger(s) to track a continuing trend outside the baseline in relation to potential effects on senior water rights. The new investigative trigger will be specific for the location and may be based upon the data set adjusted for the background influence of precipitation, tidal effects, and barometric pressure.

- Establish a management action linked to maximum drawdown level to avoid reaching a mitigation trigger. The management action is established at an intermediate monitor or sentinel well location using predictive tools to determine the maximum drawdown level at that location allowed in order to avoid approaching a mitigation trigger at a distant resource site.

- Evaluate modification of SNWA pumping distribution locations along with well production rates and duration on drawdown levels.

- Modify SNWA pumping to avoid a mitigation trigger as described in Section 3.2.1.4.

- Preemptively implement a mitigation action prior to reaching a mitigation trigger.

3.2.1.4 Management Actions Regarding SNWA GDP Pumping Operations

SNWA GDP pumping operations are managed and adjusted as necessary to manage drawdown in areas based upon recorded aquifer response from pumping operations and numerical groundwater flow model projections. Management actions associated with SNWA GDP pumping operations may be used to optimize SNWA GDP operations and respond to drawdown in certain areas. Pumping operations may also be modified based upon larger than normal recharge events or extended drought periods. Areas within the SNWA GDP basins may be rested for periods of time to allow recovery. Management actions associated with pumping operations include the following:

- Change in pumping rates of selected production wells or well field.

- Reduction in total groundwater extraction for a basin.

- Change in pumping duration - seasonal cycling.

- Change in daily pumping duration - daily cycling of production wells.

- Rotation of pumping between individual wells and/or well fields.

- Distribution of pumping within the basin.

- Rotation of pumping between basins.

- Change in pumping rates and durations related to precipitation and recharge conditions.

- Suspension of pumping at individual production well sites, well fields, basin wide, or project wide.

This 3M Plan uses a staged development approach in Spring Valley, in accordance with Ruling 6164 (NDWR, 2012, at pages 216-217). Staged development begins the project operations with a limited amount of pumping to observe and evaluate the aquifer response at various monitoring point locations under different pumping rates, durations, and distribution between production wells. The rate of change of drawdown decreases with time and with distance logarithmically from the pumping well. Therefore, the rate of change is greatest and quickest in the immediate vicinity of the production well during the beginning of pumping. The farther away from the pumping well, the less drawdown and lower the rate of change over time is observed. As a result, the greater the distance from a pumping well, the more time is available to evaluate the propagation and changes in drawdown with distance from the pumping well or to take management actions to avoid mitigation triggers.

3.2.1.5 Senior Underground Water Right Mitigation Trigger

As described in Section 3.2.1.5, wells associated with a senior underground water right are grouped into two categories where: (1) the well and current pump production capacity is above the water right diversion rate, and (2) the well and current pump production capacity is at or below the water right diversion rate. The process flow chart for mitigation triggers for senior underground water rights is presented on Figure 3-4.

In both cases, compensation by SNWA for the incremental increase in power usage to a well owner due to the unreasonable lowering of the water table by SNWA GDP pumping will occur if the usage increase is greater than 25 percent to produce a similar volume of water. The 25 percent criteria is a reasonable difference in power usage that corresponds to lower water levels which can be measured.

Well production > permitted diversion rate prior to SNWA GDP pumping

The mitigation trigger at a well which has production capacity above the permitted diversion rate is a decrease in groundwater level that reduces the column of water in the well needed to produce the permitted diversion rate based on the well's specific capacity range plus either a 10 percent or 10 ft buffer, which ever is greater. The buffer provides time to implement the mitigation action prior to reaching a conflict. An alternative fixed mitigation trigger for the well is activated if the maximum production capacity from the well decreases to less than 10 percent above the permitted diversion rate and the static groundwater level has decreased as a result of SNWA GDP pumping. An evaluation would be made to determine if the changes were a result of SNWA GDP pumping or were due to a deterioration in the well or pump conditions and efficiency.

The specific capacity is the production rate in gallons per minute divided by the amount of drawdown (static water level minus the stable pumping water level) at the senior water right POD well. The range of specific capacity derived from different pumping rates and associated pumping water levels are used to establish a mitigation trigger. The completion of the well in an unconfined or confined aquifer and the variability of specific capacity with pumping level is considered. The variability of lithology and hydraulic conductivity is also considered especially if the pumping water level declines below the high production zone identified from the lithologic log. An example of the mitigation trigger process using specific capacity is presented in the 3M Plan analysis report (Marshall et al., 2017, at Section 3.2.6.1).

A water resource assessment, as described in Section 2.1.2.4 will be performed with the owner's permission at least three years prior to SNWA GDP pumping at all senior underground water right locations assigned management categories A and B. These are sites located within 10 miles of an SNWA GDP permit POD. The wells will be tested to determine well and pump capacity. The existing pump in the well can be used or a test pump will be provided for the assessment. Well specific capacity will be calculated for a range of production rates. Additional information on well construction and current conditions will be documented. Wells located in Management Categories C

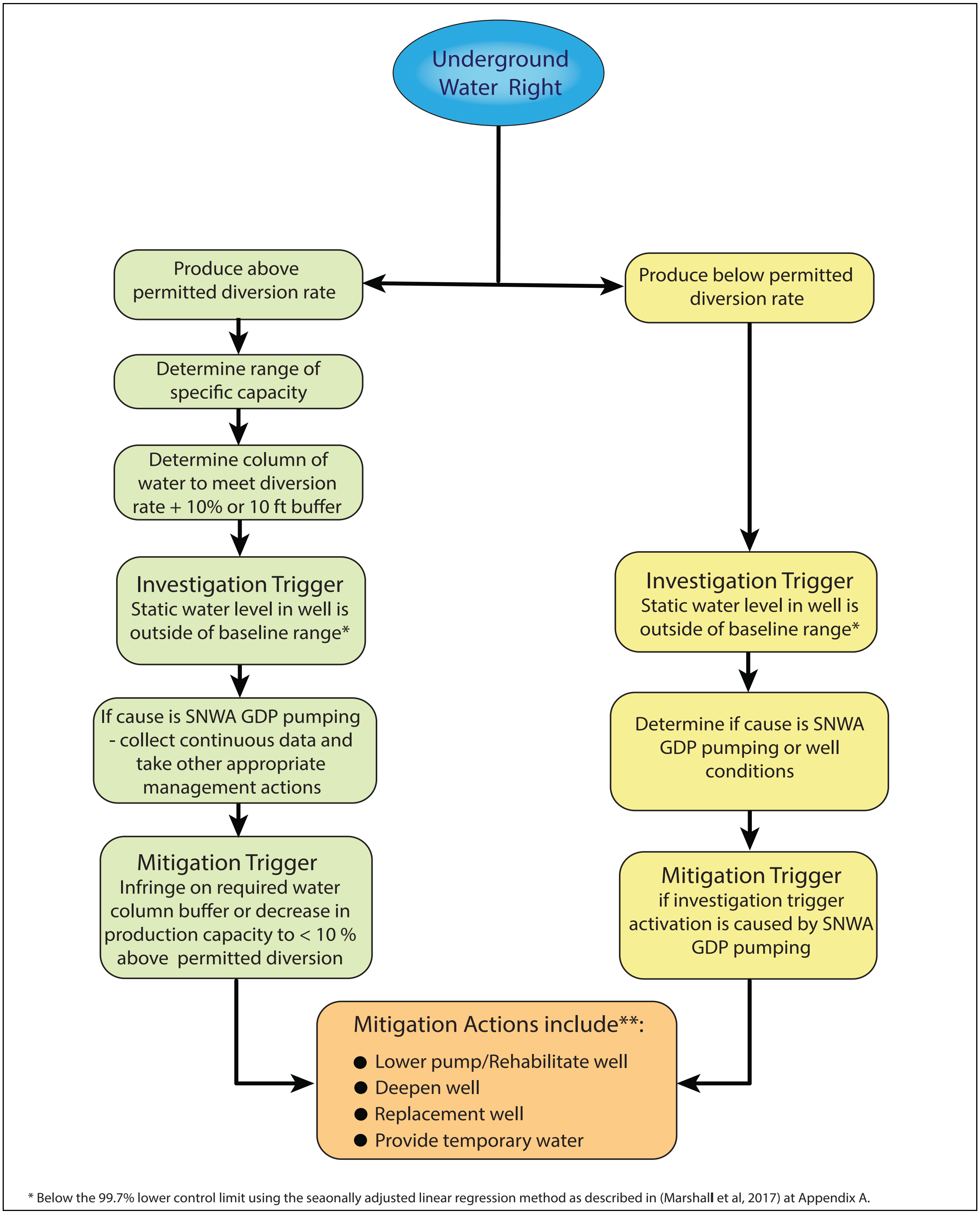

Figure 3-4
Management and Mitigation Flow Chart for Senior Underground Water Right

**Additional Mitigation actions are presented in Section 3.2.1.7

and D will have a water resource assessment performed based up a management action from activation of an investigation trigger at a sentinel well or at the request of the NSE.

Well production < permitted diversion rate prior to SNWA GDP pumping

The mitigation trigger is the same as the investigation trigger and is activated for wells with production capacity less than the permitted diversion rate if the evaluation associated with the investigation trigger determines the cause of the change to be SNWA GDP pumping. The trigger is activated when the static water level decreases below the 99.7 percent lower control limit for the baseline data for six continuous months using the SALR method, as described in 3M Plan analysis report (Marshall et al., 2017, at Appendix A). If a mitigation trigger is activated, the potential to redevelop the well to increase specific capacity in order to increase production will be evaluated based upon the original water resource assessment and more recent well performance data.

3.2.1.6 Senior Spring and Stream Water Right Mitigation Trigger

The mitigation trigger for a senior spring or stream water-right is presented under two cases: (1) spring or stream flow at the POD which has been measured consistently above the permitted diversion rate, or (2) spring or stream flow at the POD which has been measured consistently at or below the permitted diversion rate. A process flow chart is illustrated on Figure 3-5 and described below:

- If measured baseline spring or stream flow has been consistently above the permitted diversion rate, the mitigation trigger is 10 percent above the permitted diversion rate and is activated if spring or stream discharge decreases below this mitigation trigger level for six consecutive months as a result of SNWA GDP pumping. The 10 percent buffer allows time to implement mitigation, and accounts for error inherent in collecting discharge measurements.

- If measured baseline spring or stream flow has been consistently at or less than the permitted diversion rate, the mitigation trigger is activated if the evaluation associated with the investigation trigger determines the cause of the change to be SNWA GDP pumping.

A third case consists of springs which have intermittent flow or are consistently dry. A spring which has non-measurable intermittent flow or that is dry over extended periods of time will be studied as a special case using nearby shallow piezometers, if present, or visual observations. The spring conditions will be compared to water levels and regional precipitation conditions to determine the conditions under which the spring normally flows. After SNWA GDP pumping begins, the spring will be monitored to determine if there is a change in the observed spring flow compared what has been observed under similar baseline regional hydrologic conditions.

3.2.1.7 Mitigation Actions for Senior Water Rights

Mitigation actions are implemented if a mitigation trigger is activated in order to avoid or eliminate a conflict. Mitigation actions may also be conducted preemptively if data trends indicate that mitigation trigger activation is imminent. As described in Section 5.2, SNWA will submit a technical

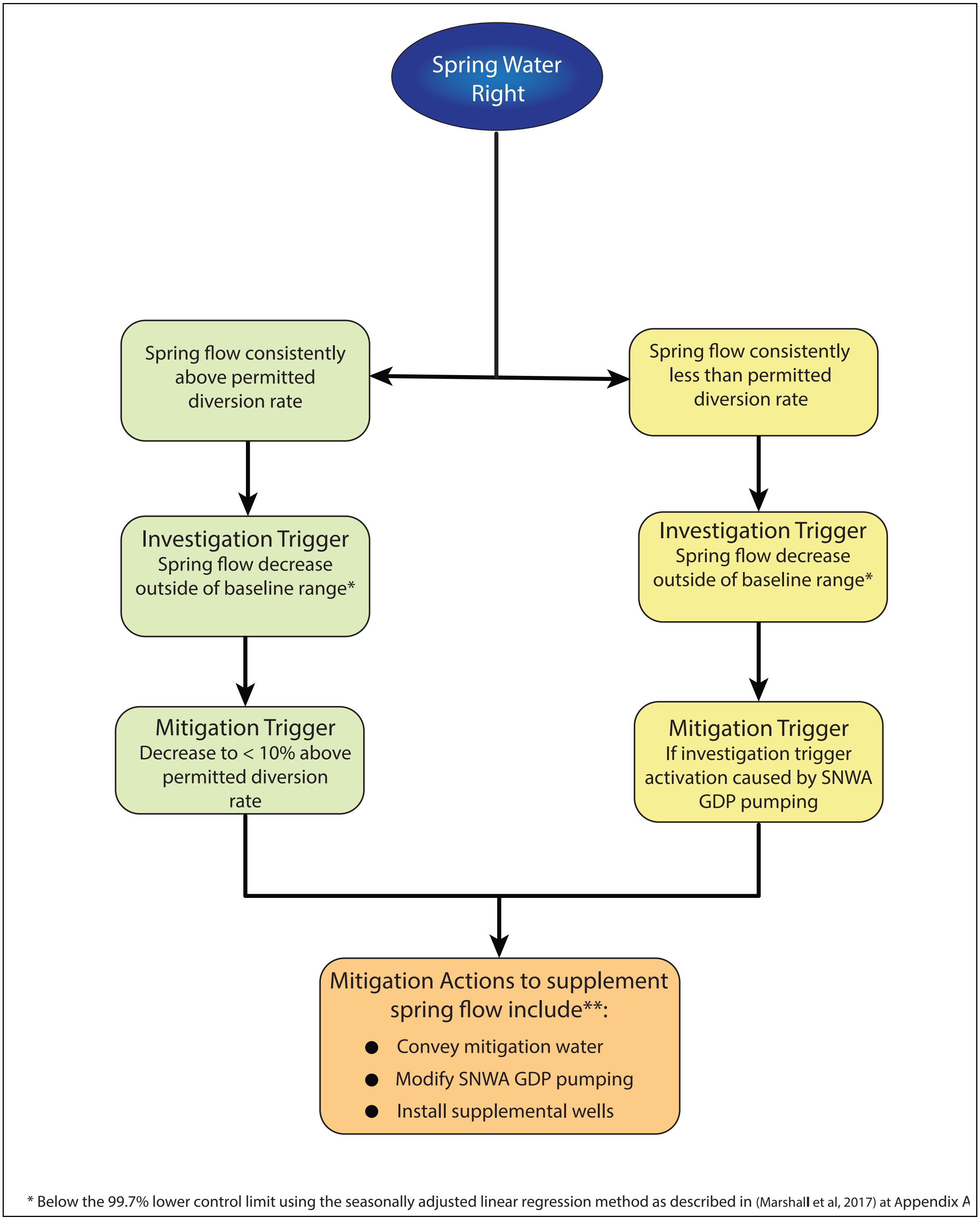

Figure 3-5
Management and Mitigation Flow Chart for Senior Spring or Stream Water Right

**Additional mitigation actions are presented in Section 3.2.1.7

memorandum of investigation findings within 30 days after mitigation trigger activation (or as required by the NSE). SNWA will implement mitigation actions no later than 30 days after activation of the mitigation trigger if the cause of activation is SNWA GDP pumping.

As part of development of this 3M Plan, mitigation actions for each senior water right have been identified and screened for appropriateness considering the hydrogeologic conditions at the site as they are currently known. If mitigation water is the mitigation action chosen to be implemented, the potential mitigation water volume needed to avoid or eliminate a conflict with a senior water right is determined by the quantity of water committed to the beneficial use of the senior water right. Baseline data and conditions documented at some water rights locations indicate that the spring or stream sources for some water rights or vested claims have not historically produced the full water right amount or have been periodically dry. However, the 3M Plan provides replacement water for the full volume of the senior water right or vested claim until such time as an adjudication occurs and a decreed replacement volume is determined. SNWA will initiate temporary and long term mitigation actions with an access agreement with the senior water right holder. The 3M Plan provides replacement water at the POD or beneficial place of use for the annual or seasonal use permitted in the senior water right.

The management and mitigation actions for each of the senior water rights in the Spring Valley analysis area are presented in summary tables in Sections 3.3 and 3.4 and in the 3M Plan analysis report (Marshall et al., 2017, at Sections 6.2 and 7.2). Additional management and mitigation actions which may be applied to senior water rights are present in 3M Plan analysis report (Marshall et al., 2017 at Sections 3.2.4 and 3.2.8).

Senior water rights assigned Management Category A (within 3 miles of the closest SNWA GDP POD) have a plan for mitigation in place or mitigation is preemptively implemented at the time of SNWA GDP pumping startup. Senior water rights assigned Management Category B (between 3 and 10 miles of the closest SNWA GDP POD) have a detailed assessment and implementation plans for mitigation actions prepared prior to initiation of SNWA GDP pumping. Water resource assessment and detailed implementation planning for senior water rights assigned Management Category C or D will occur upon activation of the investigation trigger at designated sentinel monitor wells. Mitigation actions are assessed for effectiveness and modified if needed to avoid or eliminate conflicts with senior water rights.

The mitigation actions are assessed as additional data on the aquifer conditions and the senior water right POD becomes available. Anytime a mitigation action is implemented, an assessment is conducted to determine mitigation effectiveness. Based on the assessment, mitigation actions may be modified as needed to avoid or eliminate the conflict. For example, if lowering a pump in the well is unsuccessful, a secondary option of redeveloping the well to increase well efficiency, deepening the well, or replacing the well is evaluated. As described in Section 5.2, SNWA will submit updates on mitigation actions taken and assessments of mitigation effectiveness in the annual 3M Plan report to the NSE.

3.2.2 Avoiding Unreasonable Effects to Environmental Resources

This 3M Plan uses thresholds, triggers, and monitoring, management, and mitigation actions to avoid the unreasonable effects to environmental resources defined in Section 1.2. An overview of the approach is as follows:

- The federally listed species in the Spring Valley groundwater discharge area (Pahrump poolfish) occurs at a site with a senior water right. The approach to avoid jeopardizing this federally listed species thus primarily relies on avoiding unreasonable effects to the senior water right. By avoiding unreasonable effects to senior water right, the water that the species depends on will continue to be available. As described in detail in Section 3.2.1, this approach includes investigation triggers established at intermediate wells between SNWA GDP PODs and the senior water right, preemptive management actions to avoid or minimize the risk of activating the mitigation trigger at the senior water right POD, and mitigation actions to avoid a conflict with senior water rights. Environmental mitigation actions are also included in the approach to ensure that the unreasonable effect to the federally listed species is avoided.

- Avoiding unreasonable effects to senior water rights also helps avoid extirpation of the native aquatic-dependent special status animal species from the Spring and Snake valleys groundwater discharge areas (northern leopard frog and longitudinal gland pyrg, respectively). Environmental mitigation actions are also included in the approach to ensure that unreasonable effects to the species are avoided. To provide further assurance, an SNWA deeded property in central Spring Valley that has extensive mesic habitat and northern leopard frogs will be managed to maintain and enhance mesic habitat for the benefit of the species and other wildlife. Although other wildlife are not specifically addressed in this 3M Plan, their needs are protected by avoiding unreasonable effects to senior water rights, federally listed species and native aquatic-dependent special status animal species with which they are generally co-located, and the habitat types that they use.

- The approach described above also avoids elimination of mesic and lake habitat from the basin groundwater discharge areas.[1] By attenuating groundwater drawdown and propagation, it also helps avoid elimination of shrubland habitat and terrestrial woodland habitat from the basin groundwater discharge areas, and excessive loss of shrub cover that results in extensive bare ground.[2] Environmental triggers and management and mitigation actions are established to maintain shrubland cover at or above a threshold level in Spring, Hamlin, and Snake valleys, and to maintain a viable terrestrial woodland population with tree cover area at or above a threshold level in Spring Valley.

Investigations will be conducted upon activation of investigation triggers or at the request of the NSE. The purpose of conducting investigations is to determine cause, condition, and significance of observed changes, and inform management and mitigation actions. Specific investigation actions related to senior water right triggers are outlined in Section 3.2.1.2. If an environmental investigation trigger is activated, additional investigation actions will include analyses of environmental data with

1. Within the groundwater discharge areas in the 3M Plan area, lake habitat is only in southern Snake Valley.
2. Within the groundwater discharge areas in the 3M Plan area, terrestrial woodland habitat is only in Spring Valley.

the hydrologic data. For example, if a shrubland investigation trigger is activated, investigation actions would include analyses of vegetation monitoring data with groundwater level data, SNWA GDP pumping data, and precipitation data to determine the cause and nature of the vegetation changes and identify prudent management actions. Mitigation actions will be prepared during investigation in advance of activating a mitigation trigger, including purchasing equipment, establishing contracts, and obtaining any necessary landowner permissions and permits. Mitigation actions will be implemented no later than 30 days after a mitigation trigger is activated to avoid unreasonable effects to environmental resources and comply with Nevada water law. The process for submitting investigation findings and mitigation plans to the NSE is described in Section 5.2.

Environmental monitoring activities are detailed in Section 2.2. Thresholds, investigation and mitigation triggers, and management and mitigation actions to avoid unreasonable effects to environmental resources are presented in Section 3.3.2 (Spring Valley) and Section 3.4.2 (northern Hamlin and southern Snake valleys).

3.3 Spring Valley Triggers and Management and Mitigation Actions

This section presents the thresholds, investigation triggers, preemptive management actions, mitigation triggers, and mitigation actions to avoid or eliminate unreasonable effects to senior water rights and environmental resources in Spring Valley. The rationale and analyses supporting these triggers and actions are presented in the 3M Plan analysis report (Marshall et al., 2017, at Section 6.0).

3.3.1 Senior Water Rights

This section presents the thresholds, investigation and mitigation triggers, and management and mitigation actions to avoid unreasonable effects to senior water rights and domestic wells in Spring Valley. This information is organized by the Management Blocks shown in Figure 1-1. The hydrologic monitoring activities in Spring Valley are presented in Section 2.1. A summary of investigation triggers, management actions, mitigation triggers, and mitigation actions for Spring Valleys Management Blocks 1 through 5 are summarized in Tables 3-1 to 3-4.

Table 3-1
Spring Valley Management Block 1 Senior Water Right Management and Mitigation Plan
(Page 1 of 3)

Unreasonable Effect	Conflict with a senior water right.
Investigation Trigger	Monitor hydrologic conditions in Management Block 1 according to the monitoring plan. The investigation trigger at a designated well site is a decrease in water level below the 99.7 percent lower control limit using the SALR method for the baseline data for six continuous months. The investigation trigger at a designated spring site is a decrease in spring discharge below the 99.7 percent lower control limit using the SALR method for the baseline data for six continuous months. If the investigation trigger is activated, investigate cause, determine significance, revise predictive tools, and apply appropriate management actions. Request from the NSE to investigate the cause of a change in water level or spring discharge and a location.
Management Action	If the investigation indicates cause of water level change at sentinel or other designated monitor wells is the result of SNWA GDP pumping, management actions may include the following: • Increase monitoring frequency to continuous if feasible to install a pressure traducer in the senior water right POD wells. • Prepare implementation of mitigation actions to avoid conflict at the senior water right POD or place of beneficial use, including purchasing equipment, establishing contracts, and obtaining any necessary landowner permissions and permits. • Consider preemptive mitigation actions for senior water rights in Management Category A (less than 3 miles from SNWA GDP POD) to avoid the activation of a mitigation trigger. The decision to preemptively implement mitigation actions at a site will be dependent upon the results of the water resource assessment, probability of effects, sensitivity of resource, and hydrogeologic setting. • Update the numerical groundwater flow model and other predictive tools with aquifer response data.

Table 3-1
Spring Valley Management Block 1 Senior Water Right Management and Mitigation Plan
(Page 2 of 3)

Mitigation Trigger	**Senior Underground Water Rights:** **Well production > permitted diversion rate prior to SNWA GDP pumping:** A decrease in groundwater level that reduces the column of water in the well needed to produce the permitted diversion rate based on the well's specific capacity range plus either a 10 percent or 10 ft buffer, which ever is greater. An alternative mitigation trigger for the well is activated if the maximum production capacity from the well decreases to less than 10 percent above the permitted diversion rate and the static groundwater level has decreased below the 99.7 percent control limit as a result of SNWA GDP pumping. **Well production < permitted diversion rate prior to SNWA GDP pumping:** If the evaluation associated with the investigation trigger determines the cause of the change in water level to be SNWA GDP pumping, the mitigation trigger is activated. Increase of more than 25 percent in the power usage for pumps to produce a similar amount of water as a result of decreased water levels from SNWA GDP pumping. **Senior Spring or Stream Water Rights:** **If measured baseline spring or stream flow has been consistently above the permitted diversion rate:** The mitigation trigger is 10 percent above the permitted diversion rate to provide a buffer and is activated if spring or stream discharge decreases below this mitigation trigger level for six consecutive months as a result of SNWA GDP pumping. **If measured baseline spring or stream flow has been consistently at or less than the permitted diversion rate:** The mitigation trigger is activated if the evaluation associated with the investigation trigger determines the cause of the change to be SNWA GDP pumping.

Table 3-1
Spring Valley Management Block 1 Senior Water Right Management and Mitigation Plan
(Page 3 of 3)

<table>
<tr><td>Mitigation Actions</td><td>Senior Underground Water Rights:

Mitigation actions for senior underground water rights will include one of the following or an effective alternative action:

• Lowering of the pump if the well has the depth and capacity to produce the water right

• Compensate well owners for the incremental increase in power usage if the usage increases greater than 25 percent to produce a similar volume of water.

• Deepen the well if the aquifer has the ability to yield the water right

• Rehabilitate the well to increase well efficiency in order to increase production.

• Drilling and equipping a replacement well.

• Convey water to the site from an SNWA water right POD to the effected site

• Modify SNWA pumping rates, duration, and/or distribution.

• Temporary storage tank to supplement the well production until a permanent mitigation action is implemented. Water supplying the tank can be sourced by pumping the impacted well for a longer period of time at a lower pumping rate, by a truck delivering water, or other sources.

Senior Spring or Stream Water Rights:

Mitigation actions for senior spring and stream water rights will include one of the following or an effective alternative action:

• Acquire or exchange water rights and construct a well or piping to convey the water right to the POD or place of beneficial use to supplement the effected springs.

• Transfer or exchange of the impacted senior water right for an SNWA water right of an equal or better priority at another location.

• Modify SNWA pumping rates, duration, and/or distribution.

• Temporary storage tank to supplement the spring discharge until a permanent mitigation action is implemented. Water supplying the tank can be sourced from a water truck or other sources.

Additional management and mitigation actions are presented in the 3M Plan analysis report (Marshall et al., 2017 at Sections 3.2.4 and 3.2.8).</td></tr>
<tr><td colspan="2">See Table 3-5 for the Shoshone Pond area management and mitigation plan.</td></tr>
</table>

Table 3-2
Spring Valley Management Block 2 Senior Water Right Management and Mitigation Plan
(Page 1 of 3)

Unreasonable Effect	Conflict with a senior water right.
Investigation Trigger	Monitor hydrologic conditions in Management Block 2 according to the monitoring plan. The investigation trigger at a designated well site is a decrease in water level below the 99.7 percent lower control limit using the SALR method for the baseline data for six continuous months. The investigation trigger at a designated spring site is a decrease in spring discharge below the 99.7 percent lower control limit using the SALR method for the baseline data for six continuous months. If an investigation trigger is activated, investigate cause, determine significance, revise predictive tools, and apply appropriate management actions. Request from the NSE to investigate the cause of a change in water level or spring discharge and a location.
Management Action	If investigation indicates cause of water level change at sentinel or other designated monitor wells is the result of SNWA GDP pumping, management actions may include the following: • Update and calibrate the numerical groundwater flow model with aquifer response data. • Continue to observe water levels in the sentinel and other intermediate wells to verify model projections. • Install additional monitor well(s), if needed. • Prepare mitigation actions for implementation, including purchasing equipment, establishing contracts, and obtaining any necessary landowner permissions and permits. • Modify SNWA pumping rates, durations, and/or distribution to avoid activating a mitigation trigger.

Table 3-2
Spring Valley Management Block 2 Senior Water Right Management and Mitigation Plan
(Page 2 of 3)

Mitigation Trigger	**Senior Underground Water Rights:** **Well production > permitted diversion rate prior to SNWA GDP pumping:** A decrease in groundwater level that reduces the column of water in the well needed to produce the permitted diversion rate based on the well's specific capacity range plus either a 10 percent or 10 ft buffer, which ever is greater. An alternative mitigation trigger for the well is activated if the maximum production capacity from the well decreases to less than 10 percent above the permitted diversion rate and the static groundwater level has decreased below the 99.7 percent control limit as a result of SNWA GDP pumping. **Well production < permitted diversion rate prior to SNWA GDP pumping:** If the evaluation associated with the investigation trigger determines the cause of the change in water level to be SNWA GDP pumping, the mitigation trigger is activated. Increase of more than 25 percent in the power usage for pumps to produce a similar amount of water as a result of decreased water levels from SNWA GDP pumping. **Senior Spring or Stream Water Rights:** I**f measured baseline spring or stream flow has been consistently above the permitted diversion rate:** The mitigation trigger is 10 percent above the permitted diversion rate to provide a buffer and is activated if spring or stream discharge decreases below this mitigation trigger level for six consecutive months as a result of SNWA GDP pumping. **If measured baseline spring or stream flow has been consistently at or less than the permitted diversion rate:** The mitigation trigger is activated if the evaluation associated with the investigation trigger determines the cause of the change to be SNWA GDP pumping.

Table 3-2
Spring Valley Management Block 2 Senior Water Right Management and Mitigation Plan
(Page 3 of 3)

Mitigation Action	**Senior Water Rights:** ***Senior Underground Water Rights:*** Mitigation actions for senior underground water rights will include one of the following or an effective alternative action: • Lowering of the pump if the well has the depth and capacity to produce the water right. • Compensate well owners for the incremental increase in power usage if the usage increase is greater than 25 percent to produce a similar volume of water. • Deepen the well if the aquifer has the ability to yield the water right. • Rehabilitate the well to increase well efficiency. • Drill and equip a replacement well. • Convey water to the site from an SNWA water right POD to the effected site. • Transfer or exchange of the impacted senior water right for an SNWA water right of an equal or better priority at another location. • Modify SNWA pumping rates, duration, and/or distribution. • Temporary storage tank to supplement the well production until other mitigation action is implemented. Water supplying the tank can be sourced by pumping the impacted well for a longer period of time at a lower pumping rate, by a truck delivering water, or other sources. ***Senior Spring or Stream Water Rights:*** Mitigation actions for senior spring and stream water rights will include one of the following or an effective alternative action: • Acquire or exchange water rights and construct a well or piping to convey the water right to the POD or place of beneficial use to supplement springs. • Transfer or exchange of the impacted senior water right for an SNWA water right of an equal or better priority at another location. • Modify SNWA pumping rates, duration, and/or distribution. • Temporary storage tank to supplement the spring discharge until a permanent mitigation action is implemented. Water supplying the tank can be sourced from a water truck or other sources. Additional management and mitigation actions are presented in the 3M Plan analysis report (Marshall et al., 2017 at Sections 3.2.4 and 3.2.8).

Table 3-3
Spring Valley Management Block 3 Senior Water Right Management and Mitigation Plan
(Page 1 of 2)

Unreasonable Effect	Conflict with a senior water right.
Investigation Trigger	Monitor hydrologic conditions in Management Block 3 according to the monitoring plan. Sentinel monitor well locations SPR7029M, SPR7029M2, SPR7030M, SPR7030M2 and SPR7044M (planned well) are used to detect change in water levels at the south end of Management Block 3. The investigation trigger at the sentinel monitor wells or designated well site is a decrease in water level below the 99.7 percent lower control limit using the SALR method for the baseline data for six continuous months. The investigation trigger at a designated spring site is a decrease in spring discharge below the 99.7 percent lower control limit using the SALR method for the baseline data for six continuous months. If the investigation trigger is activated, investigate cause, determine significance, revise predictive tools, and apply appropriate management actions. Request from the NSE to investigate the cause of a change in water level or spring discharge and a location.
Management Action	If investigation indicates cause of water level change at sentinel or other designated monitor wells is the result of SNWA GDP pumping, management actions may include the following: • Update and calibrate the numerical groundwater flow model with aquifer response data. • Continue to observe water levels in the sentinel and other intermediate wells to verify model projections. • Perform, with owner's permission, a water resource assessment of the senior water rights located in Management Block 3 assigned Management Category C. • Install additional monitor well(s), if needed. • Prepare mitigation actions for implementation, including purchasing equipment, establishing contracts, and obtaining any necessary landowner permissions and permits. • Modify SNWA pumping rates, durations, and/or distribution to avoid activating a mitigation trigger.

Table 3-3
Spring Valley Management Block 3 Senior Water Right Management and Mitigation Plan
(Page 2 of 2)

Mitigation Trigger	There are no senior underground water rights in the management block **Senior Spring or Stream Water Rights:** **If measured baseline spring or stream flow has been consistently above the permitted diversion rate:** The mitigation trigger is 10 percent above the permitted diversion rate to provide a buffer and is activated if spring or stream discharge decreases below this mitigation trigger level for six continuous months as a result of SNWA GDP pumping. **If measured baseline spring or stream flow has been consistently at or less than the permitted diversion rate:** The mitigation trigger is activated if the evaluation associated with the investigation trigger determines the cause of the change to be SNWA GDP pumping.
Mitigation Action	**Senior Spring or Stream Water Rights:** Mitigation actions for senior spring or stream water rights will include one of the following or an effective alternative action: • Temporary storage tank to supplement the spring discharge until a permanent mitigation action is implemented. Water supplying the tank can be sourced from a water truck or other sources. • Acquire or exchange water rights and construct a well or piping to convey the water right to the POD or place of beneficial use to supplement springs. • Transfer or exchange of the impacted senior water right for an SNWA water right of an equal or better priority at another location. • Modify SNWA pumping rates, duration, and/or distribution. • Lining of Cleve Creek diversion ditches or construction of a diversion pipeline to eliminate loss through infiltration of Cleve Creek over the alluvial fan. • Using SPR7029M2 as a production well for mitigation water, SNWA would transfer mitigation water. • Install additional production wells to be used for mitigation water along alluvial fan; • Diversion of SNWA surface water rights from Bastian and Kalamazoo Creeks to replace water. • Construct a pipeline or lined ditch to divert water from Bastian Creek for mitigation purposes. • Temporary transfer of SNWA grazing allotments. Additional management and mitigation actions are presented in the 3M Plan analysis report (Marshall et al., 2017 at Sections 3.2.4 and 3.2.8).

Table 3-4
Spring Valley Management Block 4 and 5
Senior Water Right Management and Mitigation Plan
(Page 1 of 3)

Unreasonable Effect	Conflict with a senior water right.
Investigation Trigger	Monitor hydrologic conditions in Management Blocks 4 and 5 according to the monitoring plan. Sentinel monitor well locations SPR7029M, SPR7029M2, SPR7030M, SPR7030M2 and SPR7044M (planned well) are used to detect change in water levels at the south end of Management Block 3. The investigation trigger at the sentinel monitor wells or designated well site is a decrease in water level below the 99.7 percent lower control limit using the SALR method for the baseline data for six continuous months. The investigation trigger at a designated spring site is a decrease in spring discharge below the 99.7 percent lower control limit using the SALR method for the baseline data for six continuous months. If the investigation trigger is activated, investigate cause, determine significance, revise predictive tools, and apply appropriate management actions. Request from the NSE to investigate the cause of a change in water level or spring discharge and a location.
Management Action	If investigation indicates cause of water level change at sentinel or other designated monitor wells is the result of SNWA GDP pumping, management actions may include the following: • Update and calibrate the numerical groundwater flow model with aquifer response data. • Continue to observe water levels in the sentinel and other intermediate wells to verify model projections. • Perform, with owner's permission, a water resource assessment of the senior water rights located in Management Blocks 4 and 5 assigned Management Category C. • Measure with owner's permission spring water rights 26430, 26655, and 26656 directly • Install additional monitor well(s) in northern Spring Valley, if needed. • Prepare mitigation actions for implementation, including purchasing equipment, establishing contracts, obtaining any necessary land owner permissions and permits. • Modify SNWA pumping rates, durations, and/or distribution to avoid activating a mitigation trigger.

Table 3-4
Spring Valley Management Block 4 and 5
Senior Water Right Management and Mitigation Plan
(Page 2 of 3)

Mitigation Trigger	**Senior Underground Water Rights:** **Well production > permitted diversion rate prior to SNWA GDP pumping:** A decrease in groundwater level that reduces the column of water in the well needed to produce the permitted diversion rate based on the well's specific capacity range plus either a 10 percent or 10 ft buffer, which ever is greater. An alternative mitigation trigger for the well is activated if the maximum production capacity from the well decreases to less than 10 percent above the permitted diversion rate and the static groundwater level has decreased below the 99.7 percent control limit as a result of SNWA GDP pumping. **Well production < permitted diversion rate prior to SNWA GDP pumping:** If the evaluation associated with the investigation trigger determines the cause of the change in water level to be SNWA GDP pumping, the mitigation trigger is activated. Increase of more than 25 percent in the power usage for pumps to produce a similar amount of water as a result of decreased water levels from SNWA GDP pumping. **Senior Spring or Stream Water Rights:** **If measured baseline spring or stream flow has been consistently above the permitted diversion rate:** The mitigation trigger is 10 percent above the permitted diversion rate to provide a buffer and is activated if spring or stream discharge decreases below this mitigation trigger level for six consecutive months as a result of SNWA GDP pumping. **If measured baseline spring or stream flow has been consistently at or less than the permitted diversion rate:** The mitigation trigger is activated if the evaluation associated with the investigation trigger determines the cause of the change to be SNWA GDP pumping.

Table 3-4
Spring Valley Management Block 4 and 5
Senior Water Right Management and Mitigation Plan
(Page 3 of 3)

<table>
<tr><td>Mitigation Action</td><td>Senior Water Rights:

Senior Underground Water Rights:

Mitigation actions for senior underground water rights will include one of the following or an effective alternative action:

• Lowering of the pump if the well has the depth and capacity to produce the water right.
• Compensate well owners for the incremental increase in power usage if the usage increase is greater than 25 percent to produce a similar volume of water.
• Deepen the well if the aquifer has the ability to yield the water right.
• Rehabilitate the well to increase well efficiency.
• Drill and equip a replacement well.
• Convey water to the site from an SNWA water right POD to the effected site.
• Transfer or exchange of the impacted senior water right for an SNWA water right of an equal or better priority at another location.
• Modify SNWA pumping rates, duration, and/or distribution.
• Temporary storage tank to supplement the well production until a permanent mitigation action is implemented. Water supplying the tank can be sourced by pumping the impacted well for a longer period of time at a lower pumping rate, by a truck delivering water, or other sources.

Senior Spring or Stream Water Rights:

Mitigation actions for senior spring and stream water rights will include one of the following or an effective alternative action:

• Acquire or exchange water rights and construct a well or piping to convey the water right to the POD or place of beneficial use to supplement springs.
• Transfer or exchange of the impacted senior water right for an SNWA water right of an equal or better priority at another location.
• Modify SNWA pumping rates, duration, and/or distribution.
• Temporary storage tank to supplement the spring discharge until a permanent mitigation action is implemented. Water supplying the tank can be sourced from a water truck or other sources.

Additional management and mitigation actions are presented in the 3M Plan analysis report (Marshall et al., 2017 at Sections 3.2.4 and 3.2.8).</td></tr>
<tr><td colspan="2"></td></tr>
</table>

3.3.2 Environmental Resources

This section presents the thresholds, investigation and mitigation triggers, and management and mitigation actions to avoid unreasonable effects to environmental resources in Spring Valley. This information is organized by environmental resources, with reference to the Management Blocks shown in Figure 1-1 (Section 1.2). The environmental monitoring activities in Spring Valley are presented in Section 2.2.1.

3.3.2.1 Federally Listed Species

Unreasonable effect to avoid: Jeopardy to the continued existence of the federally endangered Pahrump poolfish.

Approach: Protect the senior water right and Pahrump poolfish habitat at Shoshone Ponds (Figure 2-16 in Section 2.2.1).

The rationale and analyses supporting this approach are provided in the 3M Plan analysis report (Marshall et al., 2017, at Section 6.3.1). A summary is provided below.

The lithology underlying Shoshone Ponds consists of clays inter-fingered with sand and gravel layers, which results in confined aquifer conditions in the area (Marshall et al., 2017, at Section 6.3.1.1). Due to the confining sediments, the shallow groundwater and associated habitats are not in hydraulic connection with the underlying aquifer in which SNWA GDP wells will be installed. Thus, the only way Shoshone Ponds can be affected by SNWA GDP pumping is if the production capacity of the Shoshone Ponds wells is reduced below the amount needed to sustain the habitat.

Historical data at Shoshone Ponds demonstrate that a stable Pahrump poolfish population of sufficient size to help downlist the species can be maintained on a discharge of 3.3 gallons per minute (gpm) (Marshall et al., 2017, at Section 6.3.1.3).[1] The senior water right at the Shoshone NDOW Well (Permit Number 27768) is over three times that flow (12.39 gpm).[2] Therefore, the objective of the management and mitigation plan is the protection of the senior water right that provides water to Pahrump poolfish at Shoshone Ponds. The plan also includes environmental management and mitigation.

NDOW has responsibility for managing the Pahrump poolfish and its habitat and maintaining the Shoshone NDOW Well, and BLM has responsibility for land management at the site. This management and other factors external to the SNWA GDP may affect the Pahrump poolfish population and its habitat. SNWA's commitment is to avoid a conflict with the senior water right,

1. For the species to be considered for reclassification to federally threatened status (downlisted), the Recovery Plan states that at least three viable, reproducing populations, each with at least 500 adults, should endure for three years. The habitats would need to be free of immediate and potential threats to permit the change in status (U.S. Fish and Wildlife Service (USFWS), 1980, at pages 7 and 12). To be considered for delisting, the Recovery Plan states that these criteria should be met for an additional three years (USFWS, 1980, at page 7).
2. The permit has a 20.0 afa annual duty and a 0.0278 cfs diversion rate (calculated 12.39 gpm continuous flow rate).

ensure sufficient water supply is available to support a population of sufficient size to help recover the species, and assist NDOW and BLM with their management efforts.

The management and mitigation plan for Pahrump poolfish and the Shoshone Ponds senior water rights is presented in Table 3-5. The environmental monitoring plan for Pahrump poolfish is presented in Section 2.2.1.1, and the hydrologic monitoring plan for the Shoshone Ponds senior water right is presented in Section 2.1.3.1.

Table 3-5
Pahrump Poolfish and Shoshone Ponds Senior Water Right Management and Mitigation Plan

Unreasonable Effect	Conflict with a senior water right; Jeopardy to the continued existence of federally threatened and endangered species.
Investigation Trigger	The investigation trigger at the Shoshone NDOW Well (the POD for the senior water right) is activated when the artesian flow rate is <15 gpm with no flow valve restrictions for a continuous period of six months. If permission to install instrumentation in the Shoshone NDOW Well is denied, Shoshone Well #2 is used as a proxy monitor site for the Shoshone NDOW Well.
Management Action	If investigation indicates cause of artesian flow rate change at the Shoshone Ponds senior water right location is the result of SNWA GDP pumping, management actions may include: • Prepare the identified mitigation action for implementation, including purchasing equipment, establishing contracts, and obtaining permissions and permits. • Assist BLM and NDOW and fund habitat management activities at Shoshone Ponds to improve Pahrump poolfish habitat. • Assist BLM and NDOW and fund measures to control invasive species in Pahrump poolfish habitat at Shoshone Ponds. • Preemptively implement mitigation actions.
Mitigation Trigger	The mitigation trigger at the Shoshone NDOW Well is activated when the artesian flow rate is <13.5 gpm with no flow valve restrictions for a continuous period of six months.
Mitigation Action	Mitigation actions for the Shoshone Ponds senior underground water right will include at least one of the following: • Install a pump in the Shoshone NDOW Well to ensure the senior water right can continue to be delivered. The pump will be solar powered to avoid constructing power infrastructure, and the pump setting will be adjusted as needed to maintain the senior right. • Temporary water provided by a water truck, on-site storage or other alternative method until a permanent mitigation action is implemented. • Rehabilitate the Shoshone NDOW Well to increase well performance. • Install a new well. • Convey water from an SNWA water right. • Modify SNWA GDP pumping duration, rate, or distribution. In addition to senior water right mitigation, environmental mitigation will be implemented. Environmental mitigation actions will include at least one of the following: • Collaborate with BLM and NDOW and fund implementation of a habitat enhancement project suitable for Pahrump poolfish reproduction and growth using the senior water right. • Collaborate with the USFWS and NDOW and fund the establishment of a new Pahrump poolfish refuge population.

3.3.2.2 Native Aquatic-Dependent Special Status Animal Species and Mesic Habitat

Unreasonable effect to avoid: Extirpation of the native aquatic-dependent special status animal species northern leopard frog, and elimination of mesic habitat from the Spring Valley groundwater discharge area.[1]

Approach: Avoid or eliminate conflicts with senior water rights that support mesic habitat and northern leopard frogs, and ensure sufficient mesic habitat is preserved in Management Block 3 to support a viable, reproducing population of northern leopard frog. As part of this approach, manage the SNWA McCoy Creek Property (Figure 2-16 in Section 2.2.1) to maintain and/or enhance the mesic habitat for the benefit of northern leopard frog and other wildlife species.

The rationale and analyses supporting this approach are provided in the 3M Plan analysis report (Marshall et al., 2017, at Section 6.3.2). A summary is provided below.

Senior water rights and SNWA water rights in Management Block 3 support extensive mesic habitat and multiple northern leopard frog subpopulations (Marshall et al., 2017, at Section 6.3.2.1) (see senior water rights in Appendix B). Approximately half of the mesic habitat in the Spring Valley groundwater discharge area is located in Management Block 3 (4,500 acres, or 7 square miles). The concentration of mesic habitat, the extensive north-to-south distribution, and the variety of mesic habitat components support northern leopard frogs and provides for dispersion opportunities and seasonal needs (Marshall et al., 2017, at Section 6.3.2.1). Observations of widespread northern leopard frog use and breeding activity spanning 15 years, and extensive suitable habitat for eggs, tadpoles, juveniles and adults, demonstrate that Management Block 3 supports multiple sub-populations, large numbers, and all life stages of northern leopard frogs (Marshall et al., 2017, at Section 6.3.2.1). Thus, the strategy to avoid the unreasonable effect of extirpation of northern leopard frogs and elimination of mesic habitat from the Spring Valley groundwater discharge area focuses on avoiding conflicts with senior water rights and supporting mesic habitat in Management Block 3.

The McCoy Creek Property and associated SNWA surface water rights offer substantial integrated resource management opportunities. Approximately 40 percent of the 2,300-acre McCoy Creek Property (930 acres, or 1.5 square miles) is mesic habitat, and an additional 200 acres is irrigated land that is also used by wildlife. The mesic habitat is characterized by a series of seeps and springs that feed into wet meadows and form pools, ponds, and channels. These various mesic habitat components support the different life stages of northern leopard frog and a variety of other wildlife (Marshall et al., 2017, at Section 6.3.2.1). The property also receives water from McCoy Creek (perennial water conveyed in a pipe from the mountain block) and O'Toole Creek (intermittent water that originates in the mountain block). SNWA has water rights that support this property (Permit Number 10710, Vested Claims V00791 and V01215). Therefore, the strategy to avoid the unreasonable effect of elimination of mesic habitat and extirpation of northern leopard frog from the Spring Valley groundwater discharge area also includes maintaining and/or enhancing mesic habitat on the McCoy

1. Mesic habitat in the Spring Valley groundwater discharge area is composed of spring, seep, pond, wetland/meadow, marsh, and stream components that are often intermixed to form complexes. Additional description of mesic habitat and the species' status categories are provided in the 3M Plan analysis report (Marshall et al., 2017, at Sections 5.2 and 5.3).

Creek Property for the benefit of northern leopard frog. This mitigation will also ensure habitat is protected for other wildlife species, including greater sage-grouse, other birds, bats, and big game.

The environmental management and mitigation plan for northern leopard frogs and mesic habitat is presented in Table 3-6, and the monitoring plan is presented in Section 2.2.1.2. Hydrologic monitoring, management, and mitigation for the senior water rights in Management Block 3 are presented in Sections 2.1.3.3 and 3.3.1.

Table 3-6
Northern Leopard Frog and Mesic Habitat Management and Mitigation Plan

Unreasonable Effect	Extirpation of native aquatic-dependent special status animal species from a hydrographic basin's groundwater discharge area; elimination of a habitat type from a hydrographic basin's groundwater discharge area.
Investigation Trigger	Sentinel monitor wells SPR7029M, SPR7029M2, SPR7030M, SPR7030M2, and SPR7044M are used to detect change in water levels at the south end of Management Block 3. Investigation triggers for these sentinel monitor wells are presented in Table 3-3. These hydrologic investigation triggers are used to trigger investigation, monitoring, and management actions for senior water rights in Management Block 3, and management actions for northern leopard frogs and mesic habitat.
Management Action	Management actions for senior water rights in Management Block 3 are presented in Table 3-3. These actions include but are not limited to modification of SNWA pumping rates, durations, and/or distribution to avoid activating senior water right mitigation triggers, and preparation for mitigation. If an investigation trigger at one of the Management Block 3 sentinel wells (SPR7029M, SPR7029M2, SPR7030M, SPR7030M2, or SPR7044M is activated due to SNWA GDP pumping, the following additional environmental management actions may be taken: • Manage the McCoy Creek Property to maintain mesic habitat. Use SNWA water rights to continue to support the mesic habitat on the property (permit number 10710 and vested claims V00791 and V01215). Manage water diversions and grazing operations on the property to reduce stress on the northern leopard frog population and mesic habitat. • Preemptively implement the mitigation actions for northern leopard frog and mesic habitat conservation at the McCoy Creek Property.
Mitigation Trigger	Mitigation triggers for senior water rights in Management Block 3 are presented in Table 3-3. These hydrologic mitigation triggers are used to trigger mitigation actions for the senior water rights, northern leopard frogs, and mesic habitat.
Mitigation Action	Mitigation actions for senior water rights in Management Block 3 are presented in Table 3-3. These actions include but are not limited to: lining of Cleve Creek diversion ditches or construction of a diversion pipeline to eliminate loss and allow more water to reach Cleveland Ranch; modification of SNWA pumping rates, durations, and/or distribution; and provision of mitigation water. If a mitigation trigger at one of the Management Block 3 senior water rights is activated due to SNWA GDP pumping, additional environmental mitigation actions will be implemented. Environmental mitigation actions will include at least one of the following: • Enhance mesic habitat on the McCoy Creek Property to improve the quality of the mesic habitat for the benefit of northern leopard frog and other wildlife species. This includes modifying water diversions to enhance habitat composition and distribution, and create a more complex wetland/meadow system for northern leopard frogs. • Use livestock on the McCoy Creek Property as a tool focused on management and enhancement of mesic habitat, including northern leopard frog breeding habitat. • Collaborate with other landowners in Management Block 3 and fund modification of land use or water use to enhance or create mesic and northern leopard frog habitat in other areas.

3.3.2.3 Shrubland Habitat

Unreasonable effect to avoid: Elimination of shrubland habitat from the Spring Valley groundwater discharge area, and excessive loss of shrub cover that results in extensive bare ground.

Approach: Within the groundwater discharge area, maintain shrub cover at or above the low-density shrubland threshold level in those areas currently covered by medium-density or low-density shrubland habitat.[1] Management and mitigation actions to avoid and eliminate conflicts with senior water rights (Section 3.3.1) also helps protect shrubland habitat by attenuating groundwater drawdown and propagation.

The rationale and analyses supporting this approach are provided in the 3M Plan analysis report (Marshall et al., 2017, at Section 6.3.3). A summary is provided below.

Shrubland habitat within the Spring Valley groundwater discharge area includes facultative phreatophytic shrub species as well as shrub species that rely solely on precipitation. Facultative phreatophytic shrub species typically use groundwater as a secondary water source after precipitation, but may also exist on sites where groundwater is not available (McLendon, 2011; and Smith et al., 1997). As stated in McLendon (2011), the productivity of facultative phreatophytes is increased by access to groundwater, but lack of groundwater within their rooting zones does not, in and of itself, cause widespread plant loss.

Should depth to water increase below the main rooting zone of a phreatophytic shrub, the cover of that shrub may decrease (McLendon, 2011). Over time, the plant community would likely shift to more drought-tolerant, deeper rooted, and/or non-phreatophytic species (Patten et al., 2008; and McLendon, 2011). As depth to water increases due to SNWA GDP pumping, shrubland vegetation cover may thus decrease in the short-term, but is expected to stabilize over time. The exact nature and rate of plant transition will depend on a number of inter-relating factors, as discussed in the 3M Plan analysis report (Marshall et al., 2017, at Section 6.3.3.1). The shrubland triggers and management and mitigation actions in this 3M Plan allow time for successful transition in shrubland plant communities.

If groundwater drawdown occurs too rapidly to accommodate a gradual plant transition, excessive loss of shrub cover can result in extensive bare ground, which can lead to soil erosion and weed expansion.[2] Thus, the purpose of the triggers and management and mitigation actions in this 3M Plan are to allow for transition in shrubland plant communities while avoiding this unreasonable effect.

The approach to avoid unreasonable effects to shrubland habitat in Spring Valley focuses on Management Blocks 1 and 2 (Figure 2-16 in Section 2.2.1). Management Blocks 1 and 2 encompass the permitted SNWA GDP PODs, so effects would be seen in these blocks first. Although unreasonable effects in Management Block 4 are unlikely due to distance from GDP PODs and triggers and management and mitigation actions in Management Blocks 1-3, this approach is

1. High-density shrubland does not occur within the groundwater discharge area of the 3M Plan area. Sparse shrubland habitat already has extensive bare ground, and thus is not included in 3M Plan.
2. The proliferation of weeds is common in the 3M Plan area and may occur regardless of SNWA GWD pumping.

nonetheless applied to Management Block 4 if an investigation trigger at the West Spring Valley Complex piezometer or South Millick Spring piezometer (Figure 2-16) is activated due to SNWA GDP pumping as described in Section 3.3.1.[1] This approach is not applied to Management Block 3 (which is managed for avoiding conflicts with senior water rights and preserving mesic habitat, as discussed in Section 3.3.2.2), or to Management Block 5 (due to the unlikelihood of effects from SNWA GDP pumping) (Marshall et al., 2017, at Section 6.3.3.1).[2]

The threshold for shrubland habitat is the baseline vegetation cover in low-density shrubland. Low-density shrubland is expansive in Spring Valley and common in the Great Basin Desert, as discussed in the 3M Plan analysis report (Marshall et al., 2017, at Section 6.3.3.4) and shown in the SNWA (2007) land cover map (SNWA 2009b, at Figure 7-1). The remote sensing analysis presented in the 3M Plan analysis report showed that low-density shrubland in Management Blocks 1 and 2 maintained itself for the past 31 years, indicating that it is not a landscape on the verge of changing to extensive bare ground (Marshall et al., 2017, at Section 6.3.3.2). As shown in the photographs in the 3M Plan analysis report (Marshall et al., 2017, at Figure 6-45 in Section 6.3.3.2), "low density" is a relative term, and shrub cover remains present and regular in these areas.

Trigger parameters include NDVI (derived from Landsat imagery), and percent live shrub cover (recorded on ground vegetation transects). As discussed in the 3M Plan analysis report, these data types together provide information about landscape-scale shrubland habitat changes and the nature of those changes (Marshall et al., 2017, at Section 6.3.3). Lower control limits of prediction intervals are used to signal investigation and mitigation trigger activation, as shown in Figure 3-6. A prediction interval is a statistical estimate of an interval in which future observations will fall, with a certain probability, given what has already been observed (Meeker et al., 2017; and Hyndman and Athanasopoulos, 2014). In this case, the prediction intervals provide ranges of mean NDVI and percent live shrub cover values expected for medium- and low-density shrubland habitat across a range of precipitation levels if no significant changes occur from baseline.

An investigation trigger is activated if mean annual NDVI or mean percent live shrub cover for either habitat group (medium-density shrubland, low-density shrubland) falls below the medium-density or low-density shrubland lower control limit. A mitigation trigger is activated if mean annual NDVI or mean percent live shrub cover for either habitat group falls below the low-density shrubland lower control limit for five consecutive years as a result of SNWA GDP pumping. As discussed in the 3M Plan analysis report, the five-year time frame allows the time necessary for natural plant growth, and is necessary to observe whether the natural transition from medium to low-density shrubland is successful or if mitigation actions need to be taken. (Marshall et al., 2017, at Section 6.3.3.4).

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1. The shrubland habitat in Management Block 4 is over 15 miles from the northernmost permitted Spring Valley GDP POD.
2. Management Block 5 is over 35 miles from the northernmost permitted Spring Valley GDP POD and contains limited shrubland habitat. This distance and the triggers and management and mitigation actions in Management Blocks 1-4 provide a large buffer against effects to environmental resources in Management Block 5 (Marshall et al., 2017, at Section 6.3.1.1). The local recharge, higher elevation, and lower basin fill sediment hydraulic conductivity in Management Block 5 compared the other Management Blocks also makes effects from SNWA GDP pumping unlikely in Management Block 5.

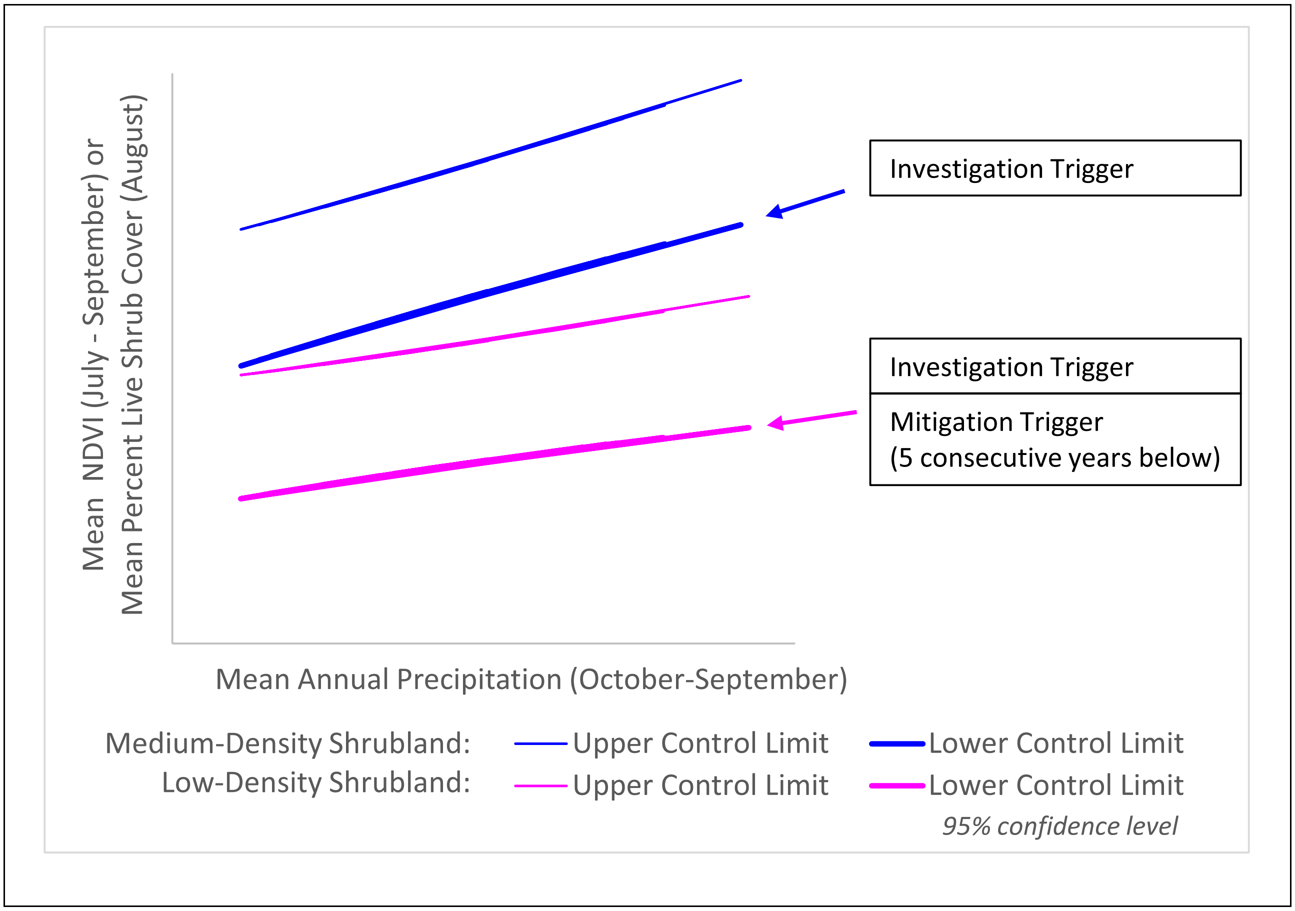
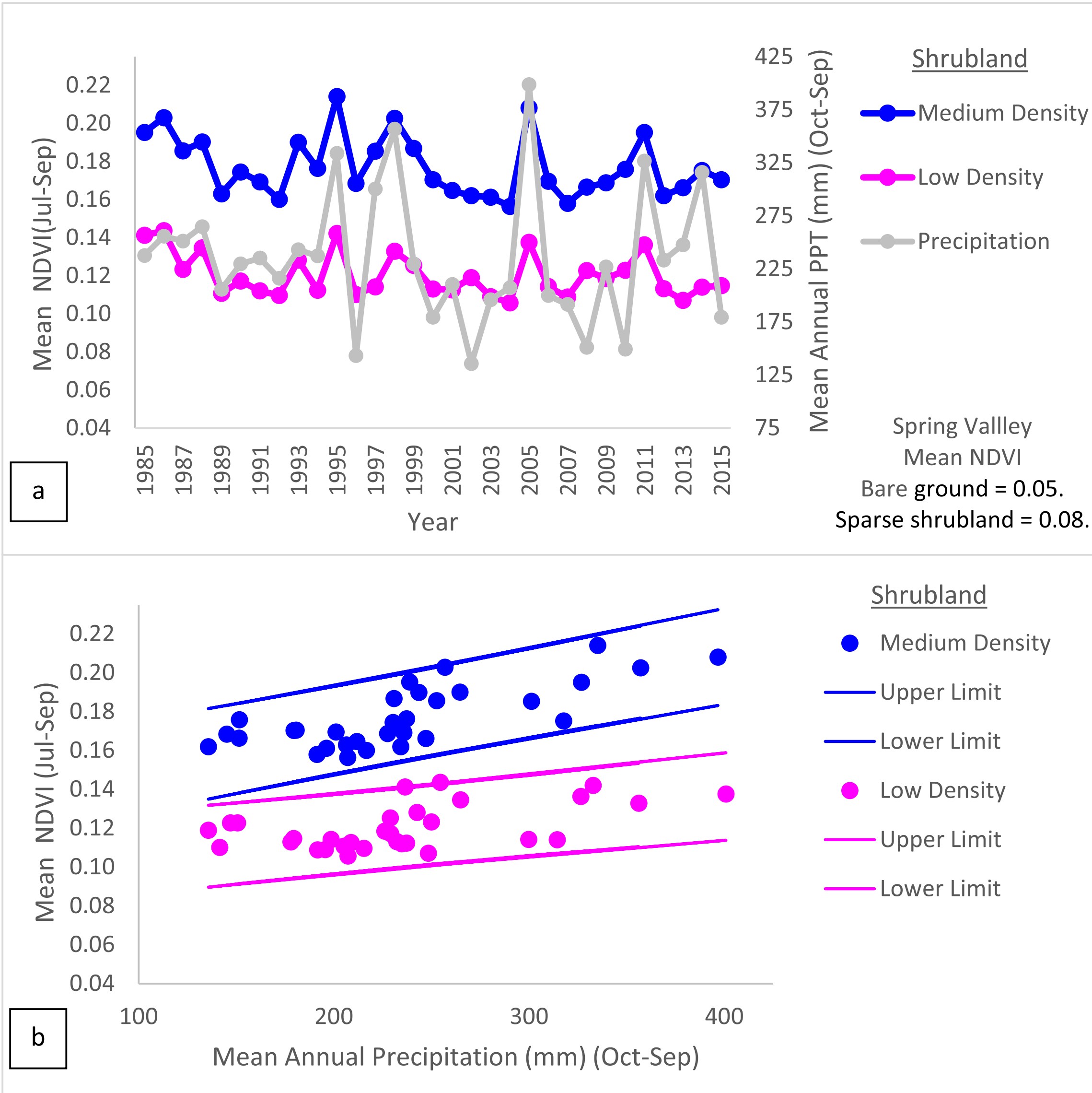


Figure 3-6
Diagram of Shrubland Prediction Intervals and Triggers

Figure 3-7 displays the 1985-2015 mean annual NDVI and precipitation values and NDVI prediction intervals calculated from the medium-density and low-density shrubland polygons shown in Figure 2-16 (Section 2.2.1). An analysis of these data and prediction intervals is presented in the 3M Plan analysis report (Marshall et al., 2017, at Section 6.3.3.2). Similar prediction intervals were calculated using the remote sensing plots that are randomly stratified within the medium- and low-density shrubland polygons (see plots in Figure 2-16; see prediction intervals in Marshall et al., 2017, at Figure 6-49 in Section 6.3.3.2). The polygons (which sample the habitat on a landscape scale) and the plots (which subsample the habitat in a structured statistical design) both provide effective ways of tracking change in NDVI over time, and they can be analyzed separately and in conjunction with one another. The polygon data are used to calculate triggers and signal trigger activation, and the plots provide additional opportunities for statistical analysis during investigations. Ground vegetation data are also used to calculate triggers and signal trigger activation, as well as to understand the nature of vegetation changes during investigations. Collection of the data, calculation of the prediction intervals, and use of the monitoring data to signal trigger activation are described in Section 2.2.1.3.

If an investigation trigger is activated, investigation actions are taken using the protocols described in Section 3.2.1.2 to determine cause, condition, and significance of observed changes, and to inform



a) Time-series line graph of mean annual NDVI and precipitation for medium-density and low-density shrubland polygons, 1985-2015.

b) Prediction interval for mean annual NDVI and precipitation for medium-density and low-density shrubland polygons. Data points are the same as those shown in graph (a). Lines display upper and lower control limits of the prediction intervals (95% confidence level).

Figure 3-7
Time Series and Prediction Intervals for NDVI and Precipitation in Shrubland Polygons, Management Blocks 1 and 2

management and mitigation actions. Investigation actions include analyses of remotely-sensed vegetation data and ground vegetation data to understand the nature of the vegetation changes; analyses of hydrologic data (e.g., groundwater level) and SNWA pumping data to understand the groundwater drawdown propagation; analyses regarding the effects of precipitation and other climatic factors on the vegetation; and analyses of vegetation and hydrologic data to determine if vegetation changes may be due to changes in groundwater availability.

An investigation trigger may also prompt management actions (Table 3-7). One such management action may include more detailed statistical tests to inform management and mitigation actions. For example, correlations can be run and graphs constructed to examine the relationship of NDVI to live shrub cover. The remote sensing plot data can be used to analyze the NDVI data in various statistical configurations, such as grouping plots by pumping locations and groundwater levels. Change in NDVI and live shrub cover over time can be analyzed with time series analyses, and differences between medium-density and low-density shrubland can be analyzed using significant difference tests (as shown in Marshall et al., 2017, at Section 6.3.3.2). Analyses of other data collected on the transects (grass, forb, dead shrub, dead tree, and ground cover; photographs; and qualitative observations) also help elucidate change factors and condition.

If the mitigation trigger is activated, at least one of the mitigation actions identified in Table 3-7 will be implemented within no more than 30 days. A variety of mitigation actions are available, and will be used in situations where they are most practical or effective. The investigation findings will inform the mitigation actions based on ground conditions. These actions may also be preemptively implemented to avoid activating the mitigation triggers. A detailed discussion of the mitigation actions, including discussion on efficacy and SNWA resources, is provided in the 3M Plan analysis report (Marshall et al., 2017, at Section 6.3.3.4). Mitigation actions will be taken to reverse the trend until the shrubland habitat is at or above the threshold level.

The environmental management and mitigation plan for shrubland habitat is presented in Table 3-7, and the monitoring plan is presented in Section 2.2.1.3.

Table 3-7
Shrubland Habitat Management and Mitigation Plan
(Page 1 of 2)

Unreasonable Effect	Elimination of shrubland habitat from the basin's groundwater discharge area; Excessive loss of shrub cover that results in extensive bare ground.
Investigation Trigger	An investigation trigger is activated if: • mean annual NDVI for either polygon habitat group (medium-density shrubland, low-density shrubland) falls below the medium-density or low-density shrubland 95 percent lower control limit for NDVI, or • mean percent live shrub cover for either polygon habitat group (medium-density shrublands, low-density shrublands) falls below the medium-density or low-density shrubland 95 percent lower control limit for percent live shrub cover.
Management Action	If an investigation trigger is activated due to SNWA GDP pumping, the following management actions may be taken: • Conduct detailed statistical tests to inform management and mitigation actions (see discussion in Marshall et al., 2017, at Section 6.3.3.4). • Prepare mitigation actions for implementation, including purchasing equipment, establishing contracts, and obtaining any necessary landowner permissions and permits. • Preemptively implement mitigation actions for shrubland habitat. Management actions to avoid conflicts with senior water rights (Section 3.3.1) also help protect shrubland habitat by attenuating groundwater drawdown and propagation.
Mitigation Trigger	A mitigation trigger is activated if, as a result of SNWA GDP pumping: • mean annual NDVI for either polygon habitat group (medium-density shrubland, low-density shrubland) falls below the low-density shrubland 95 percent lower control limit for NDVI for five consecutive years, or • mean percent live shrub cover for either polygon habitat group (medium-density shrubland, low-density shrubland) falls below the low-density shrubland 95 percent lower control limit for percent live shrub cover for five consecutive years.

Table 3-7
Shrubland Habitat Management and Mitigation Plan
(Page 2 of 2)

Mitigation Action	Mitigation actions will include at least one of the following: Vegetation treatments, using standard Great Basin Desert shrubland revegetation and restoration practices. The following treatments can be implemented on their own or in combination with one another. • Direct seeding and seedling transplanting using native, non-phreatophytic or drought-tolerant shrubs, including shrub/grass/forb mixes. Seeding can be accomplished by seed drilling and/or broadcast/aerial seeding. • Plant protection (e.g., tree shelters, rock mulch, plastic mesh, wire cages, temporary fencing, and brush). • Transplanting nursery stock. This may be done with supplemental irrigation and/or protection from herbivory and other environmental elements. • Grazing management. Supplemental watering in key restoration areas using SNWA water rights: • Methods will be site-specific and may include soil modification and surface shaping (e.g., decompaction, pitting, imprinting, microcatchments, and mulch) to improve water capture, storage, and infiltration, and/or direct irrigation (e.g., water truck, by hand, and drip irrigation). Weed control: • Weed control options include cultural control (e.g., avoiding overgrazing, using well-adapted competitive forage species, and maintaining good soil fertility), chemical control (e.g., herbicides), mechanical control (physical removal), and biological control (e.g., insects, fungi, and pathogens). Integrated resource management using SNWA Great Basin Ranch assets. Options include: • Modified use of SNWA Great Basin Ranch irrigation and stock water rights. • Modified grazing practices. Modification of SNWA GDP pumping rates, durations, and/or distribution. Mitigation actions to avoid or eliminate conflicts with senior water rights (Section 3.3.1) also help protect shrubland habitat by attenuating groundwater drawdown and propagation.

3.3.2.4 Terrestrial Woodland Habitat

Unreasonable effect to avoid: Elimination of terrestrial woodland habitat from the Spring Valley groundwater discharge area.

Approach: Maintain a viable Rocky Mountain juniper population within the Swamp Cedar ACEC (Figure 2-16 in Section 2.2.1), and maintain tree cover area at or above the threshold. The SNWA Osceola Property contiguous to the ACEC may be used to offset loss below the threshold.

The rationale and analyses supporting this approach are provided in the 3M Plan analysis report (Marshall et al., 2017, at Section 6.3.4). A summary is provided below.

The trees in the Swamp Cedar ACEC are entirely or predominantly Rocky Mountain juniper. The species has a broad ecological range, is not groundwater dependent, and is adapted to relatively dry and wet conditions within its wide range. The species is known to exploit additional moisture when available, however, which can result in higher productivity (McLendon, 2011).

Approximately 40 percent (1,500 acres) of the terrestrial woodland habitat in the Spring Valley groundwater discharge area is within the BLM-designated Swamp Cedar ACEC in Management Block 2 (Marshall, at el., 2017, at Section 6.3.4.1). This area was designated as an ACEC by the BLM for its cultural resources and its unique plant community (Rocky Mountain juniper in alkali valley soils) (BLM, 2007; and BLM, 2012, at page 3.14-19). As presented in the 2011 water rights hearing by the Confederated Tribes of the Goshute Reservation, this swamp cedar area is also an area of special cultural significance (Lahren, 2010; referred to under its former designation of "Swamp Cedar Natural Area"). Thus, the approach to avoid the unreasonable effect of elimination of terrestrial woodland habitat from the Spring Valley groundwater discharge area is focused on the Swamp Cedar ACEC.

The Swamp Cedar ACEC area is expected to be underlain by clayey lake deposits based on its hydrogeologic setting. In June 2016, SNWA hydrologists advanced a shallow hand auger within a grove of juniper trees on the adjacent SNWA Osceola Property to a depth of 15 ft. The lithology of the boring consisted of clay and silty clay sediments. The sediments were observed to be saturated at approximately 8 ft. The Osceola Property is immediately adjacent to the Swamp Cedar ACEC, and the trees on the property are a natural continuation of the trees in the ACEC (Figure 2-16 in Section 2.2.1).

The remote sensing analyses described in the 3M Plan analysis report showed that the tree population within the ACEC has maintained itself over the past 31 years, indicating that it is not a landscape on the verge of losing its woodland habitat (Marshall et al., 2017, at Section 6.3.4.3). This baseline period encompassed a range of variation across wet and dry periods, providing for a good predictor of future conditions.

Two remote sensing calculations are used to signal trigger activation: 1) tree cover area, and 2) baseline percent range in cover, using NDVI as a proxy for vegetation cover. Activation of the investigation and mitigation triggers is determined by comparing the annual tree cover area in the ACEC to the maximum tree cover area recorded during the baseline period. As discussed in

Section 2.2.1.4, tree cover area is quantified using high-resolution imagery that provides standardized measurements that are comparable over time. The allowable amount of change in tree cover area before a trigger is activated is based on the long-term baseline percent range in cover. As discussed in Section 2.2.1.4, baseline percent range in cover is calculated using NDVI derived from Landsat satellite imagery.

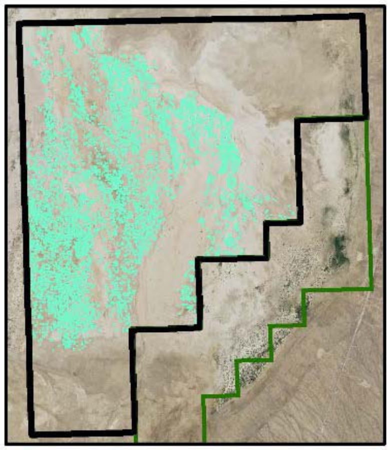
The investigation trigger is activated if annual tree cover area for the Swamp Cedar ACEC, compared to the baseline maximum tree cover area, falls within 5% of the lower limit of the baseline percent range in cover. The mitigation trigger is activated if annual tree cover area for the Swamp Cedar ACEC, compared to the baseline maximum tree cover area, falls below the lower limit of the baseline percent range in cover for a period of five consecutive years as a result of SNWA GDP pumping. As discussed in the 3M Plan analysis report, the five year time frame allows for the natural variability in tree reproduction, germination, establishment, and growth rates (Marshall et al., 2017, at Section 6.3.4.3).

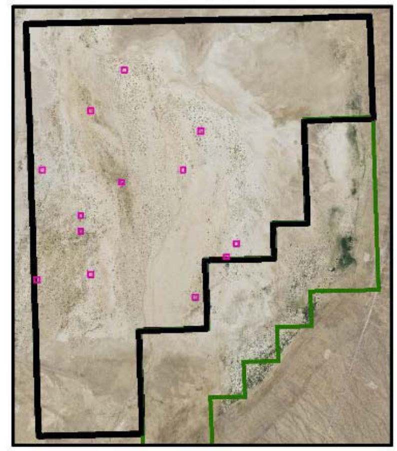
Figure 3-8 calculates these triggers using the baseline maximum tree cover area of 44 acres (the 2015 tree cover area calculated in the 3M Plan analysis report), and the 25% baseline percent range in cover calculated for the 1985-2015 baseline period (Marshall et al., 2017, at Section 6.3.4.2). These triggers will be re-calculated prior to SNWA GDP groundwater withdrawal from Spring Valley using the entire baseline period.

As discussed in Section 2.2.1.4, in addition to the remotely-sensed data, ground tree plot data are collected. The ground tree plot data aid in understanding and tracking tree population dynamics such as survivorship and recruitment. Collection of the data, calculation of tree cover area, calculation of the baseline percent range in cover, and use of the monitoring data to signal trigger activation are described in Section 2.2.1.4.

If the investigation trigger is activated, investigation actions will be taken using the protocols described in Section 3.2.1.2 to determine cause, condition, and significance of observed changes, and to inform management and mitigation actions. Investigation actions include analyses of tree cover area data and ground tree data to understand the nature of the vegetation changes; analyses of hydrologic data (e.g., groundwater level) and SNWA pumping data to understand the groundwater drawdown propagation; analyses regarding the effects of precipitation and other climatic factors on the vegetation; analysis of the interrelationship between the shallow and deeper monitor wells adjacent to the Swamp Cedar ACEC; and analyses of tree and hydrologic data to determine if tree changes are due to changes in groundwater availability. An investigation trigger may also prompt management actions (Table 3-8).

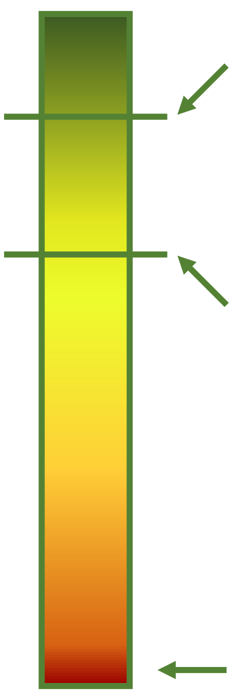
If the mitigation trigger is activated, at least one of the identified mitigation actions in Table 3-8 will be implemented within no more than 30 days. A variety of mitigation actions are available, and will be used in situations where they are most practical or effective. The investigation findings will inform the mitigation actions based on ground conditions. These actions may also be preemptively implemented to avoid activating the mitigation triggers. A detailed discussion of the mitigation actions, including discussion on efficacy and SNWA resources, is provided in the 3M Plan analysis report (Marshall et al., 2017, at Section 6.3.3.4). Mitigation actions will be taken to reverse the trend until tree cover area is at or above the threshold level.





Maximum baseline tree cover area: 44 acres

Baseline percent range in cover (NDVI): 25%



Investigation Trigger:

Baseline maximum tree cover area = 44 acres

Within 5% of lower limit of baseline percent range in cover = 25%-5%=20%

44 acres – (20% of 44) = 35 acres

Mitigation Trigger (established at the threshold):

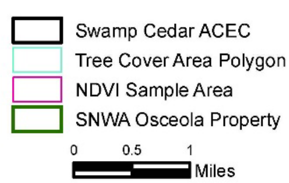
Baseline maximum tree cover area = 44 acres

Lower limit of baseline percent range in cover = 25%

44 acres – (25% of 44) = 33 acres

Unreasonable Effect:

Elimination of terrestrial woodland habitat from the Spring Valley groundwater discharge area



Numbers based on 44 acres of tree cover area calculated from 2015 imagery, and 25% baseline percent range in cover calculated using 1985-2015 NDVI data (Marshall et al., 2017, at Section 6.3.4.2). Prior to SNWA GDP groundwater withdrawal from Spring Valley, baseline maximum tree cover area and baseline percent range in cover will be re-calculated for the entire baseline period.

Figure 3-8
Terrestrial Woodland Habitat Trigger

The environmental management and mitigation plan for terrestrial woodland habitat is presented in Table 3-8, and the monitoring plan is presented in Section 2.2.1.4.

Table 3-8
Terrestrial Woodland Habitat Management and Mitigation Plan
(Page 1 of 2)

Unreasonable Effect	Elimination of terrestrial woodland habitat from the hydrographic basin's groundwater discharge area.
Investigation Trigger	The investigation trigger is activated if annual tree cover area for the Swamp Cedar ACEC, compared to the baseline maximum tree cover area, falls within 5% of the lower limit of the baseline percent range in cover.
Management Action	If the investigation trigger is activated as a result of SNWA GDP pumping, the following management actions may be taken: • Conduct detailed analyses of tree population dynamics using the tree ground monitoring plot data to inform management and mitigation actions. • Prepare mitigation actions for implementation, including purchasing equipment, establishing contracts, and obtaining any necessary BLM permissions. • Preemptively implement mitigation actions for terrestrial woodland habitat.
Mitigation Trigger	The mitigation trigger is activated if annual tree cover area for the Swamp Cedar ACEC, compared to the baseline maximum tree cover area, falls below the lower limit of the baseline percent range in cover for a period of five consecutive years as a result of SNWA GDP pumping.

Table 3-8
Terrestrial Woodland Habitat Management and Mitigation Plan
(Page 2 of 2)

Mitigation Action	Mitigation actions will include at least one of the following: Terrestrial woodland habitat enhancement within the Swamp Cedar ACEC, subject to BLM approval of activities within the ACEC. Options include: • Seeding and/or planting. In consultation with botanists, SNWA would develop and implement a planting plan identifying the most effective methods to expand and enhance the woodland habitat. The plan would utilize the most current research and science. Methods may include but are not limited to seed drilling, planting, and mycorrhizal fungi inoculation. • Temporary irrigation. SNWA would run temporary, above-ground irrigation lines from its adjacent Osceola Property, to enhance tree germination and growth. The lines would be laid above-ground, to avoid ground disturbance within the ACEC. • Shallow aquifer recharge. SNWA would apply water along the western edge of its Osceola Property so that it infiltrates and recharges the shallow aquifer underneath the downgradient ACEC. Terrestrial woodland habitat enhancement on the SNWA Osceola Property. SNWA would maintain and establish Rocky Mountain juniper trees on its property commensurate with the acreage necessary to offset the loss below the mitigation trigger. Options include: • Seeding and/or planting. As described above, a planting plan would be developed and implemented using the most effective methods to expand and enhance the woodland habitat on the property. • Application of water to enhance tree germination and growth. SNWA would use its water rights to increase the acreage of woodland habitat on the property. • Modified grazing practices, such as: resting the area; reducing grazing intensity and duration (reducing utilization), and engaging in dormant-season grazing (to improve plant vigor and growth). Such practices can be targeted to relieve stressed areas, support seeding and planting efforts, and support greater growth of young tender trees. Modified use of SNWA water rights. • SNWA's non-GDP permitted water rights and SNWA GDP permitted water rights are available for terrestrial woodland habitat mitigation. This water can be conveyed or transferred to key restoration sites to support plant germination and growth. Modification of SNWA GDP pumping rates, durations, and/or distribution.

3.4 Northern Hamlin and Southern Snake Valleys Management and Mitigation Plan

This section presents the investigation triggers, preemptive management actions, mitigation triggers, and mitigation actions to avoid or eliminate unreasonable effects to senior water rights and environmental resources in northern Hamlin and southern Snake valleys, Nevada and Utah. The rationale and analyses supporting these triggers and actions are presented in the 3M Plan analysis report (Marshall et al., 2017, at Section 7.0).

3.4.1 Senior Water Rights

Monitoring of three sentinel wells (SPR7009M, HAM1007M, and SPR7010M) and the seven closest senior water rights in Hamlin Valley provide a substantial early warning buffer to implement management actions to avoid activating mitigation triggers and avoid unreasonable effects in Snake Valley. A mitigation trigger is set at proposed monitor well HAM1008M, located upgradient of Snake Valley, which would be activated prior to effects occurring in Snake Valley. The mitigation trigger at HAM1008M is the decrease of water level below the 99.7 percent lower control limit using the SALR method for baseline data for six continuous months.

Early warning from the sentinel wells will allow time for implementation of appropriate management actions to avoid activating mitigation triggers at monitor well HAM1008M, the three distant senior water rights in Hamlin Valley (permit numbers 9981, R05277, and V02125) and all the senior water rights in Snake Valley.

The SNWA hydrologic monitoring network will provide data on changes in water levels between the SNWA PODs and the Utah state line to effectively detect and measure propagation of drawdown, if it occurs. The UGS monitoring network in Utah provides additional hydrologic data and would detect propagation of drawdown in Utah. The monitoring network provides over 15 miles of buffer between the sentinel monitor wells located along the Limestone Hills and Dearden Springs and other senior water rights located in Nevada and Utah.

Mitigation actions for the closest Hamlin Valley senior water rights are presented in Table 3-9. Mitigation triggers and actions also apply to senior water rights located in Utah if the caused by SNWA GDP pumping. The management and mitigation plan, including mitigation actions, for the distant (>11.5 miles from the closest SNWA GDP POD) senior water rights in Hamlin and Snake valleys are summarized on Table 3-10 below.

Table 3-9
Primary Mitigation Actions for Senior Water Rights in Northern Hamlin Valley, Nevada

App No.	Status[a]	Source[b]	Manner of Use	Diversion Rate (cfs)	Annual Duty (afa)	Distance to Nearest POD[c] (mi)	Site Name and Attributes Primary Mitigation Actions
Closest Northern Hamlin Valley Senior Water Rights to SNWA GDP POD							
45497	CER	UG	STK	0.12	86.8*	7.7	383325114134901 (Hyde Well) Well depth110 ft; water level at 73 ft; 37 ft of saturated column Temporary water tank; lower pump; deepen or replace well
V02199	VST	UG	STK	0.025	10.2*,d	7.6	383325114134901 (Hyde Well) Well depth 110 ft; water level at 73 ft; 37 ft of saturated column Temporary water tank; lower pump; deepen or replace well
45495	CER	SPR	STK	0.12	86.8*	8.1	Near location of monitor well HAM1007M (Troughs Area) Temporary water tank; drill well; exchange water right
V02198	VST	OGW	STK	0.025	10.2*,d	8.1	Near location of monitor well HAM1007M (Troughs Area) Temporary water tank; drill well; exchange water right
45500	CER	UG	STK	0.119	86.1*	9.6	Well 383023114115302 Well depth 435 ft; water level 178 ft; 257 ft of saturated column Temporary water tank; lower pump; deepen or replace well
45498	CER	UG	STK	0.12	86.8*	10.6	Well 383023114115302 Well depth 435 ft; water level 178 ft; 257 ft of saturated column Temporary water tank; lower pump; deepen or replace well
45499	CER	UG	STK	0.12	86.8*	11.5	383533114102901 (Monument Well) Well depth 164ft; water level at 92 ft; 72 ft of saturated column Temporary water tank; lower pump; deepen or replace well

[a]CER - Certificated, VST - Vested
[b]OGW - Other Groundwater, SPR - Spring, UG - Underground
[c]Rounded to the nearest 0.1 mile. Distance measured from the listed resource to SNWA POD No. 54003.
[d]Acre-feet per season
*The reported annual duty is not explicitly documented on the certificate, reserved right, or vested claim, but reported as such by the NDWR Hydrographic Abstract query.

3.4.2 Environmental Resources

3.4.2.1 Native Aquatic-Dependent Special Status Animal Species

Unreasonable effect to avoid: Extirpation of the native aquatic-dependent special status animal species longitudinal gland pyrg from the Snake Valley groundwater discharge area.

Approach: Protect longitudinal gland pyrg habitat at Dearden (Stateline) Springs.

The rationale and analyses supporting this approach are provided in the 3M Plan analysis report (Marshall et al., 2017, at Section 7.3). A summary is provided below.

The longitudinal gland pyrg (a springsnail) may be endemic to southern Snake Valley, and is only known to occur at Dearden Springs, Big Springs, and Clay Spring North (Figure 2-16 in Section 2.2.1). As discussed in the 3M Plan analysis report, Big Springs and Clay Spring North are sourced from local recharge, and are not located along the groundwater flow path from southern Spring Valley into Hamlin and Snake valleys (Marshall et al., 2017, at Section 7.3). Given the improbability of effects from SNWA GDP pumping, no triggers or mitigation actions are necessary to protect the species or their habitat at these sites. Inter-basin flow from southern Spring Valley joins groundwater flowing north from southern Hamlin Valley toward the area of Dearden Springs. Given the groundwater flow path and the limited range of the species, triggers and management and mitigation actions are established for longitudinal gland pyrg with a focus on Dearden Springs.

The approach primarily relies on avoiding unreasonable effects to senior water rights. As discussed above, this approach includes hydrologic monitoring, investigation triggers at intermediate wells, preemptive management actions, mitigation triggers, and mitigation actions to avoid conflicts with senior water rights. Given the number and spatial distribution of monitor wells and senior water rights and the general co-location of senior water rights with environmental resources, this approach also helps prevent unreasonable effects to the longitudinal gland pyrg. Environmental mitigation actions are also included in the approach to ensure that the unreasonable effect to the species is avoided. If the mitigation trigger is activated, at least one of the mitigation actions identified in Table 3-10 will be implemented within no more than 30 days.

The environmental management and mitigation plan for longitudinal gland pyrg is presented in Table 3-10 below, and the monitoring plan is presented in Section 2.2.2.1.

3.4.2.2 Shrubland Habitat

Unreasonable effect to avoid: Elimination of shrubland habitat from the Hamlin Valley or Snake Valley groundwater discharge area, and excessive loss of shrub cover that results in extensive bare ground.

Approach: Within the groundwater discharge areas, maintain shrub cover at or above the low-density shrubland threshold level in those areas currently covered by medium-density or low-density shrubland habitat.[1] Management and mitigation actions to avoid and eliminate conflicts with senior water rights (Section 3.4.1) also helps protect shrubland habitat by attenuating groundwater drawdown and propagation.

The approach for avoiding unreasonable effects to shrubland habitat in northern Hamlin and southern Snake valleys is the same as in Spring Valley (Section 3.3.2.3). The rationale and analyses supporting this approach are summarized in Section 3.3.2.3, and detailed in the 3M Plan analysis report (Marshall et al., 2017, at Sections 6.3.3 and 7.3).

As described in Section 3.3.2.3, trigger parameters include NDVI (derived from Landsat imagery), and percent live shrub cover (recorded on ground vegetation transects). The lower control limits of prediction intervals are used to signal investigation and mitigation trigger activation, as shown in Figure 3-6. The prediction intervals provide ranges of mean NDVI and percent live shrub cover values expected for medium- and low-density shrubland habitat across a range of precipitation levels if no significant changes occur from baseline. Collection of the data, calculation of the prediction intervals, and use of the monitoring data to signal trigger activation are described in Section 2.2.2.2.

If an investigation trigger is activated, investigation actions will be taken to determine cause, condition, and significance of observed changes, and to inform management and mitigation actions. An investigation trigger may also prompt management actions. Investigation and management actions are discussed in Section 3.3.2.3.

If the mitigation trigger is activated, at least one of the mitigation actions identified in Table 3-10 will be implemented within no more than 30 days. A variety of mitigation actions are available, and will be used in situations where they are most practical or effective. The investigation findings will inform the mitigation actions based on ground conditions. These actions may also be preemptively implemented to avoid activating the mitigation triggers. A detailed discussion of the mitigation actions, including discussion on efficacy and SNWA resources, is provided in the 3M Plan analysis report (Marshall et al., 2017, at Sections 6.3.3.4 and 7.3). Mitigation actions will be taken to reverse the trend until the shrubland habitat is at or above the threshold level.

The environmental management and mitigation plan for shrubland habitat in northern Hamlin and southern Snake valleys is presented in Table 3-10, and the monitoring plan is presented in Section 2.2.2.2.

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1. High-density shrubland does not occur within the groundwater discharge areas of the 3M Plan area.

Table 3-10
Northern Hamlin and Southern Snake Valleys Management and Mitigation Plan
(Page 1 of 5)

Unreasonable Effect	Conflict with a senior water right; extirpation of native aquatic-dependent special status animal species from a hydrographic basin's groundwater discharge area; elimination of a habitat type from a hydrographic basin's groundwater discharge area; and excessive loss of shrub cover that results in extensive bare ground.
Investigation Trigger	**Senior Water Rights:** Monitor hydrologic conditions in Spring, Hamlin, and southern Snake valleys according to the monitoring plan. Sentinel monitor well locations SPR7009M, SPR7010M, HAM1007M, are used to detect change in water levels at Spring Valley and Hamlin Valley boundary. The investigation trigger at a sentinel monitor well or designated well site is a decrease in water level below the 99.7 percent lower control limit using the SALR method for the baseline data for six continuous months. The investigation trigger at a designated spring site is a decrease in spring discharge below the 99.7 percent lower control limit using the SALR method for the baseline data for six continuous months. If the investigation trigger is activated, investigate cause, determine significance, revise predictive tools, and apply appropriate management actions. Request from the NSE to investigate the cause of a change in water level or spring discharge at a location. **Environmental Resources:** *Longitudinal Gland Pyrg* The hydrologic investigation trigger at monitor well 383533114102901 triggers longitudinal gland pyrg monitoring. *Shrubland Habitat* The hydrologic investigation trigger at sentinel well HAM1007M triggers shrubland habitat monitoring in northern Hamlin Valley. The hydrologic investigation trigger at sentinel well HAM1008M triggers shrubland habitat monitoring in southern Snake Valley. A shrubland habitat investigation trigger is activated if: • mean annual NDVI for either polygon habitat group (medium-density shrubland, low-density shrubland) falls below the medium-density or low-density shrubland 95 percent lower control limit for NDVI, or • mean percent live shrub cover for either polygon habitat group (medium-density shrubland, low-density shrubland) falls below the medium-density or low-density shrubland 95 percent lower control limit for percent live shrub cover.

Table 3-10
Northern Hamlin and Southern Snake Valleys Management and Mitigation Plan
(Page 2 of 5)

Management Action	**Senior Water Rights:** If investigation indicates cause of water level change at sentinel or other designated monitor wells is the result of SNWA GDP pumping, management actions may include the following: • Update and calibrate the numerical groundwater flow model with aquifer response data. • Continue to observe water levels in the sentinel and other intermediate wells to verify model projections. • Evaluate the addition of other existing monitoring and production wells downgradient of the sentinel wells to the monitoring network including Granite Peak Ranch wells. • Modify SNWA pumping rates, durations, and/or distribution to avoid activating a mitigation trigger. • Adjudicate all vested claims in the analysis area. • Prepare mitigation actions for implementation, including purchasing equipment, establishing contracts, obtaining any necessary land owner permissions and permits. **Environmental Resources:** *Longitudinal Gland Pyrg* If investigation indicates cause of water level change at monitor well 383533114102901 is the result of SNWA GDP pumping, SNWA will conduct annual presence/absence monitoring of the longitudinal gland pyrg at Dearden Springs, Big Springs, and Clay Spring North. *Shrubland Habitat* If investigation indicates cause of water level change at monitor well HAM1007M is the result of SNWA GDP pumping, SNWA will conduct shrubland habitat monitoring in the groundwater discharge area of northern Hamlin Valley. If investigation indicates cause of water level change at monitor well HAM1008M is the result of SNWA GDP pumping, SNWA will conduct shrubland habitat monitoring in the groundwater discharge area of southern Snake Valley, Nevada, east of Big Springs Creek. If investigation indicates cause of shrubland investigation trigger activation is a result of SNWA GDP pumping, the following management actions may be taken: • Conduct detailed statistical tests to inform management and mitigation actions. • Prepare mitigation actions for implementation, including purchasing equipment, establishing contracts, and obtaining any necessary landowner permissions and permits. • Preemptively implement mitigation actions for shrubland habitat. Management actions to avoid conflicts with senior water rights (Section 3.4.1) also help protect shrubland habitat by attenuating groundwater drawdown and propagation.

Table 3-10
Northern Hamlin and Southern Snake Valleys Management and Mitigation Plan
(Page 3 of 5)

Mitigation Trigger	**Senior Water Rights:** A special mitigation trigger is established for HAM1008M to avoid unreasonable effects in Snake Valley. The trigger is a change in water level below the 99.7 percent lower control limit for six continuous months using the SALR method. **Senior Underground Water Rights:** **Well production > permitted diversion rate prior to SNWA GDP pumping:** A decrease in groundwater level that reduces the column of water in the well needed to produce the permitted diversion rate based on the well's specific capacity range plus either a 10 percent or 10 ft buffer, which ever is greater. An alternative mitigation trigger for the well is activated if the maximum production capacity from the well decreases to less than 10 percent above the permitted diversion rate and the static groundwater level has decreased below the 99.7 percent control limit as a result of SNWA GDP pumping. **Well production < permitted diversion rate prior to SNWA GDP pumping:** If the evaluation associated with the investigation trigger determines the cause of the change in water level to be SNWA GDP pumping, the mitigation trigger is activated. Increase of more than 25 percent in the power usage for pumps to produce a similar amount of water as a result of decreased water levels from SNWA GDP pumping. **Senior Spring or Stream Water Rights:** **If measured baseline spring or stream flow has been consistently above the permitted diversion rate:** The mitigation trigger is 10 percent above the permitted diversion rate to provide a buffer and is activated if spring or stream discharge decreases below this mitigation trigger level for six consecutive months as a result of SNWA GDP pumping. **If measured baseline spring or stream flow has been consistently at or less than the permitted diversion rate:** The mitigation trigger is activated if the evaluation associated with the investigation trigger determines the cause of the change to be SNWA GDP pumping. **Environmental Resources:** *Longitudinal Gland Pyrg* The hydrologic mitigation trigger at HAM1008M is the mitigation trigger for longitudinal gland pyrg. *Shrubland Habitat* A shrubland habitat mitigation trigger is activated if, as a result of SNWA GDP pumping: • mean annual NDVI for either polygon habitat group (medium-density shrubland, low-density shrubland) falls below the low-density shrubland 95 percent lower control limit for NDVI for five consecutive years, or • mean percent live shrub cover for either polygon habitat group (medium-density shrubland, low-density shrubland) falls below the low-density shrubland 95 percent lower control limit for percent live shrub cover for five consecutive years.

Table 3-10
Northern Hamlin and Southern Snake Valleys Management and Mitigation Plan
(Page 4 of 5)

Mitigation Action	**Senior Water Rights:** ***Senior Underground Water Rights:*** Mitigation actions for senior underground water rights will include one of the following or an effective alternative action: • Lowering of the pump if the well has the depth and capacity to produce the water right. • Compensate well owners for the incremental increase in power usage if the usage increase is greater than 25 percent to produce a similar volume of water. • Deepen the well if the aquifer has the ability to yield the water right. • Rehabilitate the well to increase well efficiency. • Drill and equip a replacement well. • Modify SNWA pumping rates, duration, and/or distribution. • Temporary storage tank to supplement the well production until other mitigation action is implemented. Water supplying the tank can be sourced by pumping the impacted well for a longer period of time at a lower pumping rate, by a truck delivering water, or other sources. ***Senior Spring or Stream Water Rights:*** Mitigation actions for senior spring and stream water rights will include one of the following or an effective alternative action: • Acquire or exchange water rights and construct a well or piping to convey the water right to the POD or place of beneficial use to supplement springs. • Transfer or exchange of the impacted senior water right for an SNWA water right of an equal or better priority at another location. • Modify SNWA pumping rates, duration, and/or distribution. • Temporary storage tank to supplement the spring discharge until a permanent mitigation action is implemented. Water supplying the tank can be sourced from a water truck or other sources. Additional management and mitigation actions are presented in the 3M Plan analysis report (Marshall et al., 2017 at Sections 3.2.4 and 3.2.8).

Table 3-10
Northern Hamlin and Southern Snake Valleys Management and Mitigation Plan
(Page 5 of 5)

Mitigation Action	**Environmental Resources:** *Longitudinal Gland Pyrg* Mitigation actions for the longitudinal gland pyrg focus primarily on Dearden Springs. In addition to the mitigation actions identified for senior water rights, mitigation actions for the longitudinal gland pyrg will include at least one of the following: • Collaborate with private landowners and/or water right holders and fund measures to ensure water is available to support the species and its habitat; • Collaborate with private landowners and NDOW and/or Utah Division of Wildlife Resources (UDWR) and fund improvements to existing habitat; and • Collaborate with NDOW and/or UDWR and fund expansion of habitat, creation of suitable habitat, and/or establishment of additional populations of the longitudinal gland pyrg. *Shrubland Habitat* Shrubland habitat mitigation actions will include at least one of the following: • Collaborate with BLM and/or private landowners and fund vegetation treatments (e.g., direct seeding and seedling transplanting; plant protection; transplanting nursery stock; weed control), see details in Table 3-7). • Collaborate with private landowners and/or water right holders and fund measures to increase water availability to the shrubland habitat; • Collaborate with BLM, private landowners, and/or federal grazing permittees and fund measures to reduce other stressors. Mitigation actions to avoid or eliminate conflicts with senior water rights (Section 3.4.1) also help protect shrubland habitat by attenuating groundwater drawdown and propagation.

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4.0 Numerical Groundwater Flow Modeling and Other Predictive Tools

Numerical groundwater flow modeling will be used by SNWA as an analysis tool for the management of SNWA GDP pumping. In accordance with Ruling 6164, SNWA will update the NSE approved numerical groundwater flow model once before groundwater pumping begins, and at least every eight years thereafter, and provide predictive results for 10-year, 25-year, and 100-year periods (NDWR, 2012, at page 217). SNWA will also evaluate updating the model as aquifer response data becomes available or as a management action associated with a investigation trigger. The results of groundwater flow modeling will be evaluated by the NSE prior to NSE approval to advance to the next stage of phased groundwater development in Spring Valley (Table 1-1).

4.1 Central Carbonate-Rock Province Model

SNWA has developed a regional groundwater flow model known as the Central Carbonate-Rock Province (CCRP) Model (SNWA, 2009b). In accordance with Ruling 6164, the NSE requires SNWA to improve and use its model as a management tool (NDWR, 2012, at page 92).

To be of value, all model results must be qualified based on a comparison of the accuracy of the model and the capability of the model to predict actual observed conditions. Data collected during monitoring under this 3M Plan will provide additional information on aquifer properties, which will be used to calibrate the CCRP transient-state numerical flow model. The CCRP model will be updated as additional data is acquired, as required by the NSE. The updated CCRP model will provide refined estimates of future drawdown with distance and time under different pumping operation scenarios with greater certainty.

SNWA will provide model output to the NSE in the form of input files, output files, drawdown maps, tabular data summaries, and plots of simulated water levels through time for the aquifer system. Additional model output and/or other supporting information will be provided to the NSE as requested.

4.2 Other Predictive Tools

SNWA may also use additional predictive tools during trigger investigations if the tools can assist in differentiating water-level changes from multi-source pumping responses or natural variability. These tools may include, but are not limited to: more detailed (local scale) groundwater flow models, Theis analytical models or programs such as USGS Series SEE (Halford et al., 2012).

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5.0 REPORTING

5.1 Monitoring Data and Operation Plans

SNWA will submit all monitoring data collected for this 3M plan in an electronic format to the NSE. Hydrologic data will be submitted quarterly, and environmental data will be submitted annually. Water chemistry laboratory reports will be also made available to the NSE within 90 calendar days of receipt or within an alternative time frame required by the NSE.

SNWA will also report the results of all hydrologic and environmental monitoring pursuant to this 3M Plan in an annual monitoring data report, submitted to the NSE by March 31 for each year that this 3M Plan is in effect. An annual operations plan will also be submitted to the NSE by December 1 presenting the anticipated pumping distribution for the following year. The operation plan will also identify planned or implemented management and mitigation actions regarding SNWA GDP pumping in Spring Valley.

5.2 Trigger Activation, Investigations, and Management and Mitigation Actions

SNWA will notify the NSE when investigation and mitigation triggers are activated, and will submit data and technical findings to the NSE as follows:

- A memorandum will be submitted to the NSE within 30 days of activating a mitigation trigger. The memorandum will describe the mitigation trigger and planned mitigation actions. Mitigation actions will be implemented no later than 30 days after a mitigation trigger is activated to avoid unreasonable effects and comply with Nevada water law.

- Implemented mitigation actions, assessments of mitigation efficacy, and plans for continuing mitigation will be submitted in annual reports.

- Notification of investigation trigger activation will be included in the quarterly data submittal to the NSE.

- Investigation findings, preemptive management actions, and mitigation planning will be reported in the annual reports. Mitigation planning will be conducted in advance of activating a mitigation trigger, and will include purchasing equipment, establishing contracts, and obtaining landowner permissions and permits.

The NSE may also perform independent investigations at any time, and senior water right holders and other parties may pursue independent investigations and submit reports for NSE review. The NSE will distribute information among parties as needed.

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Appendix A

Location Information and Site Attributes for Hydrologic Monitoring Sites

Table A-1
Existing Spring Valley3M Plan Well Network (arranged from north to south)
(Page 1 of 2)

SNWA Site Number	NDWR Station Local Number[b]	Location UTM[a] Northing (m)	Location UTM[a] Easting (m)	Surface[c] Elevation (ft amsl)	Completion Date	Drill Depth (ft bgs)	Well Depth (ft bgs)	Well Casing Diameter (in.)	Screened Interval (ft bgs)	Open Interval	Aquifer	Monitoring Frequency
184 N20 E66 13AB 1	184 N20 E66 13BADA1	4,386,884.19	714,871.84	5,774.93	6/26/1966	907	296	16	135 to 296	---	Basin Fill	Quarterly
393442114231801	184 N20 E67 26ABBD1	4,383,955.15	723,240.35	5,708.77	Unknown	130	130	6	---	50 to 130	Basin Fill	Quarterly
Robison Crooked	184 N19 E66 11B 1	4,378,627.03	713,381.69	5,698.43	4/22/1960	---	400	---	---	50 to 400	Basin Fill	Continuous
392703114230501	184 N18 E67 01CCAA1	4,369,956.56	724,523.82	5,587.78	1934-36?	45	42	38	---	---	Basin Fill	Quarterly
SPR7029M2	184 N16 E66 25DBCA1	4,344,123.42	716,052.20	5,876.66	4/18/2011	437	422.6	12	382.14 to 422.1	360 to 430	Basin Fill	Quarterly
SPR7029M	184 N16 E66 25DBCD1	4,344,090.03	716,054.99	5,876.83	4/29/2011	275	260.34	4	219.75 to 260.04	213 to 261.75	Basin Fill	Quarterly
SPR7030M	184 N16 E67 32ABAB1	4,343,631.40	719,460.97	5,617.15	2/19/2011	98	96.67	4	53.67 to 96.37	53.67 to 98	Basin Fill	Quarterly
SPR7030M2	184 N16 E67 32ABAB2	4,343,620.29	719,454.00	5,617.79	2/11/2011	240	236.42	4	194.17 to 236.12	173.8 to 237	Basin Fill	Quarterly
390803114251001	184 N15 E67 26CA 1	4,334,740.47	722,963.02	5,727.21	Unknown	---	200	2	---	50 to 200	Basin Fill	Continuous
SPR7008X	184 N15 E67 26CADC1	4,334,727.66	722,847.72	5,702.99	11/27/2007	970	960	20	240 to 940	102 to 970	Basin-Fill	Quarterly
SPR7008M	184 N15 E67 26CDAB1	4,334,702.61	722,865.27	5,704.86	7/25/2007	960	946	8	226 to 926	54 to 960	Basin Fill	Continuous
SPR7005X	184 N14 E66 09ABCA2	4,330,506.86	710,356.78	6,397.56	4/11/2008	1,395	1,350	20	669 to 1,330	511 to 1,395	Carbonate	Quarterly
SPR7005M	184 N14 E66 09ABCA1	4,330,471.51	710,372.44	6,395.68	7/10/2007	1,412	1,404	8	663 to 1,383	439 to 1,412	Carbonate	Continuous
SPR7006M	184 N14 E67 14DDAC1	4,328,163.49	723,872.61	6,525.18	9/20/2007	1,720	1,701	8	980 to 1,680	167 to 1,720	Carbonate	Continuous
390352114305401	184 N14 E66 24BDDD1	4,326,894.19	714,873.84	5,846.04	1980	---	160	2	---	50 to 160	Basin Fill	Quarterly
385636114265501	184 N13 E67 33DDA 1	4,313,590.54	721,086.82	5,769.73	Unknown	---	---	36	---	---	Basin Fill	Quarterly
SPR7024M2	184 N12 E67 01CCCD2	4,311,765.99	724,560.80	5,863.08	3/27/2011	720	699.38	4	661.13 to 669.08	650.08 to 720	Basin Fill	Continuous
SPR7024M	184 N12 E67 01CCCD1	4,311,753.95	724,554.55	5,861.10	3/30/2011	260	249.76	4	209.3 to 249.46	200.5 to 260	Basin Fill	Continuous
184 N12 E66 21CD 1	184 N12 E66 21DCCB1	4,306,700.53	710,871.15	6,370.31	9/13/1966	631	631	6	3 to 631	3 to 631	Carbonate	Quarterly
184W506M	184 N12 E66 26BADC1	4,306,214.21	713,939.81	6,014.04	10/19/2006	1,160	1,140	8	430 to 1,120	80 to 1,160	Carbonate	Continuous
184W105	184 N12 E66 26BDAA1	4,306,176.07	713,991.23	6,007.30	11/7/2006	1,160	1,135	20	418 to 1,114	60 to 1,160	Carbonate	Quarterly
SPR7007X	184 N11 E68 05BCBC2	4,303,152.00	727,946.17	6,017.53	1/24/2008	1,040	1,020	20	299 to 1,000	155 to 1,040	Basin-Fill	Quarterly
SPR7007M	184 N11 E68 05BCBC1	4,303,146.59	727,976.03	6,017.73	8/17/2007	1,040	1,020	8	300 to 1,000	101 to 1,040	Basin Fill	Continuous
384831114314301	184 N11 E66 23AB 1	4,298,411.13	714,633.01	5,842.94	Unknown	102	102	2	---	50 to 102	Basin Fill	Continuous
384745114224401	184 N11 E68 19DCDC1	4,297,304.22	727,554.19	5,900.18	Unknown	200	200	2	---	50 to 200	Basin Fill	Continuous
184W504M	184 N11 E66 35CCCC1	4,293,712.49	713,647.12	5,900.11	11/17/2006	1,040	1,020	8	309 to 999	61 to 1,040	Carbonate	Continuous
184W103	184 N11 E66 35CCCC2	4,293,693.03	713,697.74	5,899.06	12/6/2006	1,046	1,017	20	296 to 996	60 to 1,046	Carbonate	Quarterly
384310114261401	184 N10 E67 22AA 1	4,289,331.34	722,826.33	5,853.54	Unknown	---	100	2	---	50 to 100	Basin Fill	Quarterly

Table A-1
Existing Spring Valley3M Plan Well Network (arranged from north to south)
(Page 2 of 2)

SNWA Site Number	NDWR Station Local Number[b]	Location UTM[a] Northing (m)	Location UTM[a] Easting (m)	Surface[c] Elevation (ft amsl)	Completion Date	Drill Depth (ft bgs)	Well Depth (ft bgs)	Well Casing Diameter (in.)	Screened Interval (ft bgs)	Open Interval	Aquifer	Monitoring Frequency
384227114082701[d]	195 N10 E70 28CBCB1	4,288,208.30	748,609.36	5,815.18	9/27/2009	460	460	8	300 to 460	140 to 460	Basin Fill	Continuous
384112114091101[d]	196 N09HE70 32BBA 1	4,285,847.90	747,616.56	6,019.53	7/7/2010	700	700	8	500 to 700	450 to 700	Carbonate	Continuous
184W502M	184 N09 E68 11BDBD1	4,282,116.35	733,294.42	6,189.72	1/25/2007	1,828	1,799	8	495 to 1,779	58 to 1,828	Carbonate	Continuous
184W101	184 N09 E68 11BDCA1	4,282,062.02	733,297.65	6,190.90	2/24/2007	1,760	1,749	20	796 to 1,728	135 to 1,760	Carbonate	Quarterly
184W508M	184 N09 E67 11DBCD1	4,281,308.68	724,070.89	6,056.19	12/15/2006	1,180	1,160	8	376 to 1,140	241 to 1,180	Volcanic	Continuous
383704114225001	184 N09 E68 30AAAB1	4,277,594.57	727,759.99	6,002.52	8/7/1980	700	679	11	559 to 679	50 to 700	Basin Fill	Continuous
383325114134901	196 N08 E69 15B 1	4,271,103.41	741,539.28	5,729.98	Unknown	---	110	6	---	50 to 110	Basin Fill	Quarterly
383351114180201	184 N08 E68 14A 1	4,269,504.76	733,845.43	6,184.22	Unknown	---	495	6	50 to 495	50 to 495	Basin Fill	Quarterly
383023114115302	196 N08 E69 35DC 2	4,265,403.02	743,597.36	5,837.67	8/7/1980	520	435	2	320 to 420	35 to 520	Basin Fill	Continuous
HAM1005M	196 N10 E69 02 BBA 1	4,284,588[d]	742,819[d]	6,397[d]	Future	---	---	---	---	---	Basin Fill	Continuous
HAM1006M	196 N95 E70 32 AAD 1	4,285,699[d]	748,554[d]	5,797[d]	Future	---	---	---	---	---	Basin Fill	Continuous
SPR7009M	184 N10 E68 36 ACC 1	4,285,242[d]	735,445[d]	6,494[d]	Future	---	---	---	---	---	Carbonate	Continuous
HAM1007M	196 N09 E69 20 BCB 1	4,279,203[d]	737,774[d]	6,025[d]	Future	---	---	---	---	---	Carbonate	Continuous
SPR7010M	184 N08 E69 29 CBB 1	4,267,545[d]	738,113[d]	6,458[d]	Future	---	---	---	---	---	Carbonate	Continuous
SPR7025M	---	---[e]	---[e]	---[e]	Future	---	---	---	---	---	Basin Fill	Continuous
SPR7026M	---	---[e]	---[e]	---[e]	Future	---	---	---	---	---	Carbonate	Continuous
SPR7044M	---	---[e]	---[e]	---[e]	Future	---	---	---	---	--	---[e]	Continuous
391224114293601[f]	184 N16 E66 36DBAD1	4,342,683.25	716,362.90	5,870.25	Unknown	---	---	---	---	---	Basin Fill	---
384039114232701[f]	184 N10 E68 31CD 1	4,284,275.68	726,871.51	5,896.49	Unknown	---	150	2	---	50 to 150	Basin Fill	---
383533114102901[f]	196 N08 E70 06B 1	4,275,166.91	747,014.36	5,676.76	7/22/1947	---	164	6	111 to 115/ 152 to 164	---	Basin Fill	---

[a]Universal Transverse Mercator, North American Datum, 1983, Zone 11.
[b]Station Local Numbers provided by the Nevada Department of Water Resources.
[c]Elevations are North American Vertical Datum of 1988 (NAVD88).
[d]Coordinates and Elevation are approximate and will be updated upon a professional survey of the well location.
[e]To be determined.
[f]Monitor wells removed from program in 2014 by TRP in consensus with NSE.

Table A-2
SNWA Inter-basin Monitoring Zone Well Locations

Site Number	Well Alias Name	Well Common Name	Location[a]		Estimated Surface Elevation[a] (ft amsl)
			UTM Northing (m)	UTM Easting (m)	
Basin Fill					
196 N10 E69 02 BBA 1	HAM1005M	Wash Alluvial Well	4,284,588	742,819	6,397
196 N95 E70 32 AAD 1	HAM1006M	Big Springs Well	4,285,699	748,554	5,797
Carbonate					
184 N10 E68 36 ACC 1	SPR7009M	North Carbonate Well	4,285,242	735,445	6,494
196 N09 E69 20 BCB 1	HAM1007M	Troughs Carbonate Well	4,279,203	737,774	6,025
184 N08 E69 29 CBB 1	SPR7010M	Limestone Hills Well	4,267,545	738,113	6,458
184 N09 E68 11 BDBD1	184W502M[b]	184W502M	4,282,116	733,294.42	6,189.72

[a]Coordinates and elevations are approximate and will be updated based upon professional survey of well location.
[b]Existing Well, professional survey complete.
Note: Monitor wells SPR7025M and SPR7026M will be located between the closest SNWA GDP production well completed in carbonate and basin fill and the Inter-basin Monitoring Zone. Monitor well SPR7044M will be located approximately one mile north of the northern most SNWA GDP production well on the east side of the valley.

Table A-3
Spring Monitoring Locations

Spring Name	Location[a]		Geology
	UTM Northing (m)	UTM Easting (m)	
4WD Spring - piezometer	4,335,263	716,236	Alluvium/Fan Margin
Blind Spring - piezometer	4,298,999	724,727	Alluvium/Valley Floor
Keegan Spring - piezometer and discharge	4,369,693	714,899	Alluvium/Fan Margin
Layton Spring- piezometer and discharge (dry recently)	4,331,753	720,064	Alluvium/Valley Floor
Minerva Spring - piezometer	4,301,058	726,134	Alluvium/Fan Margin
Rock Spring - discharge	4,340,191	726,753	Carbonate/Mountain Block
South Millick Spring - piezometer and discharge	4,353,624	725,156	Alluvium/Valley Floor
Stonehouse Spring - piezometer	4,406,417	710,618	Alluvium/Valley Floor
Swallow Spring - discharge	4,302,920	728,597	Alluvium/Range Front
Seep - piezometer (recently dry)	4,306,272	724,093	Alluvium/Valley Floor
West Spring Valley Complex 1-piezometer	4,353,816	717,284	Alluvium/Fan Margin
Willow Spring - piezometer and discharge	4,397,090	713,753	Alluvium/Valley Floor
Unnamed 5 Spring - piezometer	4,340,637	718,886	Alluvium/Valley Floor

[a]Coordinates are approximate. All coordinates are Universal Transverse Mercator, North American Datum, 1983, Zone 11.
NOTE: Monitoring at Bastian Spring in Schell Creek Range mountain block and Chokecherry Spring in Snake Range mountain block are planned to be added to the monitoring network prior to GDP pumping.

Table A-4
Spring Valley 3M Plan Stream Monitoring Locations

Station Number	Station Name	Location[a]		Annual Discharge Statistics Period of Record (cfs)[b]			Annual Discharge Statistics Water Years 2006 - 2016 (cfs)		
		UTM Northing (m)	UTM Easting (m)	Minimum	Maximum	Mean	Minimum	Maximum	Mean
1841611	Cleve Creek near Ely	4,343,423	712,669	5.15	22.2	10.1	5.76	20.9	9.36
1951901	Big Springs at Gaging Station[c]	4,287,293	749,422	---	---	---	8.35	10.3	9.42

[a]All coordinates are Universal Transverse Mercator, North American Datum, 1983, Zone 11.
[b]Source: USGS NWIS. Period of record for Cleve Creek is 1914 - 2016, and 2006 - 2016 for Big Springs.
[c]Discharge data is the combination of the northern and southern channels.
Note: Three gaging stations are proposed for Cleve Creek and the Summer and Winter Diversion Ditches in the vicinity of Cleveland Ranch to document irrigation practices as described in Section Section 2.1.3.3

Table A-5
Precipitation Stations

Station Number	Station Name	Surface Elevation[a] (ft amsl)	Location[b] UTM Northing (m)	UTM Easting (m)	Monitoring/ Reporting Agency	Remarks
RP1790102	Schellborne	7,580	4,408,811	701,240	NDWR	Shielded standpipe storage precipitation gage. Typically two measurements collected each year, one in the summer and a second near the end of the water year.
RP1830101	Mount Wilson	7,370	4,254,245	731,613	NDWR	Shielded standpipe storage precipitation gage. Typically two measurements collected each year, one in the summer and a second near the end of the water year.
RP1790202	McGill	6,270	4,365,043	691,693	WRCC	Standard rain and snow gage. Daily precipitation collected with a measuring stick as part of the NWS Coop network.
RP1790203	Ely WBO	6,260	4,351,755	685,692	WRCC	Standard rain and snow gage. Daily precipitation collected with a measuring stick as part of the NWS Coop network.
RP1950205	Great Basin NP	6,850	4,321,069	740,678	WRCC	Standard rain and snow gage. Daily precipitation collected with a measuring stick as part of the NWS Coop network.
RP1790301	Bird Creek	7,540	4,370,461	702,177	NRCS	Shielded standpipe storage precipitation gage with a pressure transducer. Daily temperature and precipitation collected as part of the NRCS Snotel network.
RP1790302	Berry Creek	9,380	4,354,989	705,169	NRCS	Shielded standpipe storage precipitation gage with a pressure transducer. Daily temperature and precipitation collected as part of the NRCS Snotel network.
RP1840301	Kalamazoo	7,780	4,381,606	703,606	NRCS	Shielded standpipe storage precipitation gage with a pressure transducer. Daily precipitation collected as part of the NRCS Snotel network.
RP1840302	Cave Mountain	10,580	4,337,619	706,205	NRCS	Shielded standpipe storage precipitation gage with a pressure transducer. Daily precipitation collected as part of the NRCS Snotel network.
RP1950301	Takka Wiiya	9,120	4,402,513	758,523	NRCS	Shielded standpipe storage precipitation gage with a pressure transducer. Daily precipitation collected as part of the NRCS Snotel network.
RP1950302	Wheeler Peak	10,060	4,321,329	732,917	NRCS	Shielded standpipe storage precipitation gage with a pressure transducer. Daily precipitation collected as part of the NRCS Snotel network.
RP1950303	Silver Creek Nv	8,220	4,346,275	737,362	NRCS	Shielded standpipe storage precipitation gage with a pressure transducer. Daily precipitation collected as part of the NRCS Snotel network.
PSPR7008	Lower Osceola	5,700	4,334,845	722,874	SNWA	Shielded weighing rain gage. Daily precipitation collected as part of the SNWA hydrologic monitoring network.
P1840602	Muncy Creek	7,000	4,386,070	710,920	SNWA	Shielded weighing rain gage. Daily precipitation collected as part of the SNWA hydrologic monitoring network.
P1841701	Bastian Creek	6,400	4,336,914	711,105	SNWA	Shielded weighing rain gage. Daily precipitation collected as part of the SNWA hydrologic monitoring network.
P1841901	Eightmile Creek	6,570	4,363,740	730,744	SNWA	Shielded weighing rain gage. Daily precipitation collected as part of the SNWA hydrologic monitoring network.
P1846201	Swallow Springs	6,080	4,302,847	728,661	SNWA	Shielded weighing rain gage. Daily precipitation collected as part of the SNWA hydrologic monitoring network.

[a] Elevations are NAVD88.
[b] All coordinates are Universal Transverse Mercator, North American Datum, 1983, Zone 11.

Table A-6
Additional Monitoring Sites for the Spring Valley 3M Plan

Name	Type	Purpose	Approximate Depth (ft bgs)	Monitoring Frequency
SPR7041M[a]	Swamp Cedar ACEC deep monitor well paired with SPR7041Z	Monitor deep aquifer conditions near the Swamp Cedar	300	Continuous
SPR7041Z[a]	Swamp Cedar ACEC shallow paired piezometer	Monitor shallow groundwater conditions near the Swamp Cedar	20-30[b]	Continuous
SPR7042Z[a]	Swamp Cedar ACEC shallow piezometer	Monitor shallow groundwater conditions near the Swamp Cedar	20-30[b]	Continuous
SPR7043Z[a]	Swamp Cedar ACEC shallow Piezometer	Monitor shallow groundwater conditions near the Swamp Cedar	20-30[b]	Continuous
To be determined	Six shrubland piezometers in Management Blocks 1 and 2	Monitor shallow groundwater conditions in shrubland habitat	< 50[b]	Quarterly
Shoshone NDOW Well	Flowing artesian well	Monitor artesian conditions at Shoshone Ponds	440	Continuous
Bastian South Well	Deep monitor well	Monitor aquifer conditions south of Cleveland Ranch and provide vertical hydraulic gradient with 4WD piezometer	700	Continuous
391224114293601 (Old Cleve Well)	Deep monitor well	Monitor aquifer conditions south of Cleveland Ranch	--	Quarterly
HAM1008M[a]	HAM1008M	Mitigation Trigger for Snake Valley	500	Continuous
PSPR7008	Swamp Cedar ACEC precipitation station	Precipitation Monitoring Station near Swamp Cedar ACEC	N/A	Continuous

[a]Proposed future site.
[b]Dependent upon hydrogeologic conditions.

Appendix B

Spring Valley 3M Plan Senior Water Rights

B.1.0

This appendix contains the senior water-rights tables as documented within the 3M Plan analysis report (Marshall et al., 2017). The tables include information on the water rights as well as geographic location, distance to the nearest SNWA GDP POD, and the management category assigned in the 3M Plan analysis report (Marshall et al., 2017).

Table B-1
Water Rights within Management Block 1 Senior to SNWA GDP Permits

App No.	Status[a]	Source[b]	Manner of Use[c]	Priority Date	Diversion Rate (cfs)	Annual Duty (afa)	Owner of Record	Geographic Location	Distance to Nearest POD[d] (mi)	DEM Elevation[e] (ft amsl)	Management Category[f]
8074	CER	UG	STK	1927	0.05	26.9*,g	Collis, Chris & Karen	Valley Floor	1.4	5,790	A
8076	CER	UG	STK	1927	0.05	36.2*,g	Collis, Chris & Karen	Valley Floor	1.1	5,790	A
8077	CER	UG	STK	1927	0.05	27.0*,g	Robison, Doyle C.	Valley Floor	1.4	5,790	A
8713	CER	UG	STK	1928	0.013	9.4*	Swallow, George N.	Valley Floor	2.0	5,830	A
12467	CER	UG	MM	1948	0.1	72.4*	Minerva Scheelite Mining Co.	Valley Floor / Alluvial Fan	2.8	5,840	A
18043	CER	UG	STK	1959	0.006	4.5*	Collis, Chris & Karen	Valley Floor	1.4	5,760	A
18044	CER	UG	STK	1959	0.006	4.5*	Collis, Chris & Karen	Valley Floor	1.1	5,770	A
18045	CER	UG	STK	1959	0.01	9.0*	Collis, Chris & Karen	Valley Floor	1.4	5,790	A
45496	CER	UG	STK	1982	0.12	86.2*	Okelberry, Ray	Alluvial Fan / Valley Floor	2.8	6,180	A
R05273	RES	SPR	OTH	1926	0.003	2.1*	BLM	Valley Floor / Alluvial Fan	1.1	5,840	A
R05274	RES	SPR	OTH	1926	0.003	1.8*	BLM	Alluvial Fan	6.0	6,240	E
V01026	VST	STR	IRR	1898	0	16.0*,g	Swallow, George	Alluvial Fan	4.6	6,080	E
Shoshone Ponds Area of Critical Environmental Concern											
27768	CER	UG	WLD	1973	0.027	20.0	Nevada-Department of Wildlife	Valley Floor / Alluvial Fan	5.0	5,780	B

[a]CER - Certificated, RES - Reserved, VST - Vested
[b]SPR - Spring, STR - Stream, UG - Underground
[c]IRR - Irrigation, MM - Mining & Milling, OTH - Other, STK - Stock watering, WLD - Wildlife
[d]Rounded to the nearest tenth of a mile.
[e]Rounded to the nearest 10 ft.
[f]See Section 2.1.2.3 for an explanation of the Management Categories; A - Resource within 3 miles of SNWA GDP POD, B - Resource between 3 miles and 10 miles of SNWA GDP POD, E - Resource not in hydraulic connection with producing aquifer in which SNWA GDP production wells will be installed.
[g]Acre-ft per season
*The reported annual duty is not explicitly documented on the certificate, reserved right, or vested claim, but reported as such by the NDWR Hydrographic Abstract query.

Table B-2
Water Rights within Management Block 2 Senior to SNWA GDP Permits
(Page 1 of 3)

App No.	Status[a]	Source[b]	Manner of Use[c]	Priority Date	Diversion Rate (cfs)	Annual Duty (afa)	Owner of Record	Geographic Location	Distance to Nearest POD[d] (mi)	DEM Elevation[e] (ft amsl)	Management Category[f]
983	CER	STR	MM	1908	1	724.0*	Pilot Knob Gold Mining & Milling Co.	Alluvial Fan	3.8	6,020	E
3203	CER	SPR	IRR	1914	0.35	190.6[g]	George Eldridge & Son, Inc.	Valley Floor	6.5	5,580	B
3973	CER	SPR	STK	1916	0.008	5.7*	LDS	Valley Floor	6.8	5,580	B
4171	CER	SPR	STK	1916	0.02	14.3*	Robison Brothers	Valley Floor	1.8	5,700	A
5691	CER	STR	IRR	1919	1.895	919.0	George Eldridge & Son, Inc.	Valley Floor	8.4	5,560	B
7446	CER	UG	STK	1925	0.019	13.4*[,g]	Production Credit Corp. of Berkeley	Valley Floor	0.8	5,830	A
8721	CER	SPR	STK	1928	0.02	14.5*	Corp. of Church of Latter-Day Saints	Valley Floor	9.6	5,580	B
10921	CER	SPR	IRR	1943	0.79	570.7	George Eldridge & Son, Inc.	Valley Floor	10.5	5,560	C
10993	CER	SPR	IRR	1943	0.6	433.6	George Eldridge & Son, Inc.	Valley Floor	10.8	5,560	C
16890	CER	UG	QM	1956	0.1	72.4*	Pierce, L.L.	Alluvial Fan	4.6	6,530	B
18841	CER	UG	STK	1960	0.011	9.0*	Vogler, Henry Conrad IV	Valley Floor	1.8	5,640	A
18842	CER	UG	STK	1960	0.013	9.0*	Vogler, Henry Conrad IV	Valley Floor	2.4	5,670	A
18843	CER	UG	STK	1960	0.013	9.0*	Vogler, Henry Conrad IV	Valley Floor	2.2	5,650	A
21832	CER	SPR	STK	1964	0.001	0.7*	Eldridge, David and Helen	Alluvial Fan / Mountain Block	3.2	6,410	E
29371	CER	UG	MM	1975	1.11	803.4	The Infinity Mine, LLC	Alluvial Fan / Valley Floor	1.5	5,790	A
29567	CER	UG	MM	1975	1.11	699.9	The Infinity Mine, LLC	Alluvial Fan / Valley Floor	1.5	5,790	A
31239	CER	UG	MM	1977	0.49	177.4	Ostlund, Robert	Alluvial Fan	0.9	5,950	A
80453	PER	STR	IRR	1914	1.6	583.9	LDS	Alluvial Fan	7.3	6,070	E
80454	PER	STR	IRR	1927	1.512	544.9	LDS	Alluvial Fan	7.3	6,070	E
80455	PER	STR	IRR	1940	2.873	1,149.2	LDS	Alluvial Fan	7.3	6,070	E
80456	PER	STR	DEC	1887	0.26	77.9	LDS	Alluvial Fan	7.3	6,070	E
80902	PER	UG	IRR	1989	3	2,080.0	George Eldridge & Son, Inc.	Valley Floor	10.3	5,570	C

Table B-2
Water Rights within Management Block 2 Senior to SNWA GDP Permits
(Page 2 of 3)

App No.	Status[a]	Source[b]	Manner of Use[c]	Priority Date	Diversion Rate (cfs)	Annual Duty (afa)	Owner of Record	Geographic Location	Distance to Nearest POD[d] (mi)	DEM Elevation[e] (ft amsl)	Management Category[f]
R05269	RES	SPR	OTH	1926	0.005	3.6*	BLM	Alluvial Fan / Valley Floor	1.1	5,760	A
R05272	RES	SPR	OTH	1926	0.093	67.2*	BLM	Alluvial Fan / Valley Floor	1.0	5,780	A
R05278	RES	SPR	OTH	1926	0.093	67.2*	BLM	Alluvial Fan / Valley Floor	1.3	5,750	A
R05279	RES	SPR	OTH	1926	0.011	7.9*	BLM	Valley Floor	2.4	5,630	A
R05280	RES	SPR	OTH	1926	0.011	7.9*	BLM	Valley Floor / Alluvial Fan	2.1	5,640	A
R05281	RES	SPR	OTH	1926	0.042	8.1*	BLM	Alluvial Fan / Mountain Block	3.0	6,420	E
R05282	RES	SPR	OTH	1926	0.042	30.4*	BLM	Alluvial Fan / Mountain Block	3.5	6,540	E
R05283	RES	SPR	OTH	1926	0.042	30.4*	BLM	Alluvial Fan / Mountain Block	3.8	6,680	E
R05284	RES	SPR	OTH	1926	0.042	30.4*	BLM	Alluvial Fan / Mountain Block	3.9	6,730	E
R05285	RES	SPR	OTH	1926	0.042	30.4*	BLM	Alluvial Fan / Mountain Block	3.0	6,340	E
R05291	RES	SPR	OTH	1926	0.008	5.8*	BLM	Valley Floor / Alluvial Fan	6.0	5,590	B
R05292	RES	SPR	OTH	1926	0.011	7.9*	BLM	Valley Floor / Alluvial Fan	3.1	5,640	A
R05294	RES	SPR	OTH	1926	0.011	7.9*	BLM	Valley Floor / Alluvial Fan	3.2	5,640	A
V02077	VST	SPR	STK	1890	0.05	11.2*	Robison, Doyle C.	Valley Floor	1.8	5,750	A
V10073	VST	SPR	STK	1873	0.039[h]	28.28[h]	LDS	Valley Floor	1.8	5,700	A
V10074	VST	SPR	STK	1873	0.12	48.0*	LDS	Alluvial Fan	1.2	5,760	A
V10075	VST	SPR	STK	1873	0.12	48.0*	LDS	Alluvial Fan	1.0	5,800	A
V10076	VST	SPR	STK	1873	0.12	48.0*	LDS	Valley Floor	2.4	5,660	A

Table B-2
Water Rights within Management Block 2 Senior to SNWA GDP Permits
(Page 3 of 3)

App No.	Status[a]	Source[b]	Manner of Use[c]	Priority Date	Diversion Rate (cfs)	Annual Duty (afa)	Owner of Record	Geographic Location	Distance to Nearest POD[d] (mi)	DEM Elevation[e] (ft amsl)	Management Category[f]
V10077	VST	SPR	STK	1873	0.12	48.0*	LDS	Valley Floor	2.3	5,680	A
V10078	VST	SPR	STK	1873	0.12	48.0*	LDS	Valley Floor	2.7	5,620	A
V10079	VST	SPR	STK	1873	0.12	48.0*	LDS	Valley Floor	2.6	5,620	A
V10080	VST	SPR	STK	1873	0.12	48.0*	LDS	Valley Floor	2.5	5,630	A
V10081	VST	SPR	STK	1873	0.12	48.0*	LDS	Valley Floor	2.2	5,650	A
V10082	VST	SPR	STK	1873	0.039[h]	28.28[h]	LDS	Valley Floor	3.2	5,640	B
V10083	VST	SPR	STK	1873	0.039[h]	28.28[h]	LDS	Valley Floor	3.1	5,640	B
V10084	VST	SPR	STK	1873	0.039[h]	28.28[h]	LDS	Valley Floor	2.9	5,620	A
V10085	VST	SPR	STK	1873	0.12	48.0*	LDS	Valley Floor	2.8	5,620	A
V10087	VST	SPR	STK	1873	0.039[h]	28.28[h]	LDS	Valley Floor	8.2	5,580	B
V10088	VST	SPR	STK	1873	0.039[h]	28.28[h]	LDS	Valley Floor	9.9	5,580	B

[a]CER - Certificated, PER - Permitted, RES - Reserved, VST - Vested
[b]SPR - Spring, STR - Stream, UG - Underground
[c]DEC - As Decreed, IRR - Irrigation, MM - Mining & Milling, OTH - Other, QM - Quasi-municipal, STK - Stock watering
[d]Rounded to the nearest tenth of a mile.
[e]Rounded to the nearest 10 ft.
[f]See Section 2.1.2.3 for an explanation of the Management Categories; A - Resource within 3 miles of SNWA GDP POD, B - Resource between 3 miles and 10 miles of SNWA GDP POD, C - Distant resource > 10 miles, E - Resource not in hydraulic connection with SNWA GDP POD producing aquifer in which SNWA GDP production wells will be installed.
[g]Acre-ft per season.
[h]Reported number was derived from an analysis documented in Stanka (2017b).
*The reported annual duty is not explicitly documented on the certificate, reserved right, or vested claim, but reported as such by the NDWR Hydrographic Abstract query.

Table B-3
Water Rights within Management Block 3 Senior to SNWA GDP Permits
(Page 1 of 2)

App No.	Status[a]	Source[b]	Manner of Use[c]	Priority Date	Diversion Rate (cfs)	Annual Duty (afa)	Owner of Record	Geographic Location	Distance to Nearest POD[d] (mi)	DEM Elevation[e] (ft amsl)	Management Category[f]
1159	CER	STR	IRR	1908	2.09	758.4*	George Eldridge & Son, Inc.	Valley Floor	8.5	5,570	B
2745	CER	SPR	IRR	1913	0.2	80.0*	Adams-McGill Company	Valley Floor	9.4	5,580	B
2852	CER	STR	IRR	1913	8.02	2,406.5[g]	LDS	Alluvial Fan	5.8	5,900	E
3383	CER	STR	IRR	1915	0.200	59.9[g]	Andrae, Arthur & Audrae	Alluvial Fan	12.7	6,540	E
6754	CER	SPR	IRR	1922	0.538	195.0[g]	Cazier, James	Valley Floor / Alluvial Fan	10.1	5,580	C
10801	CER	STR	IRR	1942	6	277.2	Moriah Ranches Inc	Valley Floor	9.9	5,560	B
21220	CER	STR	IRR	1870	4	721.0[g]	Andrae, Arthur J.	Alluvial Fan	13.2	7,090	E
21687	CER	STR	IRR	1943	3.5	1,540.0[g]	Andrae, Arthur J.	Alluvial Fan	13.2	7,090	E
R05293	RES	SPR	OTH	1926	0.011	7.9*	BLM	Valley Floor / Alluvial Fan	3.8	5,630	B
V00790	VST	STR	IRR	1873	2.5	10,847.7*	LDS	Alluvial Fan	5.8	5,900	E
V01217	VST	STR	IRR	1873	1	12,035.0*	LDS	Alluvial Fan	6.3	5,780	E
V01218	VST	STR	IRR	1873	0	4,800.0*	LDS	Valley Floor	8.6	5,650	E
V01764	VST	STR	IRR	1902	0	40.0*	Casier, Elaine E.	Alluvial Fan	10.0	5,620	E
V02817	VST	SPR	IRR	1884	10	9,600.0*	LDS	Valley Floor	6.8	5,610	B
V02818	VST	SPR	IRR	1884	10	9,600.0*	LDS	Valley Floor / Alluvial Fan	6.1	5,600	B
V02819	VST	SPR	IRR	1884	10	9,600.0*	LDS	Valley Floor	6.1	5,600	B
V02820	VST	SPR	IRR	1884	10	9,600.0*	LDS	Valley Floor	6.1	5,600	B
V02821	VST	SPR	IRR	1884	10	9,600.0*	LDS	Valley Floor	5.6	5,630	B
V02822	VST	SPR	IRR	1884	10	9,600.0*	LDS	Valley Floor	5.9	5,590	B
V02823	VST	SPR	IRR	1884	10	9,600.0*	LDS	Valley Floor	5.4	5,590	B
V02824	VST	SPR	IRR	1884	10	9,600.0*	LDS	Alluvial Fan / Valley Floor	5.2	5,660	B
V02825	VST	SPR	IRR	1884	10	9,600.0*	LDS	Valley Floor	5.6	5,630	B
V02826	VST	SPR	IRR	1884	10	9,600.0*	LDS	Valley Floor	5.4	5,590	B
V02827	VST	SPR	IRR	1884	10	9,600.0*	LDS	Valley Floor	5.0	5,610	B

Table B-3
Water Rights within Management Block 3 Senior to SNWA GDP Permits
(Page 2 of 2)

App No.	Status[a]	Source[b]	Manner of Use[c]	Priority Date	Diversion Rate (cfs)	Annual Duty (afa)	Owner of Record	Geographic Location	Distance to Nearest POD[d] (mi)	DEM Elevation[e] (ft amsl)	Management Category[f]
V02828	VST	SPR	IRR	1884	10	9,600.0*	LDS	Valley Floor	5.4	5,590	B
V09665	VST	SPR	IRR	1900	2	0.0*	Andrae, Arthur and Audrae	Valley Floor / Alluvial Fan	12.4	5,600	C
V09666	VST	SPR	IRR	1900	2	0.0*	Andrae, Arthur and Audrae	Valley Floor / Alluvial Fan	12.4	5,600	C
V09667	VST	SPR	IRR	1900	2	0.0*	Andrae, Arthur and Audrae	Valley Floor / Alluvial Fan	12.4	5,600	C
V09668	VST	SPR	IRR	1900	2	0.0*	Andrae, Arthur and Audrae	Valley Floor / Alluvial Fan	11.9	5,590	C
V09669	VST	SPR	IRR	1900	2	0.0*	Andrae, Arthur and Audrae	Valley Floor / Alluvial Fan	11.4	5,570	C
V09670	VST	SPR	IRR	1900	2	0.0*	Andrae, Arthur and Audrae	Valley Floor / Alluvial Fan	11.4	5,570	C
V09671	VST	SPR	IRR	1900	2	0.0*	Andrae, Arthur and Audrae	Valley Floor / Alluvial Fan	10.5	5,610	C
V09672	VST	SPR	IRR	1900	2	0.0*	Andrae, Arthur and Audrae	Valley Floor / Alluvial Fan	11.2	5,560	C
V10086	VST	SPR	STK	1873	0.039[h]	28.28[h]	LDS	Valley Floor	10.9	5,570	C

[a]CER - Certificated, VST - Vested
[b]SPR - Spring, STR - Stream
[c]IRR - Irrigation, STK - Stock watering
[d]Rounded to the nearest tenth of a mile.
[e]Rounded to the nearest 10 ft.
[f]See Section 2.1.2.3 for an explanation of the Management Categories; B - Distance 3 to 10 miles between resource and SNWA GDP POD, C - Distant resource > 10 miles SNWA GDP POD, E - Resource not in hydraulic connection with SNWA GDP POD producing aquifer in which SNWA GDP production wells will be installed.
[g]Acre-ft per season.
[h]Reported number was derived from an analysis documented in Stanka (2017b).
*The reported annual duty is not explicitly documented on the certificate, reserved right, or vested claim, but reported as such by the NDWR Hydrographic Abstract query.

Table B-4
Water Rights within Management Block 4 Senior to SNWA GDP Permits
(Page 1 of 2)

App No.	Status[a]	Source[b]	Manner of Use[c]	Priority Date	Diversion Rate (cfs)	Annual Duty (afa)	Owner of Record	Geographic Location	Distance to Nearest POD[d] (mi)	DEM Elevation[e] (ft amsl)	Management Category[f]
1520	CER	STR	IRR	1901	0.08	32.0*,[g]	Olsen, Casten	Alluvial Fan	33.6	5,970	E
4951	CER	STR	IRR	1918	0.083	25.1[g]	Bundy, Clarence A. & Josephine	Alluvial Fan	34.7	6,080	E
5247	PER	STR	IRR	1918	2	201.6*,[g]	George Eldridge & Son, Inc.	Alluvial Fan	30.4	6,010	E
6632	CER	UG	STK	1922	0.024	17.0*	George Eldridge & Son, Inc.	Alluvial Fan	26.6	6,800	C
8104	CER	STR	STK	1927	0.012	3.7*,[g]	Vogler, Henry Conrad IV	Alluvial Fan	30.2	5,930	E
8542	CER	UG	STK	1928	0.025	17.9*	George Eldridge & Son, Inc.	Valley Floor	24.4	5,620	C
8701	CER	UG	STK	1928	0.012	9.0*	George Eldridge & Son, Inc.	Valley Floor	19.6	5,590	C
9435	CER	UG	STK	1931	0.019	10.3*,[g]	George Eldridge & Son, Inc.	Valley Floor	28.3	5,710	C
10914	PER	STR	IRR	1943	1	300.0	George Eldridge & Son, Inc.	Alluvial Fan	30.1	5,960	E
11354	CER	UG	STK	1945	0.04	26.4*	B Enterprises, Limited Partnership UDI and George L. Gardner & Laree Gardner UDI	Alluvial Fan	31.2	5,840	C
13457	CER	STR	IRR	1950	3.44	613.9[g]	George Eldridge & Son, Inc.	Alluvial Fan	18.4	6,310	E
17723	PER	STR	IRR	1958	4	857.0*	George Eldridge & Son, Inc.	Alluvial Fan	19.9	6,170	E
26430	PER	SPR	IRR	1971	2	1,200.0	George Eldridge & Son, Inc.	Valley Floor	22.0	5,650	C
26655	PER	SPR	IRR	1972	1	724.0	George Eldridge & Son, Inc.	Valley Floor	21.9	5,610	C
26656	PER	SPR	IRR	1972	1	724.0	George Eldridge & Son, Inc.	Valley Floor	22.0	5,640	C
28818	CER	STR	IRR	1965	4.8	243.1	George Eldridge & Son, Inc.	Valley Floor / Alluvial Fan	16.0	5,660	E
39818	PER	UG	IRR	1989	2	1,360.0	George Eldridge & Son, Inc.	Valley Floor	16.8	5,590	C
45675	PER	STR	PWR	1982	8	0.0*	George Eldridge & Son, Inc.	Alluvial Fan	18.4	6,320	E
56050	CER	UG	IRR	1979	0.78	240.0	George Eldridge & Son, Inc.	Valley Floor / Alluvial Fan	15.4	5,600	C
56051	CER	UG	IRR	1989	0.34	144.0	George Eldridge & Son, Inc.	Valley Floor / Alluvial Fan	21.9	5,660	C
V00789	VST	STR	IRR	1875	(-)[h]	(-)[h]	McGill, WM.	Valley Floor	20.4	5,610	E
V01069	VST	STR	STK	NA	0.4	12.0*	BLM	Alluvial Fan	34.9	7,240	E

Table B-4
Water Rights within Management Block 4 Senior to SNWA GDP Permits
(Page 2 of 2)

App No.	Status[a]	Source[b]	Manner of Use[c]	Priority Date	Diversion Rate (cfs)	Annual Duty (afa)	Owner of Record	Geographic Location	Distance to Nearest POD[d] (mi)	DEM Elevation[e] (ft amsl)	Management Category[f]
V01213	VST	STR	IRR	1888	0	1,280.0*	George Eldridge & Son, Inc.	Valley Floor / Alluvial Fan	18.4	5,670	E
V01214	VST	STR	IRR	1888	0	2,000.0*	George Eldridge & Son, Inc.	Alluvial Fan	16.3	5,860	E
V01219	DEC	STR	IRR	1878	7.728	1,804.3	George Eldridge & Son, Inc.	Alluvial Fan	20.5	5,750	E
V01969	VST	STR	IRR	1872	1	300.0*[,g]	George Eldridge & Son, Inc.	Alluvial Fan	30.4	6,010	E

[a]DEC - Decreed, CER - Certificated, PER - Permitted, VST - Vested
[b]SPR - Spring, STR - Stream, UG - Underground
[c]IRR - Irrigation, PWR - Power, STK - Stock watering
[d]Rounded to the nearest tenth of a mile.
[e]Rounded to the nearest 10 ft.
[f]See Section 2.1.2.3 for an explanation of the Management Categories; C - Distant resource > 10 miles, E - Resource not in hydraulic connection with the SNWA GDP POD producing aquifer in which SNWA GDP production wells will be installed.
[g]Acre-ft per season.
[h] No diversion rate or duty as documented in Stanka (2017b)
*The reported annual duty is not explicitly documented on the certificate, permit, or vested claim, but reported as such by the NDWR Hydrographic Abstract query.
NA - Not available.

Table B-5
Water Rights within Management Block 5 Senior to SNWA GDP Permits

App No.	Status[a]	Source[b]	Manner of Use[c]	Priority Date	Diversion Rate (cfs)	Annual Duty (afa)	Owner of Record	Geographic Location	Distance to Nearest POD[d] (mi)	DEM Elevation[e] (ft amsl)	Management Category[f]
1111	CER	SPR	STK	1908	0.025	18.1*	Olsen, Casten	Valley Floor / Alluvial Fan	36.8	5,990	D
3433	CER	STR	IRR	1915	0.726	261.4[g]	Bundy, Clarence A.	Alluvial Fan / Valley Floor	39.4	6,100	E
5571	CER	SPR	STK	1919	0.012	8.6*	Henry Conrad Vogler IV	Alluvial Fan	55.0	7,080	E
11311	CER	UG	STK	1945	0.017	7.1*	Intermountain Ranches, Ltd	Valley Floor / Alluvial Fan	47.7	6,410	D
11314	CER	UG	STK	1945	0.016	6.5*[,g]	Intermountain Ranches, Ltd	Alluvial Fan	44.6	6,290	D
11355	CER	UG	STK	1945	0.004	2.9*	Henriod, Eugene A.	Valley Floor / Alluvial Fan	49.6	6,490	D
V02329	VST	SPR	STK	1899	0.05	20.9*[,g]	Vogler, Henry Conrad IV	Alluvial Fan	48.8	6,510	E

[a]CER - Certificated, VST - Vested
[b]SPR - Spring, STR - Stream, UG - Underground
[c]IRR - Irrigation, STK - Stock watering
[d]Rounded to the nearest tenth of a mile.
[e]Rounded to the nearest 10 ft.
[f]See Section 2.1.2.3 for an explanation of the Management Categories; D - Distant resource > 10 miles, E - Resource not in hydraulic connection with producing aquifer in which SNWA GDP production wells will be installed.
[g]Acre-ft per season.
*The reported annual duty is not explicitly documented on the certificate or vested claim, but reported as such by the NDWR Hydrographic Abstract query.

Table B-6
Water Rights in Northern Hamlin and Southern Snake Valleys, Nevada Senior to SNWA GDP Permits
(Page 1 of 2)

App No.	Status[a]	Source[b]	Manner of Use[c]	Priority Date	Diversion Rate (cfs)	Annual Duty (afa)	Owner of Record	Geographic Location	Distance to Nearest POD[d] (mi)	DEM Elevation[e] (ft amsl)	Management Category[f]
Northern Hamlin Valley											
9981	CER	UG	STK	1936	0.017	6.7*[h]	Ashdown, Sidney	Alluvial Fan	15.1	5,950	D
45495	CER	SPR	STK	1982	0.12	86.8*	Okelberry, Ray	Alluvial Fan	8.1	6,060	D
45497	CER	UG	STK	1982	0.12	86.8*	Okelberry, Ray	Alluvial Fan	7.7	5,730	D
45498	CER	UG	STK	1982	0.12	86.8*	Okelberry, Ray	Valley Floor	10.6	5,760	D
45499	CER	UG	STK	1982	0.12	86.8*	Okelberry, Ray	Alluvial Fan	11.5	5,670	D
45500	CER	UG	STK	1982	0.119	86.1*	Okelberry, Ray	Valley Floor	9.6	5,780	D
R05277	RES	SPR	OTH	1926	0.036[i]	26.32[i]	BLM	Valley Floor	16.8	5,570	D
V02125	VST	SPR	STK	1900	0.025	13.33[i]	Swallow, A.M.	Valley Floor	16.5	5,610	D
V02198	VST	OGW	STK	1899	0.025	10.2*[h]	Swallow, A.M.	Alluvial Fan	8.1	6,060	D
V02199	VST	UG	STK	1899	0.025	10.2*[h]	Swallow, A.M.	Alluvial Fan	7.6	5,730	D
Southern Snake Valley, Nevada											
3723	CER	SPR	STK	1915	0.05	24.2*[h]	Production Credit Corp. of Berkeley	Alluvial Fan	25.8	6,090	D
84145	PER	UG	IRR	1972	1	263.0	Granite Peak Properties LC	Valley Floor	19.0	5,510	D
84146	PER	UG	IRR	1986	1.003	180.0	Granite Peak Properties LC	Valley Floor	19.7	5,510	D
84147	PER	UG	IRR	1986	0.886	159.0	Granite Peak Properties LC	Valley Floor	21.0	5,480	D
84148	PER	UG	IRR	1986	0.55	99.0	Granite Peak Properties LC	Valley Floor	19.4	5,510	D
84149	PER	UG	IRR	1986	0.45	81.0	Granite Peak Properties LC	Valley Floor	20.2	5,500	D
84150	PER	UG	IRR	1986	0.78	141.0	Granite Peak Properties LC	Valley Floor	19.8	5,500	D
84151	PER	UG	IRR	1986	1.67	300.0	Granite Peak Properties LC	Valley Floor	19.9	5,500	D
R05271	RES	SPR	OTH	1926	0.036	26.1*	BLM	Alluvial Fan	18.9	5,560	D
V01650	VST	STR	STK	1919[g]	0	6.7*[h]	Murray Sheep Company	Valley Floor / Alluvial Fan	16.6	5,580	D

Table B-6
Water Rights in Northern Hamlin and Southern Snake Valleys, Nevada Senior to SNWA GDP Permits
(Page 2 of 2)

App No.	Status[a]	Source[b]	Manner of Use[c]	Priority Date	Diversion Rate (cfs)	Annual Duty (afa)	Owner of Record	Geographic Location	Distance to Nearest POD[d] (mi)	DEM Elevation[e] (ft amsl)	Management Category[f]
V01651	VST	STR	IRR	1919[g]	1.555	534.8[*,h]	Smith, Charles	Valley Floor / Alluvial Fan	16.6	5,580	D
V01652	VST	STR	IRR	1919[g]	2.6	251.2[*,h]	Winder, Leo C.	Valley Floor / Alluvial Fan	16.6	5,580	D
V02200	VST	SPR	STK	1900	0.025	9.3[*,h]	Granite Peak Properties, L.C.	Valley Floor	21.2	5,470	D
V04568	VST	UG	STK	1970	0[i]	0[i]	Granite Peak Properties LC or NV LC	Valley Floor	21.1	5,480	D
V09610	VST	STR	IRR	1895	7.6[i]	2,621.4[i]	Baker Ranches, Inc.	Alluvial Fan	23.0	5,470	D
V09745	VST	UG	IRR	1934	0.89	82.0[i]	Granite Peak Properties, L.C.	Valley Floor	21.6	5,470	D
V09746	PER	UG	IRR	1934	1.12	80.0	Granite Peak Properties, L.C.	Valley Floor	20.9	5,480	D
V09747	PER	UG	IRR	1934	0.55	80.0	Granite Peak Properties, L.C.	Valley Floor	20.3	5,540	D
V09748	PER	UG	IRR	1934	2.22	80.0	Granite Peak Properties, L.C.	Valley Floor	21.6	5,470	D

[a]CER - Certificated, PER - Permitted, RES- Reserved, VST - Vested
[b]OGW - Other Groundwater, SPR - Spring, STR - Stream, UG - Underground
[c]IRR - Irrigation, OTH - Other, STK - Stock watering
[d]Rounded to the nearest tenth of a mile. Distance measured from the listed resource to SNWA POD No.54003.
[e]Rounded to the nearest 10ft.
[f]See Section 2.1.2.3 for an explanation of the Management Categories; D - Senior water right in an adjacent hydrographic area.
[g]Filing date, not priority date.
[h]Acre-ft per season.
[i]Reported number was derived from an analysis documented in Stanka (2017b).
*The reported annual duty is not explicitly documented on the certificate, reserved right, or vested claim, but reported as such by the NDWR Hydrographic Abstract query.

Table B-7
Water Rights in Southern Snake Valley, Utah Senior to SNWA GDP Permits
(Page 1 of 2)

App No.	Chexnum[a]	Status[b]	Source[c]	Manner of Use[d]	Priority Date	Diversion Rate (cfs)	Duty (af)	Owner of Record	Geographic Location	Distance to Nearest POD[e] (mi)	DEM Elevation[f] (ft amsl)	Management Category[g]
18-203		P	UG	S	1958	0.015	0.0	USA Bureau of Land Management	Alluvial Fan	26.4	5,580	D
18-219		P	UG	IS	1961	0	742.8	Davies Ranch Incorporated	Alluvial Fan	26.3	5,420	D
18-219	a33632	A	UG	IS	2007	0	742.8	Davies Ranch Incorporated	Valley Floor	26.3	5,420	D
18-219	a33632	A	UG	IS	2007	0	742.8	Davies Ranch Incorporated	Alluvial Fan	26.4	5,420	D
18-244		P	Surface	DIS	1895	0	2,588.0	Baker Ranches Inc.	Alluvial Fan	31.2	5,380	D
18-245		P	Spring	DIS	1881	0.562	0.0	Baker Ranches, Inc.	Alluvial Fan	30.0	5,440	D
18-262		P	UG	DIS	1930	0.011	0.0	Davies Ranch Inc.	Valley Floor	26.5	5,410	D
18-393		P	Surface	I	1895	0	12.9	B & E Ranches Incorporated	Alluvial Fan	31.2	5,380	D
18-461		P	UG	IS	1981	3	0.0	Carl J. Dearden	Valley Floor	25.4	5,430	D
18-497		P	UG	OS	1983	0.025	11.8	USA Bureau of Land Management	Alluvial Fan	26.2	5,420	D
18-497	a17864	A	UG	OS	2016	0.025	11.8	USA Bureau of Land Management	Alluvial Fan	26.2	5,420	D
18-571		P	Spring	OS	1903	0.013	0.0	Richfield District USA BLM	Alluvial Fan	23.4	5,450	D
18-620		P	Point to Point	OS	1903	0.02	0.0	USA Bureau of Land Management	Valley Floor	31.6	5,310	D
18-621		P	Point to Point	OS	1903	0.02	0.0	USA Bureau of Land Management	Valley Floor	30.6	5,580	D
18-621		P	Point to Point	OS	1903	0.02	0.0	USA Bureau of Land Management	Valley Floor	30.0	5,370	D
18-630		P	UG	DS	1992	0	1.4	Kenneth C. Knudson	Valley Floor	23.0	5,460	D
18-645		A	Spring	IS	1995	2	0.0	Dearden Land and Livestock	Valley Floor	27.6	5,400	D
18-647		P	UG	I	2004	0	641.4	Kenneth C. Knudson	Valley Floor	23.0	5,450	D
18-667		P	UG	I	2001	2	400.0	Kenneth C. Knudson	Valley Floor	23.0	5,450	D

Table B-7
Water Rights in Southern Snake Valley, Utah Senior to SNWA GDP Permits
(Page 2 of 2)

App No.	Chexnum[a]	Status[b]	Source[c]	Manner of Use[d]	Priority Date	Diversion Rate (cfs)	Duty (af)	Owner of Record	Geographic Location	Distance to Nearest POD[e] (mi)	DEM Elevation[f] (ft amsl)	Management Category[g]
18-673		A	UG	OS	2002	0.026	19.1	USA Bureau of Land Management	Alluvial Fan	24.0	5,710	D
18-678		P	UG	S	2002	0.018	13.0	USA Bureau of Land Management	Alluvial Fan	24.4	5,500	D
18-680		P	UG	S	2003	0.004	0.0	State of Utah School & Institutional Trust Land Admin	Alluvial Fan	24.0	5,710	D
18-684		P	Spring	DIS	1881	30	0.0	Second Big Springs Irrigation Company	Valley Floor	23.3	5,440	D
18-708		P	Surface	IS	1895	0	1,710.7	Baker Ranches Inc.	Alluvial Fan	31.2	5,380	D
18-715		A	UG	OS	2007	0.018	6.9	USA Bureau of Land Management	Alluvial Fan	29.0	5,410	D
18-721		A	UG	I	2008	0	400.0	Carter's Cattle	Valley Floor	27.3	5,400	D
18-721	a40465	A	UG	DIS	2015	0	400.0	Carter's Cattle	Valley Floor	27.5	5,410	D
18-721	a40465	A	UG	DIS	2015	0	400.0	Carter's Cattle	Valley Floor	27.1	5,410	D
18-721	a40465	A	UG	DIS	2015	0	400.0	Carter's Cattle	Valley Floor	27.3	5,400	D
18-721	a40465	A	UG	DIS	2015	0	400.0	Carter's Cattle	Valley Floor	27.3	5,400	D
18-727		A	UG	OS	2009	0.044	23.5	Department of Interior Bureau of Land Management	Alluvial Fan	29.4	5,790	D

[a]Change or Exchange Number
[b]P - Perfected: proof filed, right certificated; A - Approved
[c]UG - Underground, Point to Point - Point to point diversions are not developed points of diversion. The reference is to a stream segment from which stock may drink. See https://www.waterrights.utah.gov/gisinfo/wrpod.htm for more detail.
[d]D - Domestic, I - Irrigation, O - Other, S - Stock watering
[e]Rounded to the nearest tenth of a mile. Distances measured from listed resource to SNWA POD No. 54003.
[f]Rounded to the nearest 10 ft.
[g]See Section 2.1.2.3 for an explanation of the Management Categories; D - Senior water right in adjacent hydrographic area.

Table B-8
Domestic Water Wells
(Page 1 of 2)

Well Log No.	Construction End Date	Hole Depth (ft)	Cased To (ft)	Static Water Level (ft bls)[a]	Geographic Location	Distance to Nearest POD[b] (mi)	DEM Elevation[c] (ft amsl)	Management Category[d]
Spring Valley (HA 184)								
Management Block 2								
1452	08/28/1950	317	187	6	Valley Floor	8.0	5,580	B
3207	10/05/1955	45	45	15	Mountain Block / Alluvial Fan	4.6	6,530	B
10216	08/10/1968	452	452	102	Alluvial Fan	2.9	6,150	A
16633	06/04/1977	294	294	250	Alluvial Fan	0.7	5,890	A
21278	06/18/1980	120	120	25	Valley Floor	1.5	5,720	A
76375	06/29/1999	168	168	24	Mountain Block / Alluvial Fan	3.3	6,600	B
76376	06/29/1999	265	265	167	Mountain Block / Alluvial Fan	3.6	6,810	B
81770	09/07/2000	123	123	39	Mountain Block / Alluvial Fan	3.6	6,620	B
98402	11/10/2005	203	203	102	Mountain Block / Alluvial Fan	4.4	6,950	B
100565	06/16/2006	215	215	58	Alluvial Fan	2.5	5,790	A
101457	09/11/2006	190	190	10	Valley Floor	0.8	5,720	A
107076	08/28/2008	320	320	86	Mountain Block / Alluvial Fan	4.3	6,960	B
Management Block 3								
12584	08/26/1972	100	100	Flowing	Alluvial Fan	10.2	5,710	C
63014	06/03/1996	125	125	21	Valley Floor	11.6	5,620	C
94786	06/21/2004	120	120	Flowing	Alluvial Fan	10.2	5,710	C

Table B-8
Domestic Water Wells
(Page 2 of 2)

Well Log No.	Construction End Date	Hole Depth (ft)	Cased To (ft)	Static Water Level (ft bls)[a]	Geographic Location	Distance to Nearest POD[b] (mi)	DEM Elevation[c] (ft amsl)	Management Category[d]
Management Block 4								
20404	09/25/1979	111	108	Flowing	Valley Floor	21.8	5,660	C
108832	09/04/2009	420	420	315	Alluvial Fan	30.1	5,960	C
Management Block 5								
114077	06/15/2011	220	220	25	Valley Floor	46.1	6,360	C
Snake Valley (HA 195)								
67360	04/27/1997	400	400	28	Valley Floor	21.3	5,470	D
67897	06/02/1997	120	120	52	Alluvial Fan	26.7	6,270	D

[a]Static water level at the time of drilling.
[b]Rounded to the nearest tenth of a mile.
[c]Rounded to the nearest ten feet.
[d]See Section 2.1.2.3 for an explanation of the Management Categories; A - Senior water right < 3 miles from the closest SNWA GDP POD, B - Senior water right 3 to 10 miles from the closest SNWA GDP POD, C - Distant senior water right >10 miles from SNWA GDP POD, and is within the same basin, D - Senior water right site located in a hydrographic area adjacent to SNWA GDP basins,

Appendix C

Hydrographs and Triggers for Selected Monitor Wells and Springs

Table C-1
Triggers for Spring Valley Sentinel and Select Monitor Wells
(Page 1 of 2)

Well	Type	Spring Valley Block # or Basin
SPR7029M	Sentinel Monitor Well	Spring Valley Block 3
SPR7029M2	Sentinel Monitor Well	Spring Valley Block 3
SPR7030M	Sentinel Monitor Well	Spring Valley Block 3
SPR7030M2	Sentinel Monitor Well	Spring Valley Block 3
383351114180201	Select Monitor Well	Spring Valley Block 1
383704114225001	Select Monitor Well	Spring Valley Block 1
384039114232701[a]	Select Monitor Well	Spring Valley Block 1
384310114261401	Select Monitor Well	Spring Valley Block 1
384745114224401	Select Monitor Well	Spring Valley Block 1
384831114314301	Select Monitor Well	Spring Valley Block 1
385636114265501	Select Monitor Well	Spring Valley Block 1
184 N12 E66 21CD 1	Select Monitor Well	Spring Valley Block 1
184W502M	Select Monitor Well	Spring Valley Block 1
184W504M	Select Monitor Well	Spring Valley Block 1
184W506M	Select Monitor Well	Spring Valley Block 1
184W508M	Select Monitor Well	Spring Valley Block 1
SPR7007M	Select Monitor Well	Spring Valley Block 1
SPR7007X	Select Monitor Well	Spring Valley Block 1
SPR7007Z	Select Monitor Well	Spring Valley Block 1
SPR7011Z	Select Monitor Well	Spring Valley Block 1
SPR7014Z	Select Monitor Well	Spring Valley Block 1
SPR7024M2	Select Monitor Well	Spring Valley Block 1

[a]Well removed from program previously.

Note: Planned Sentinel Monitor Wells that have not been constructed yet will be included after construction and data are available. These wells are: HAM1007M, HAM1008M, SPR7009M, and SPR7010M.

Table C-1
Triggers for Spring Valley Sentinel and Select Monitor Wells
(Page 2 of 2)

Well	Type	Spring Valley Block # or Basin
390352114305401	Select Monitor Well	Spring Valley Block 2
391224114293601[a]	Select Monitor Well	Spring Valley Block 2
Bastian South	Select Monitor Well	Spring Valley Block 2
SPR7005M	Select Monitor Well	Spring Valley Block 2
SPR7006M	Select Monitor Well	Spring Valley Block 2
SPR7008M	Select Monitor Well	Spring Valley Block 2
SPR7012Z	Select Monitor Well	Spring Valley Block 2
SPR7016Z	Select Monitor Well	Spring Valley Block 2
SPR7018Z	Select Monitor Well	Spring Valley Block 2
SPR7019Z	Select Monitor Well	Spring Valley Block 2
SPR7015Z	Select Monitor Well	Spring Valley Block 3
SPR7031Z	Select Monitor Well	Spring Valley Block 3
184 N20 E66 13AB 1	Select Monitor Well	Spring Valley Block 4
392703114230501	Select Monitor Well	Spring Valley Block 4
393442114231801	Select Monitor Well	Spring Valley Block 4
Robison Crooked Well	Select Monitor Well	Spring Valley Block 4
SPR7021Z	Select Monitor Well	Spring Valley Block 4
SPR7020Z	Select Monitor Well	Spring Valley Block 5
SPR7022Z	Select Monitor Well	Spring Valley Block 5
383023114115302	Select Monitor Well	Hamlin Valley
383325114134901	Select Monitor Well	Hamlin Valley
383533114102901[a]	Select Monitor Well	Hamlin Valley
384112114091101	Select Monitor Well	Hamlin Valley
384227114082701	Select Monitor Well	Snake Valley
Cleveland Ranch South Spring - 1848501	Select Spring	Spring Valley Block 3

[a]Well removed from program previously.

Note: Planned Sentinel Monitor Wells that have not been constructed yet will be included after construction and data are available. These wells are: HAM1007M, HAM1008M, SPR7009M, and SPR7010M.

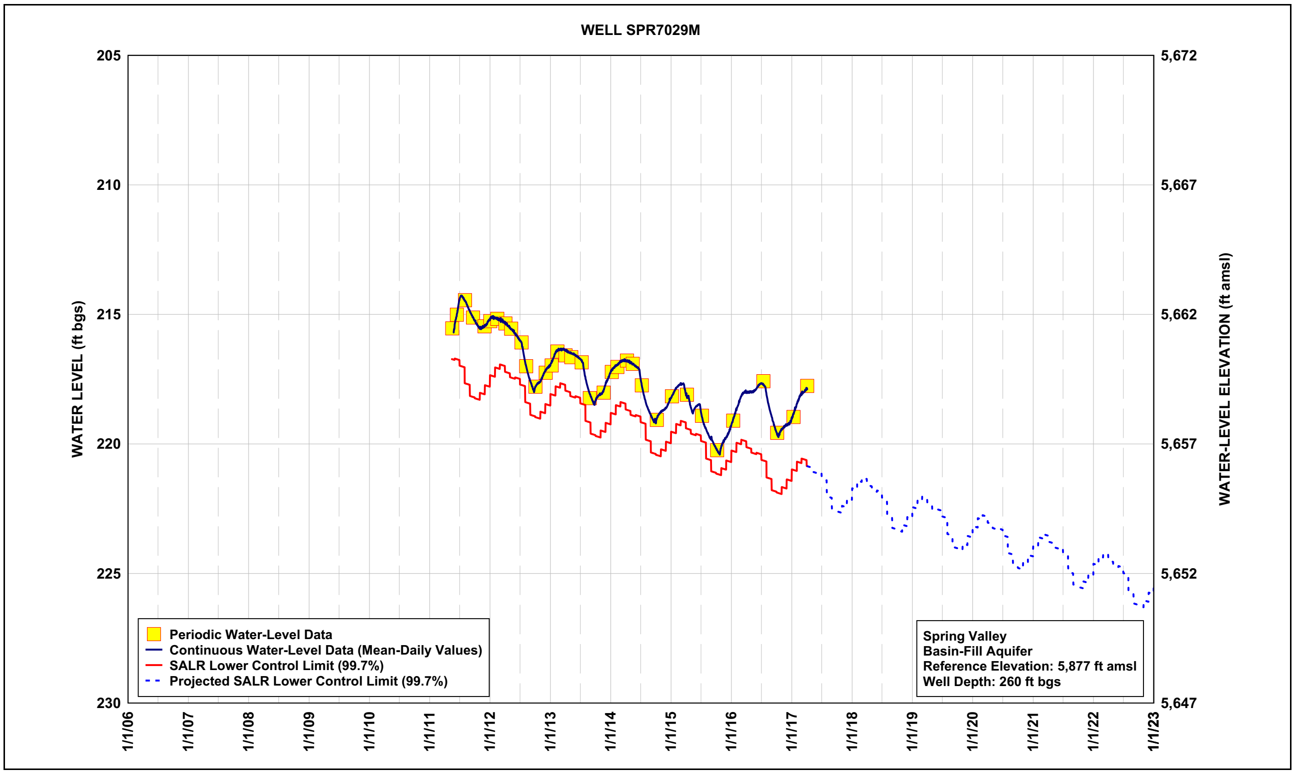

Figure C-1
Trigger, SPR7029M, Spring Valley Block 3

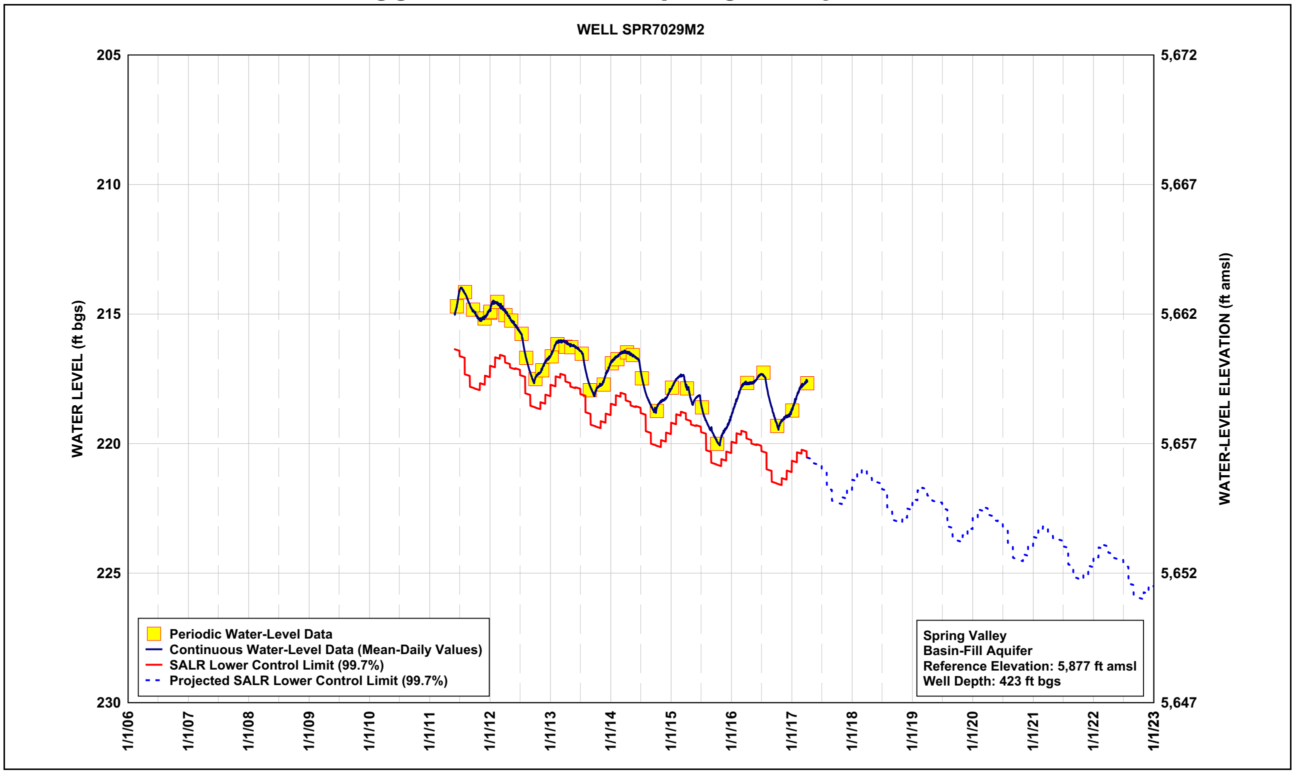

Figure C-2
Trigger, SPR7029M2, Spring Valley Block 3

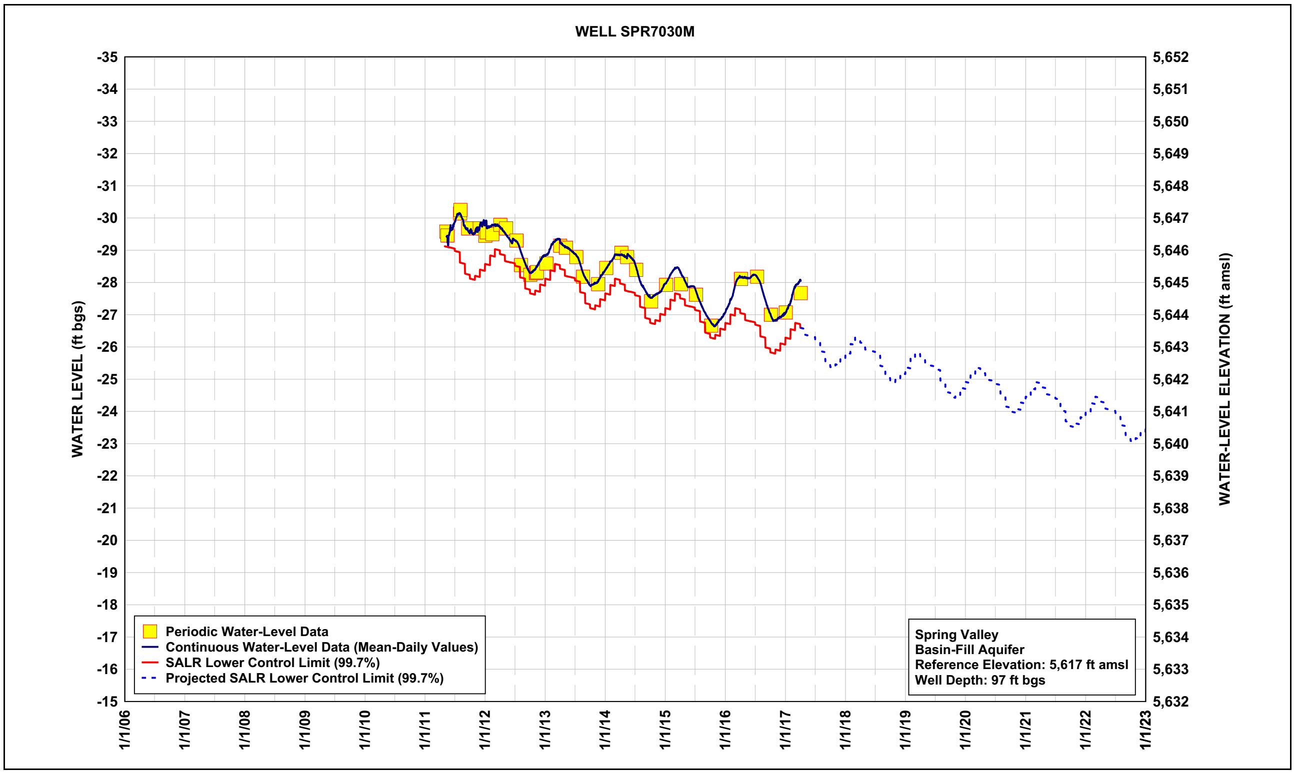

Figure C-3
Trigger, SPR7030M, Spring Valley Block 3

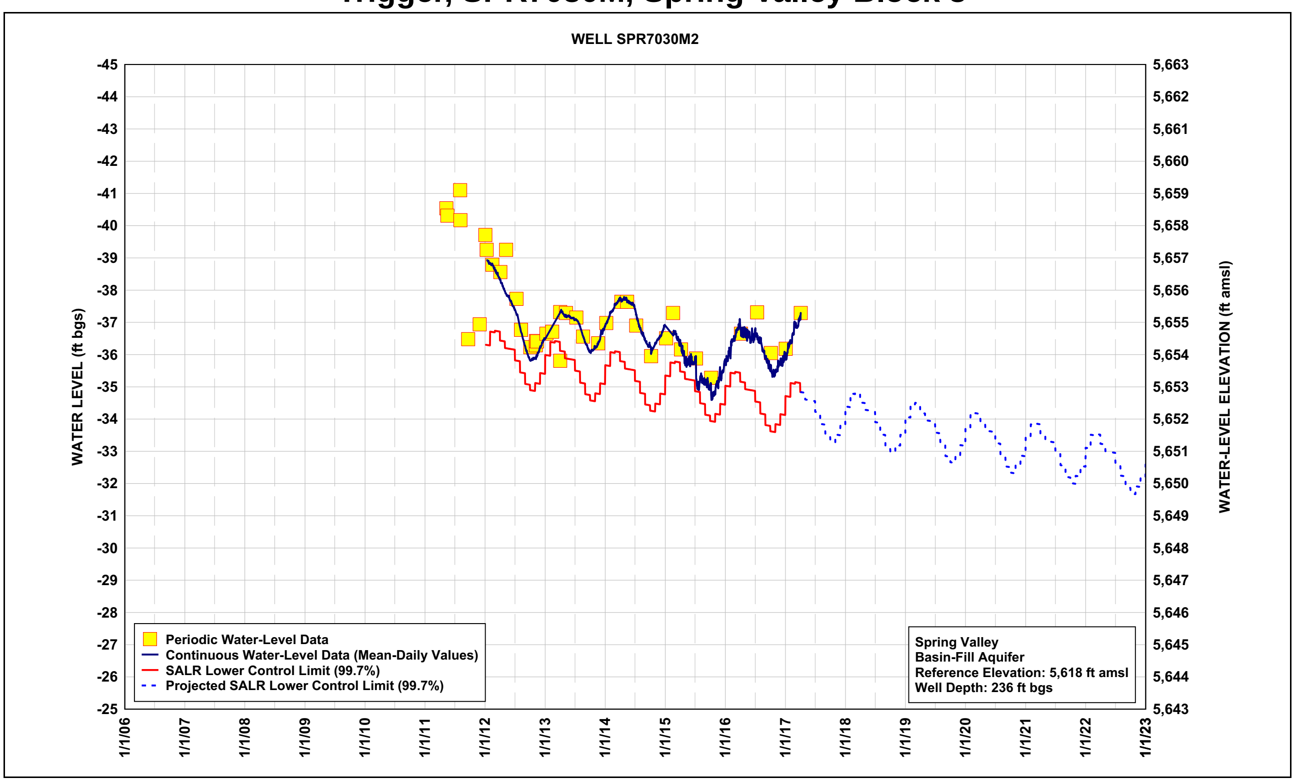

Figure C-4
Trigger, SPR7030M2, Spring Valley Block 3

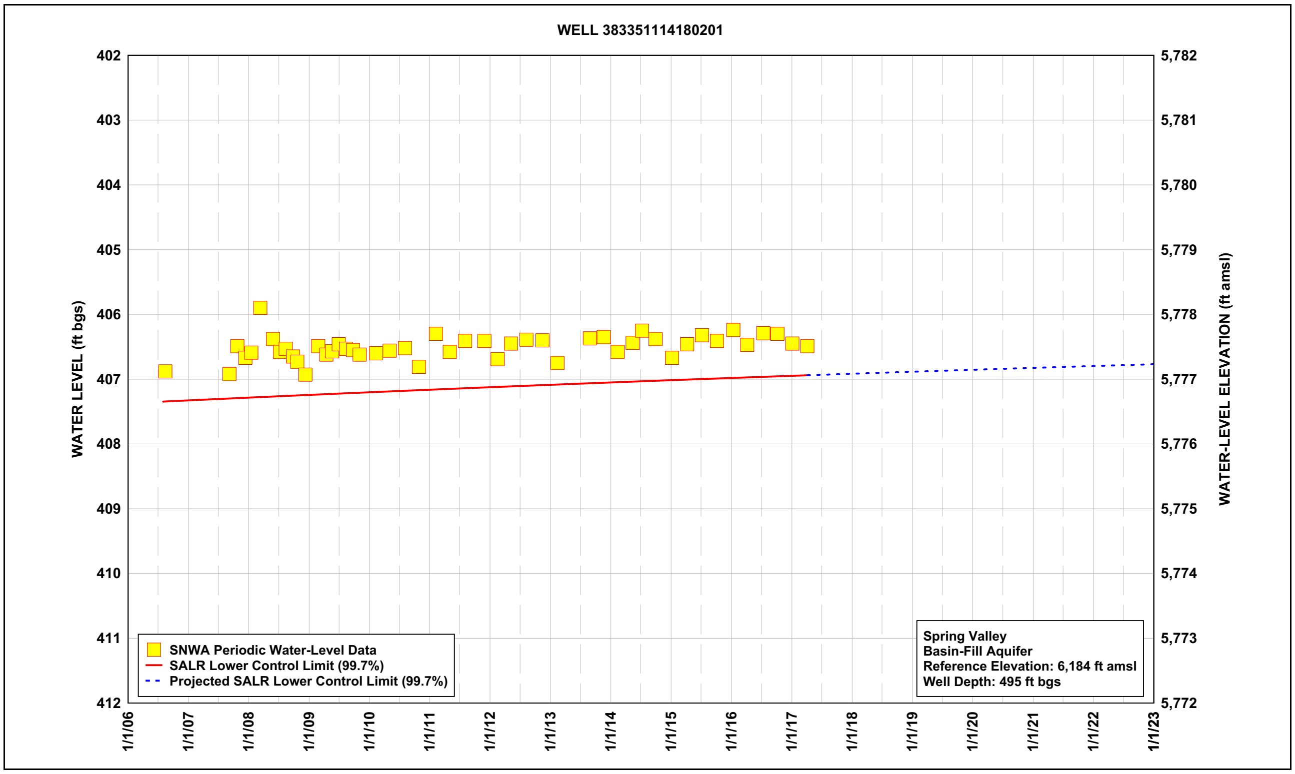

Figure C-5
Trigger, Well 383351114180201, Spring Valley Block 1

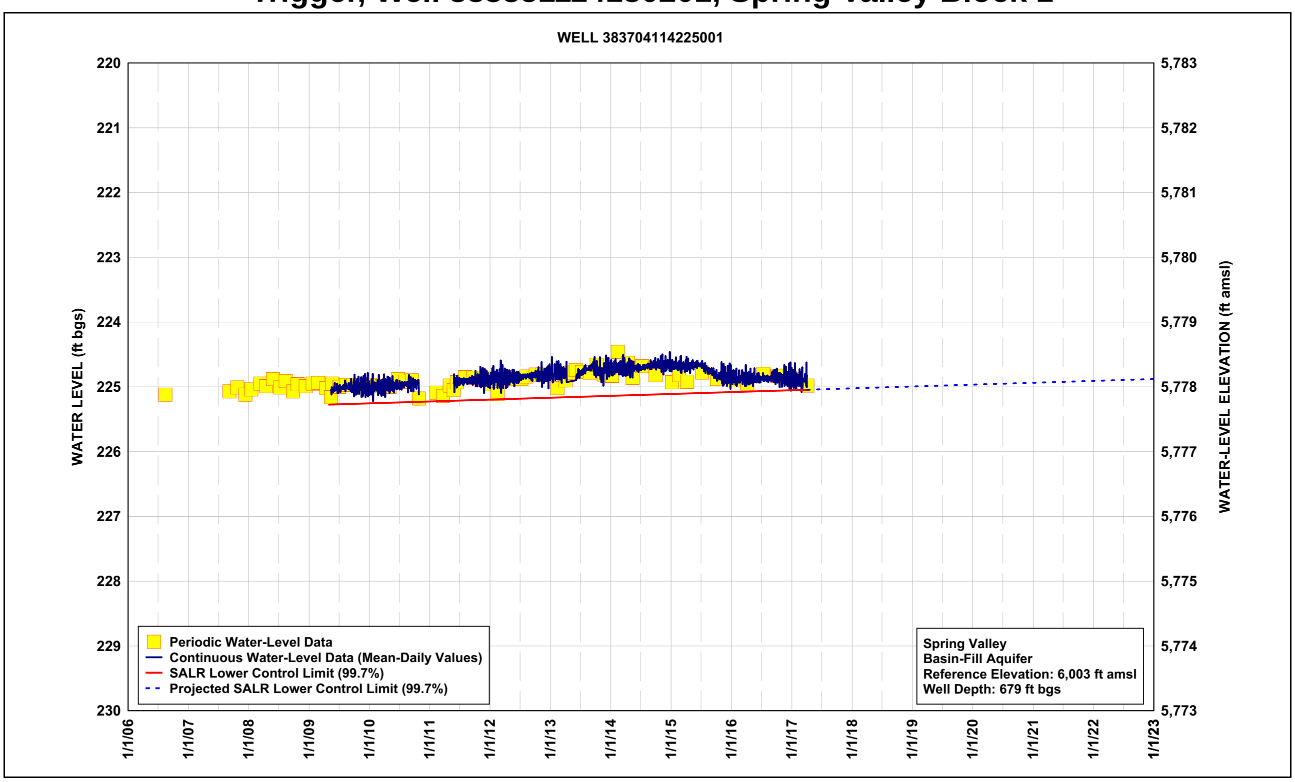

Figure C-6
Trigger, Well 383704114225001, Spring Valley Block 1

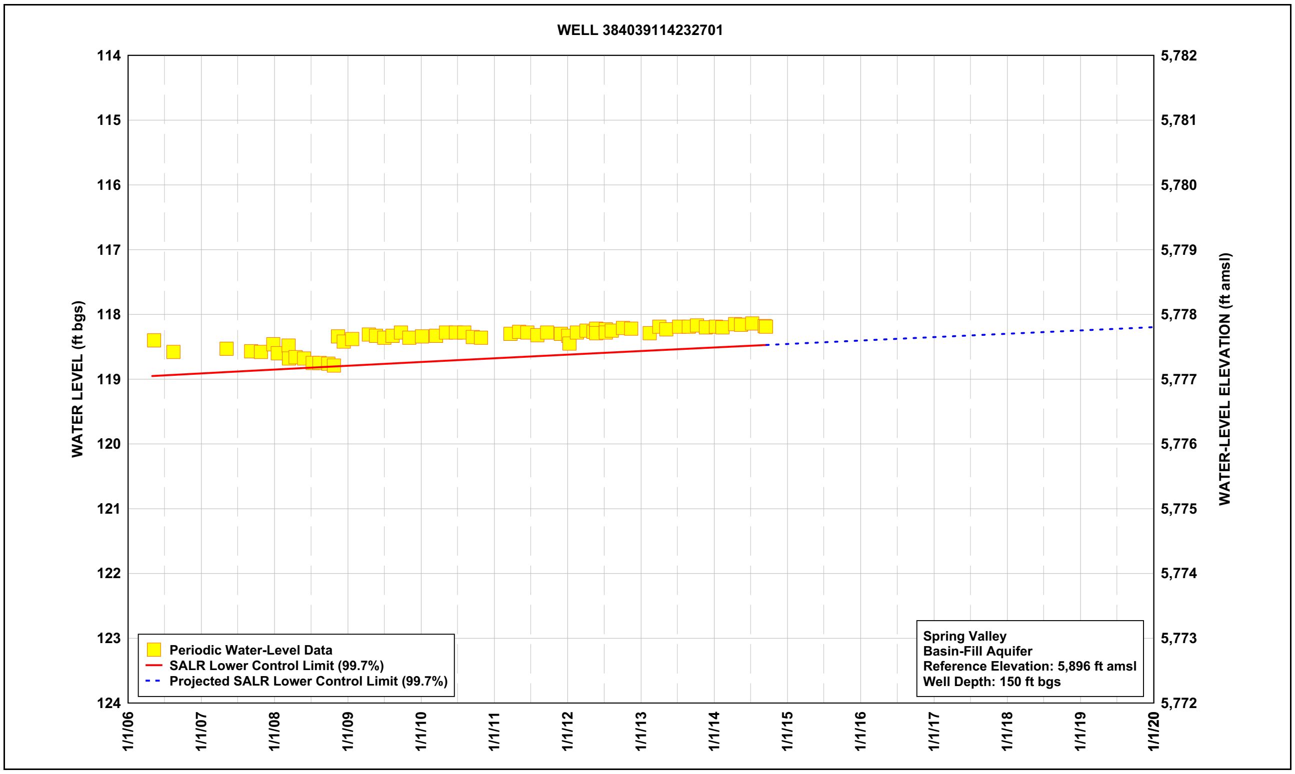

Figure C-7
Trigger, Well 384039114232701, Spring Valley Block 1

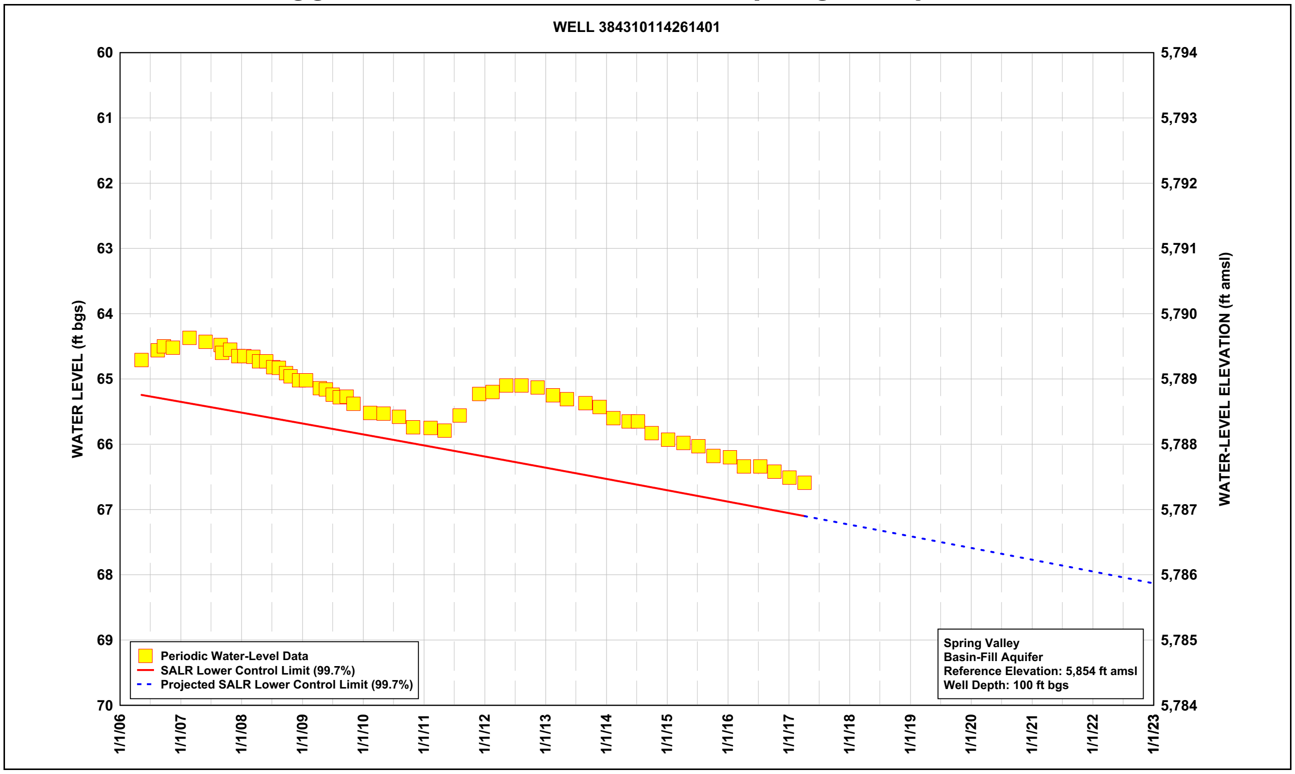

Figure C-8
Trigger, Well 384310114261401, Spring Valley Block 1

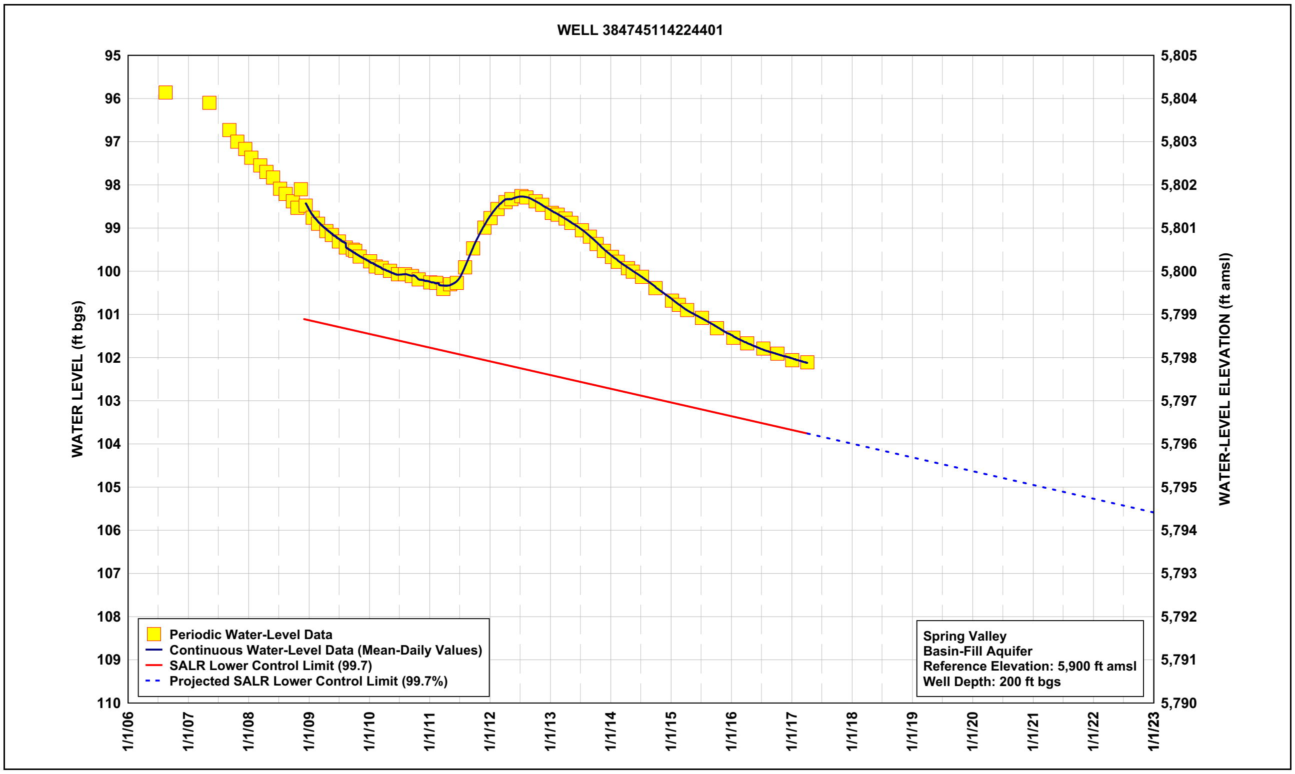

Figure C-9
Trigger, Well 384745114224401, Spring Valley Block 1

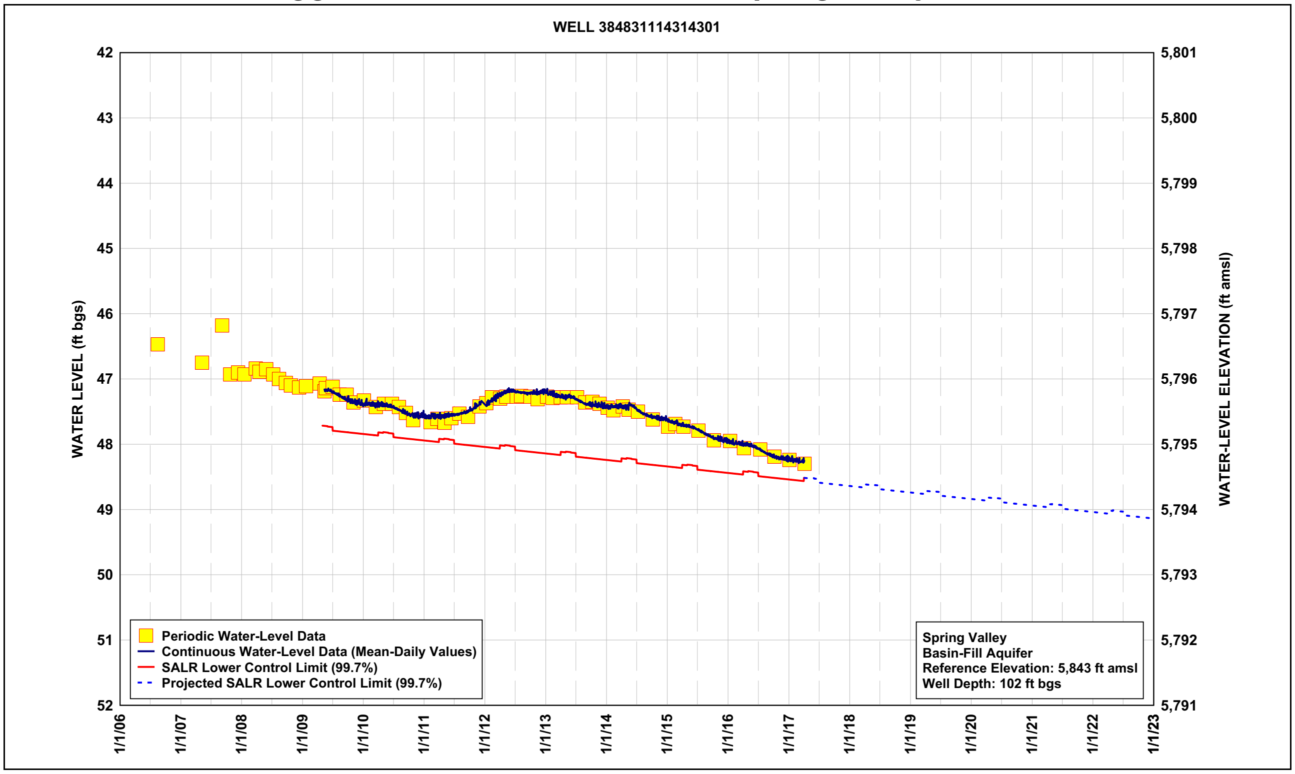

Figure C-10
Trigger, Well 384831114314301, Spring Valley Block 1

Figure C-11
Trigger, Well 385636114265501, Spring Valley Block 1

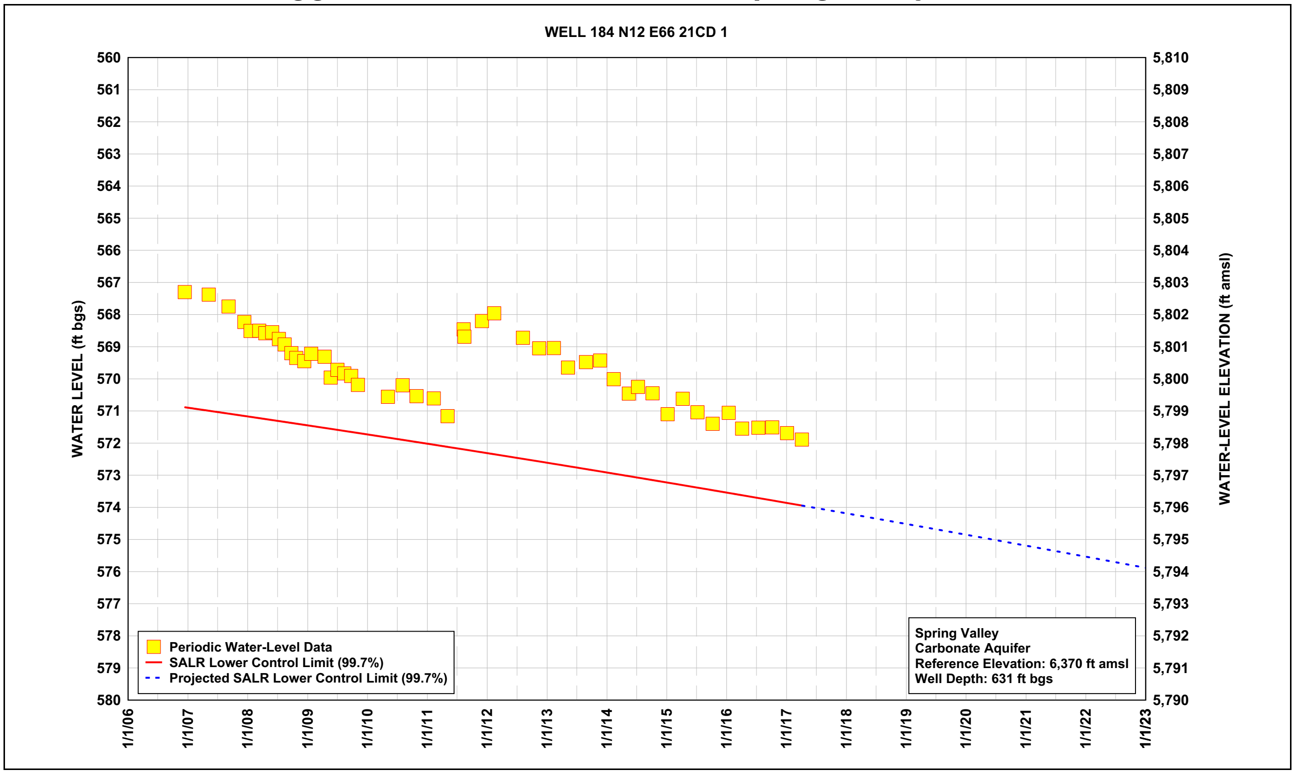

Figure C-12
Trigger, Well 184 N12 E66 21CD 1, Spring Valley Block 1

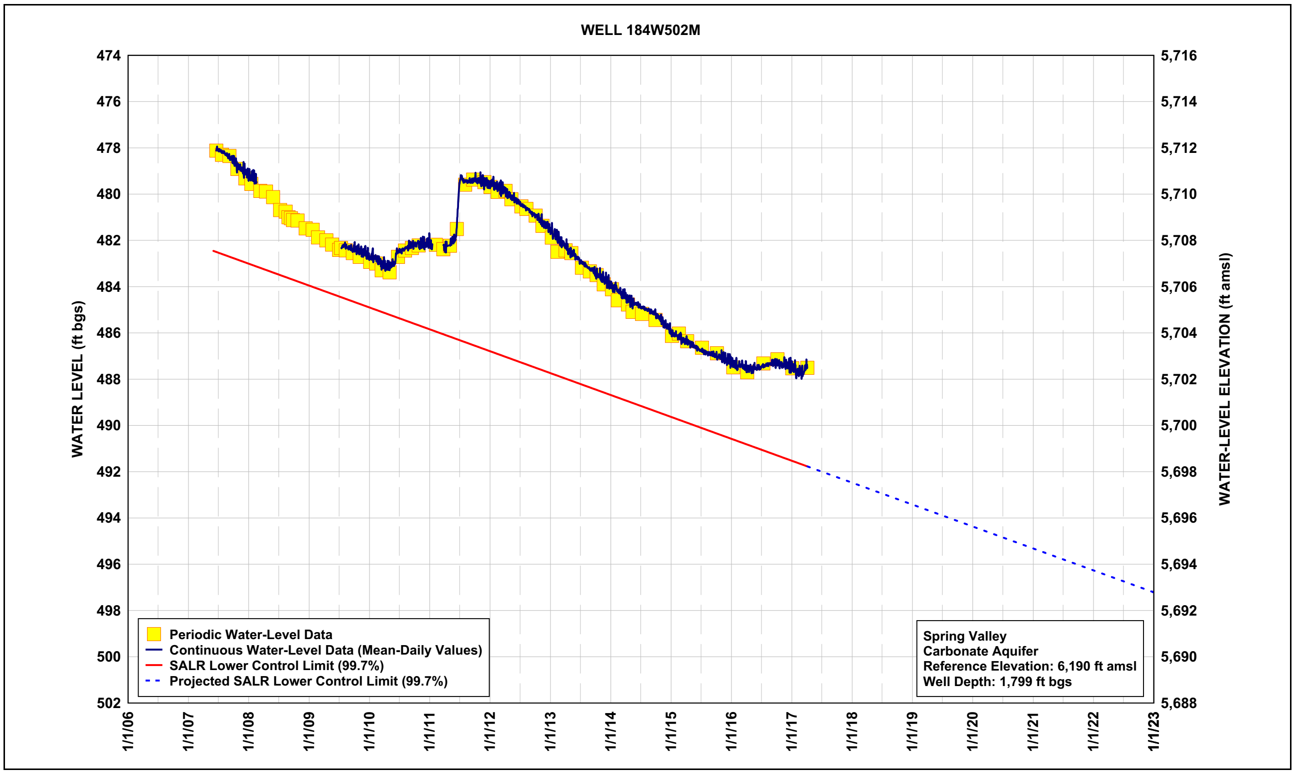

Figure C-13
Trigger, Well 184W502M, Spring Valley Block 1

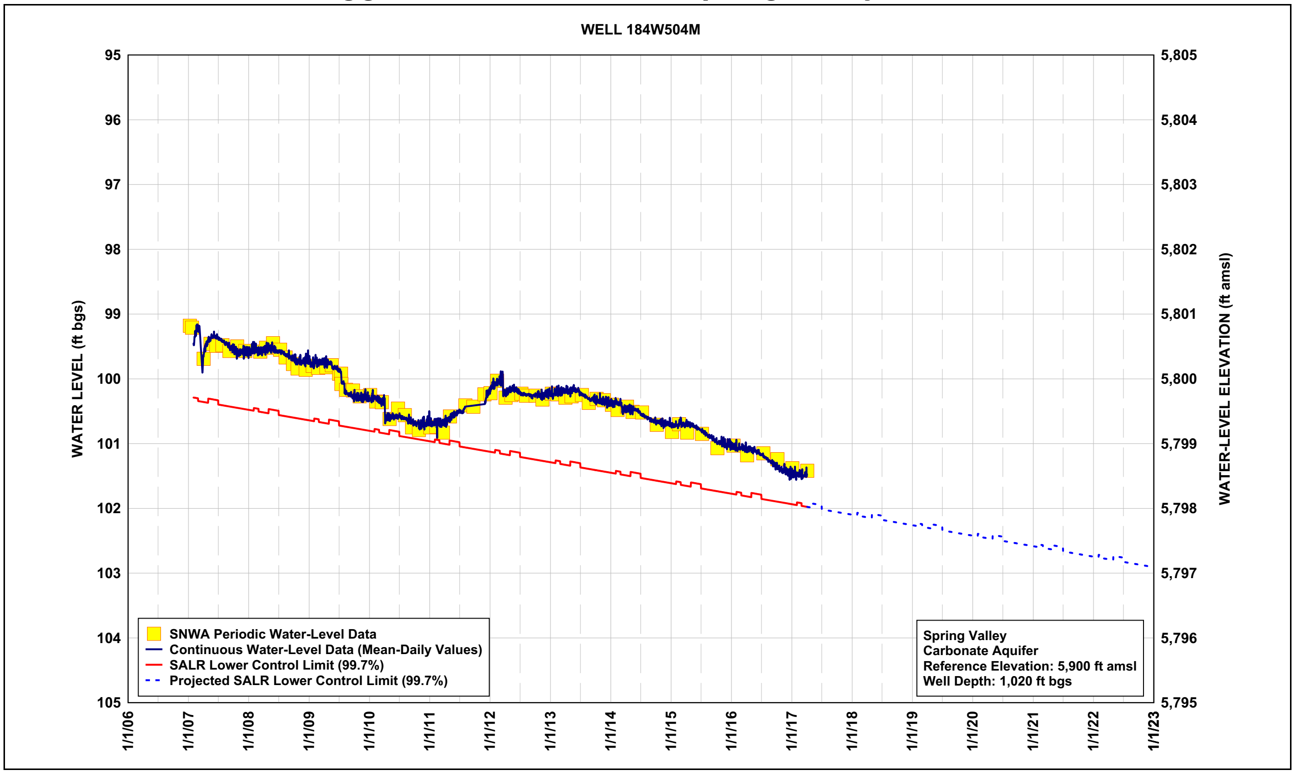

Figure C-14
Trigger, Well 184W504M, Spring Valley Block 1

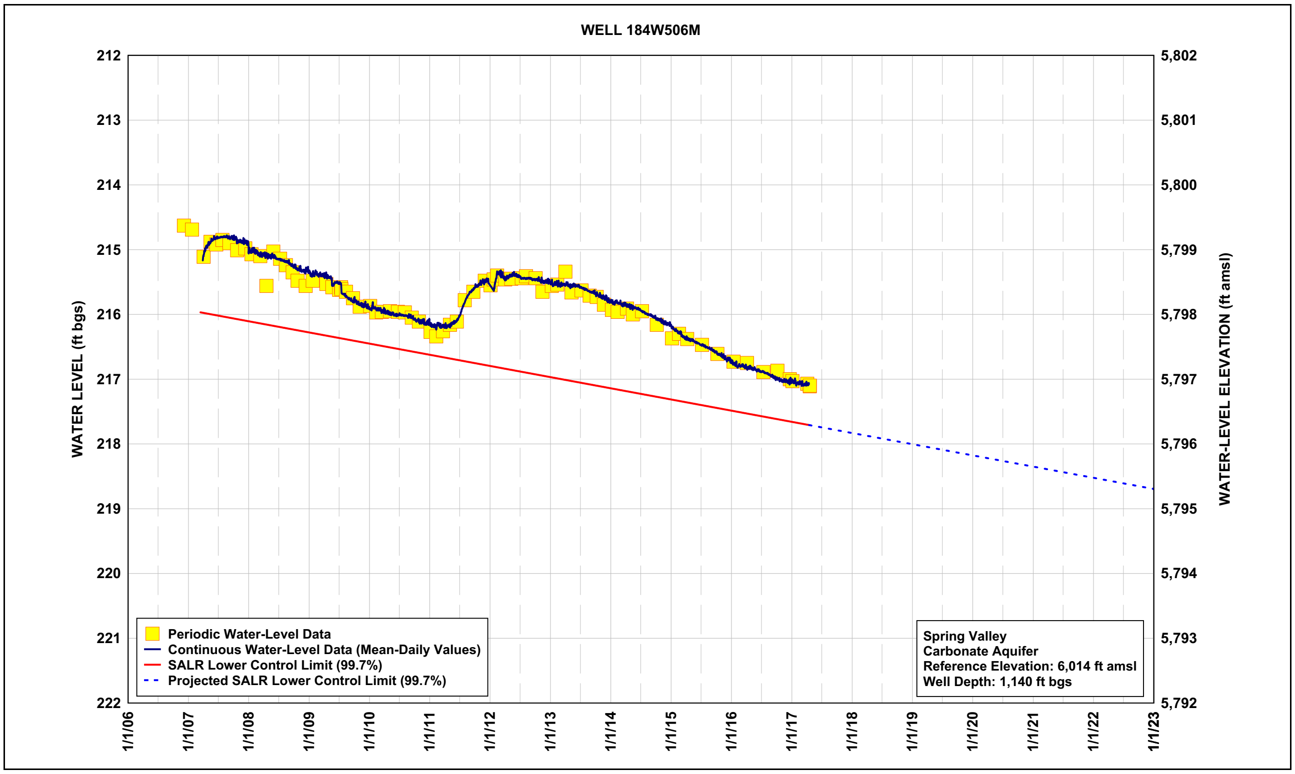

Figure C-15
Trigger, Well 184W506M, Spring Valley Block 1

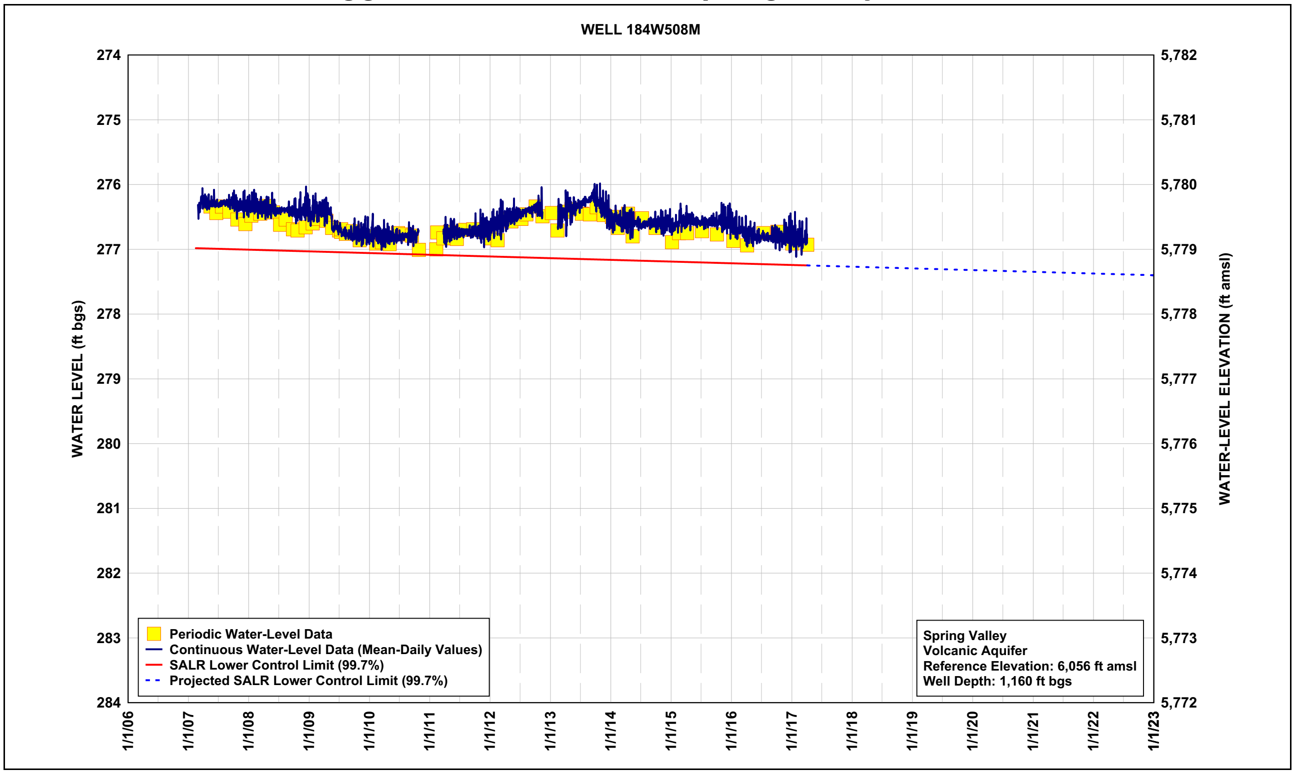

Figure C-16
Trigger, Well 184W508M, Spring Valley Block 1

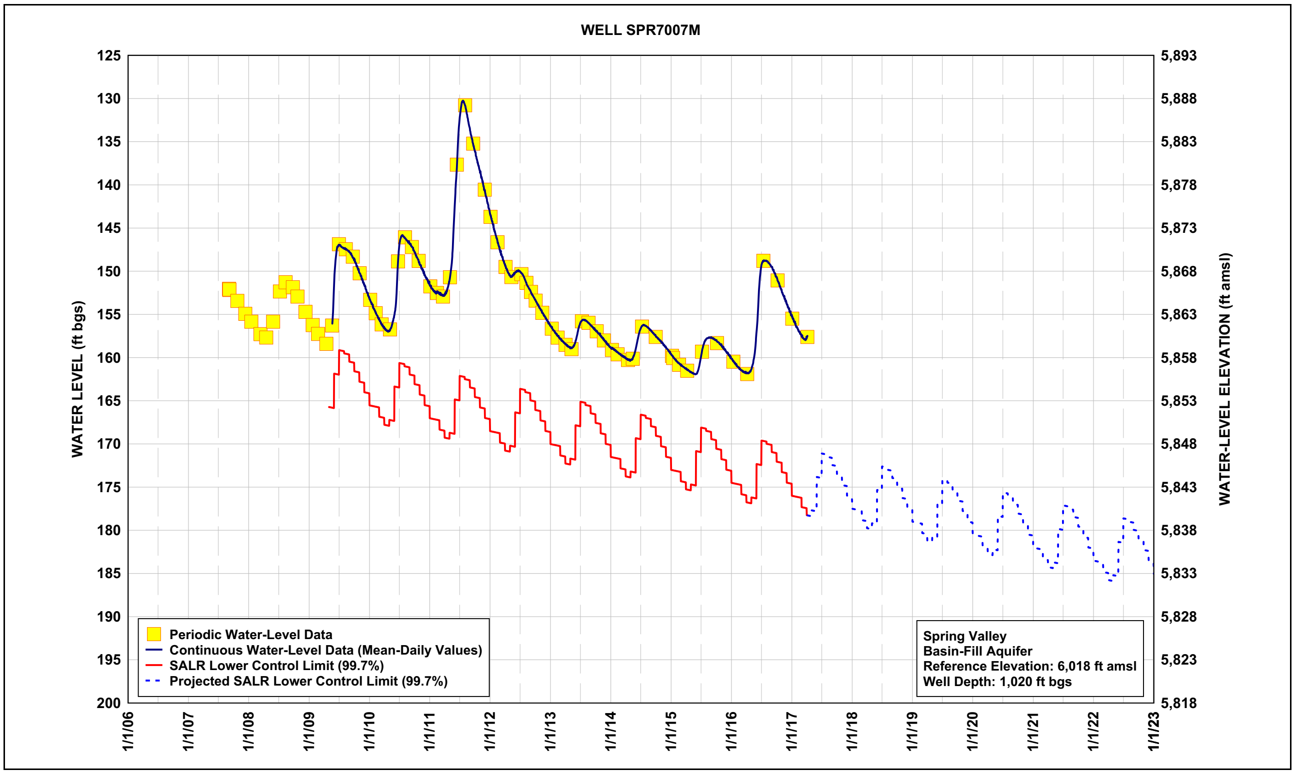

Figure C-17
Trigger, Well SPR7007M, Spring Valley Block 1

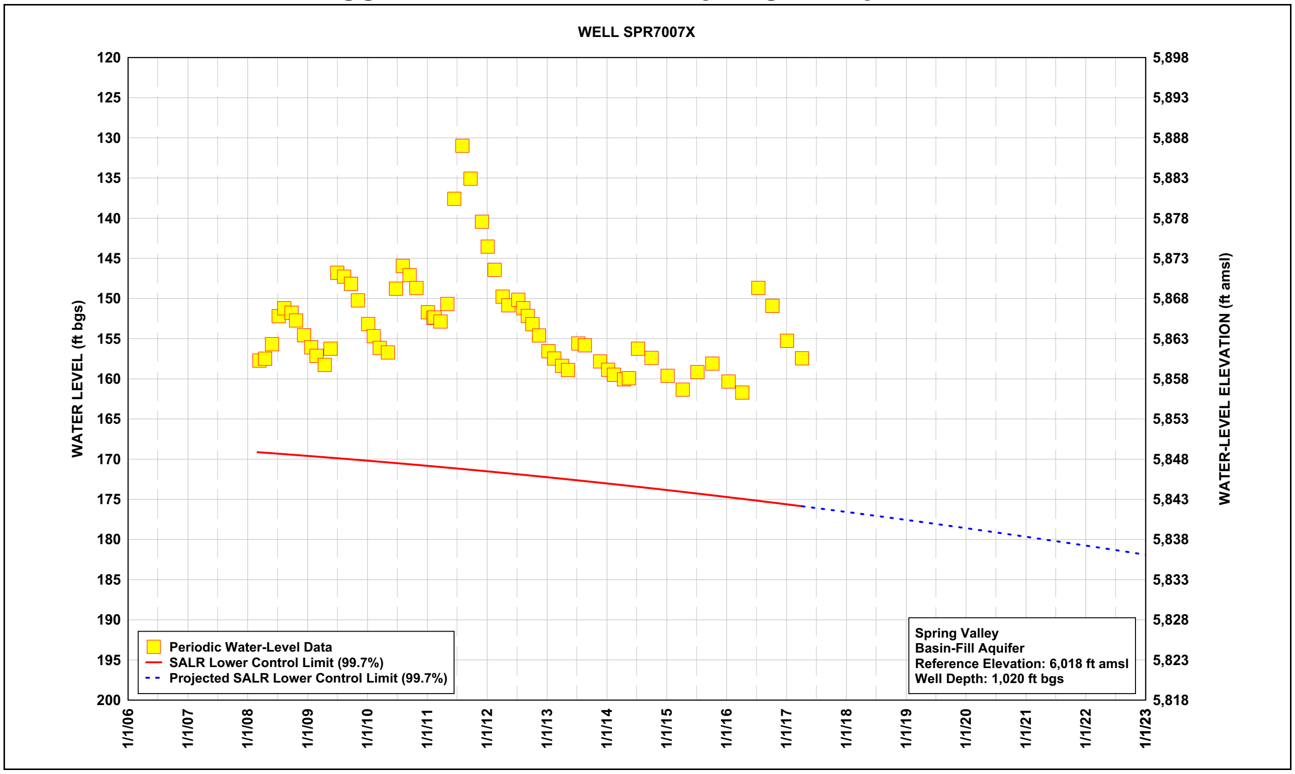

Figure C-18
Trigger, Well SPR7007X, Spring Valley Block 1

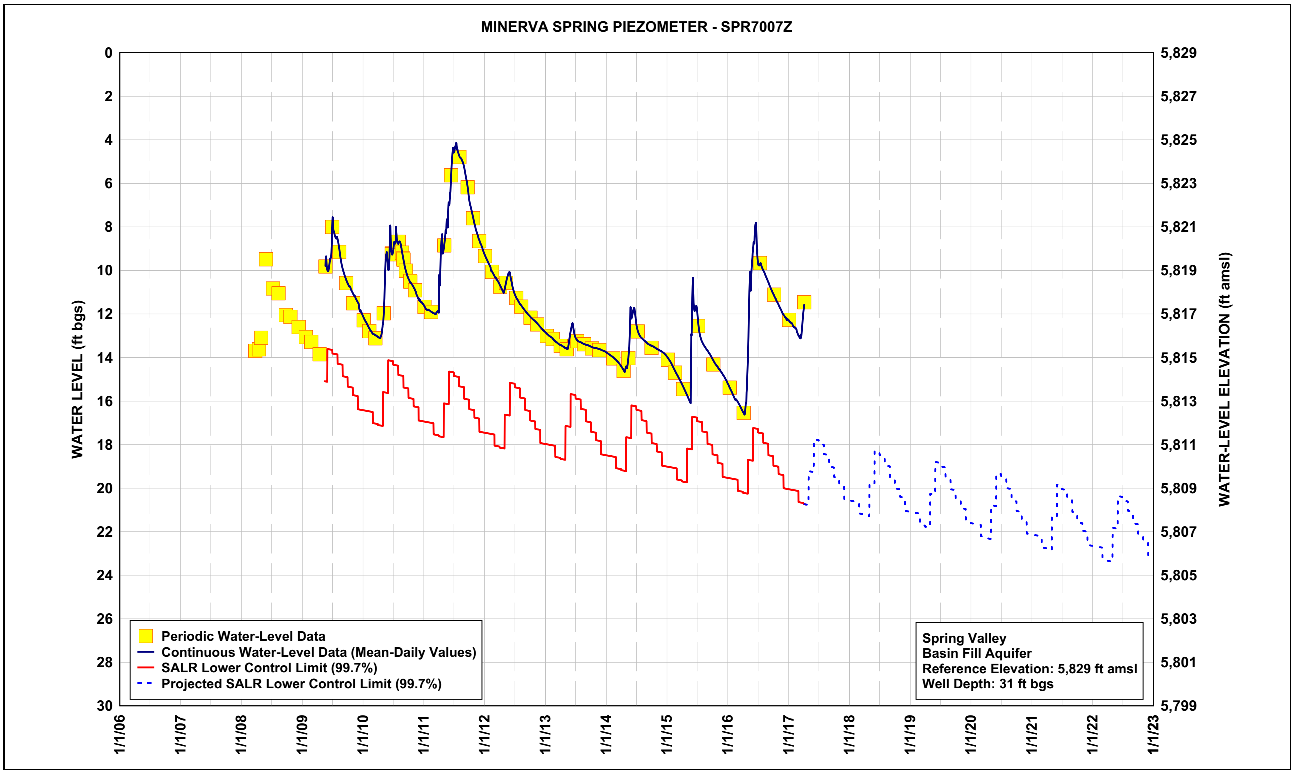

Figure C-19
Trigger, Well SPR7007Z, Spring Valley Block 1

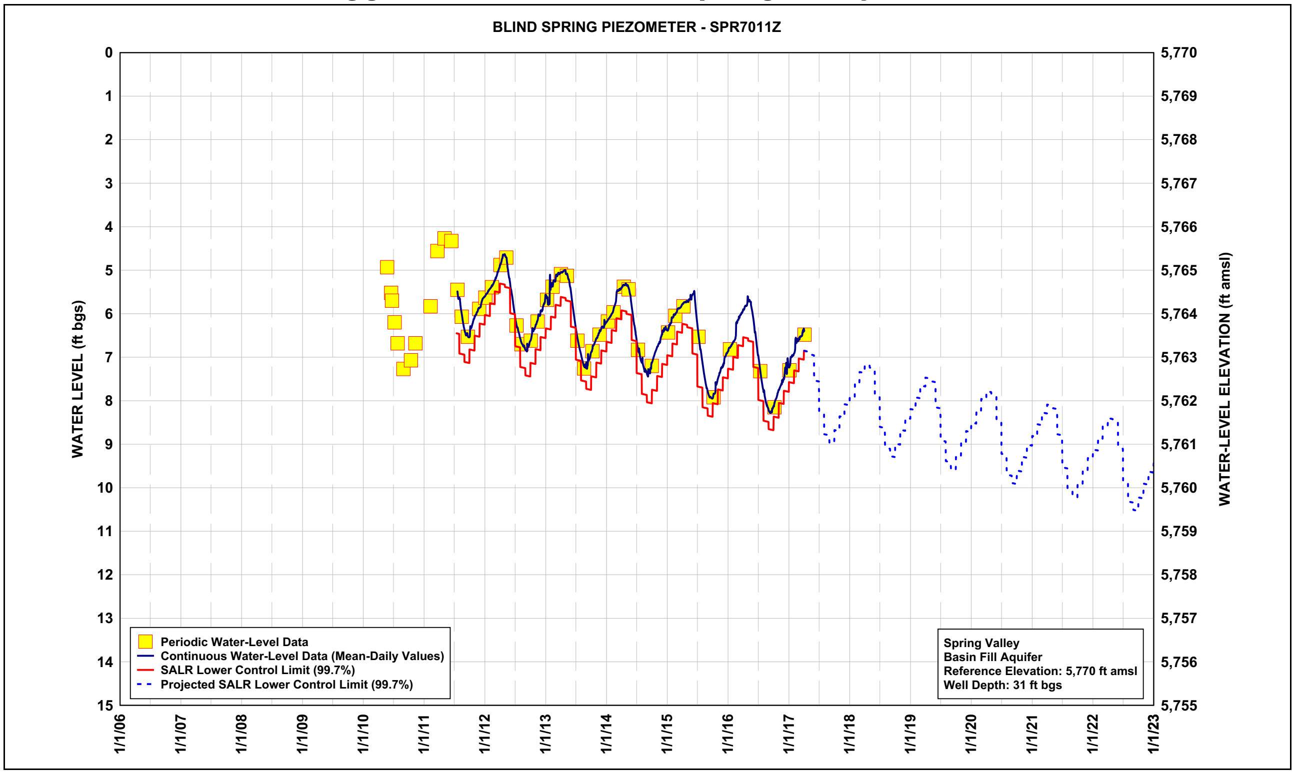

Figure C-20
Trigger, Well SPR7011Z, Spring Valley Block 1

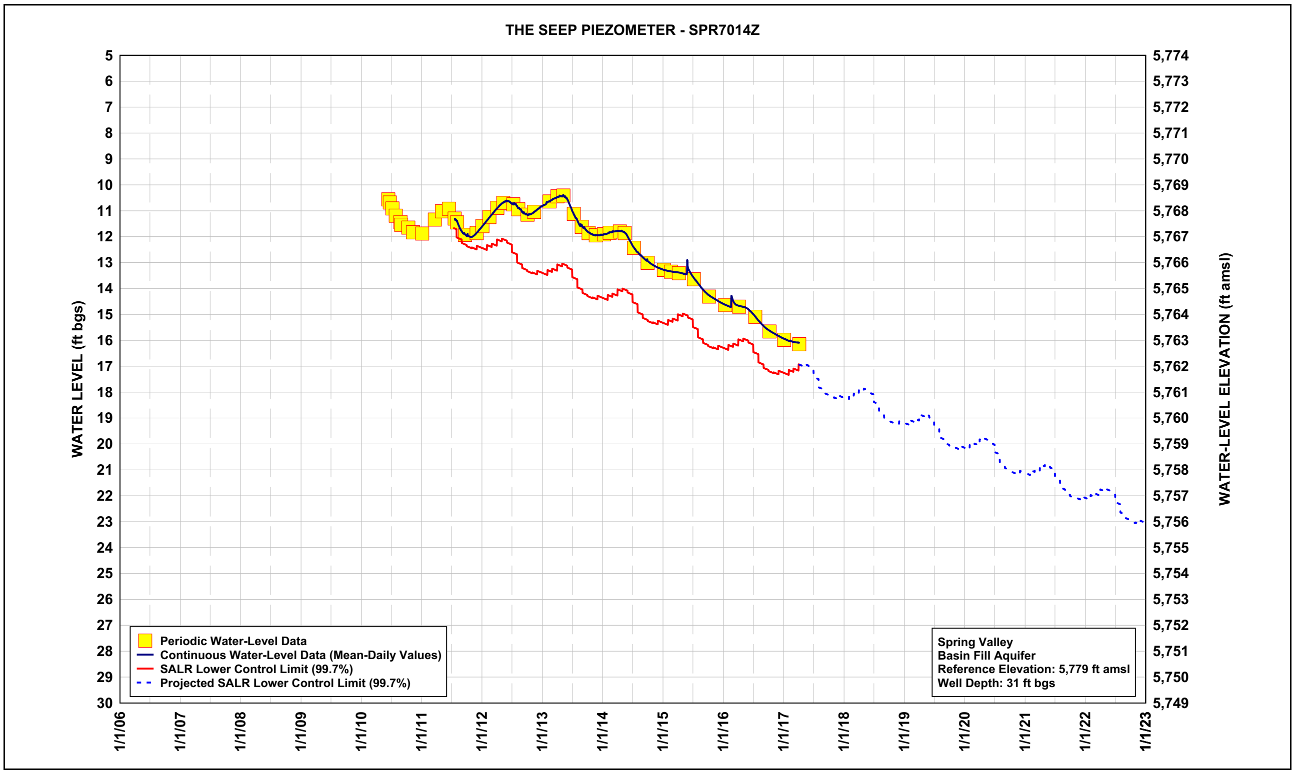

Figure C-21
Trigger, Well SPR7014Z, Spring Valley Block 1

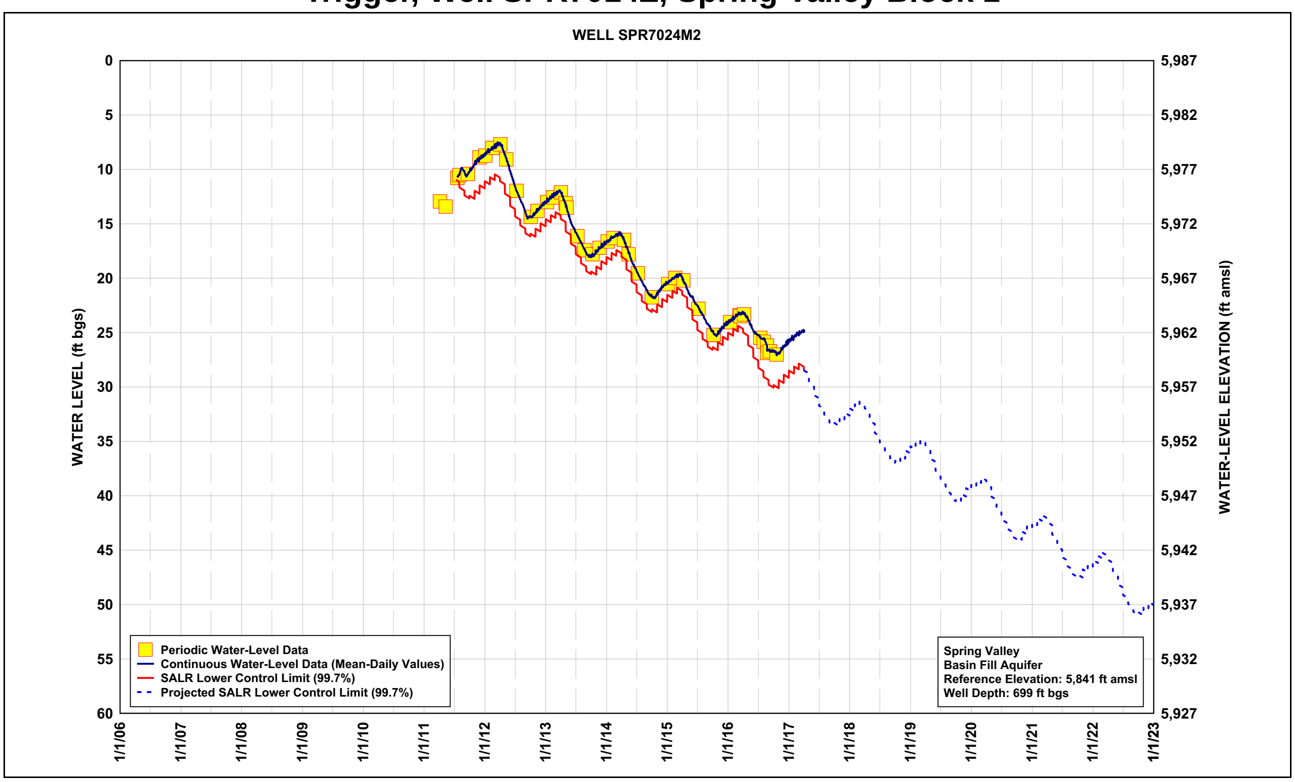

Figure C-22
Trigger, Well SPR7024M2, Spring Valley Block 1

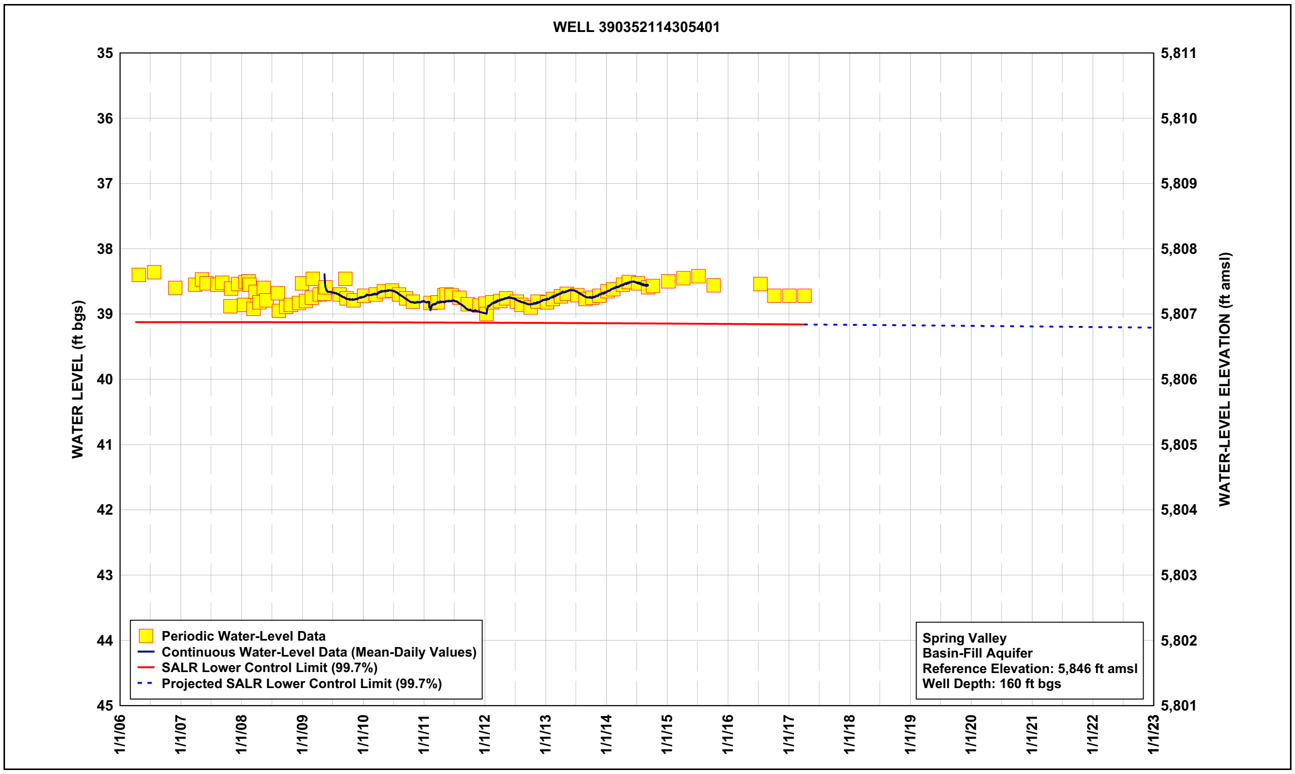

Figure C-23
Trigger, Well 390352114305401, Spring Valley Block 2

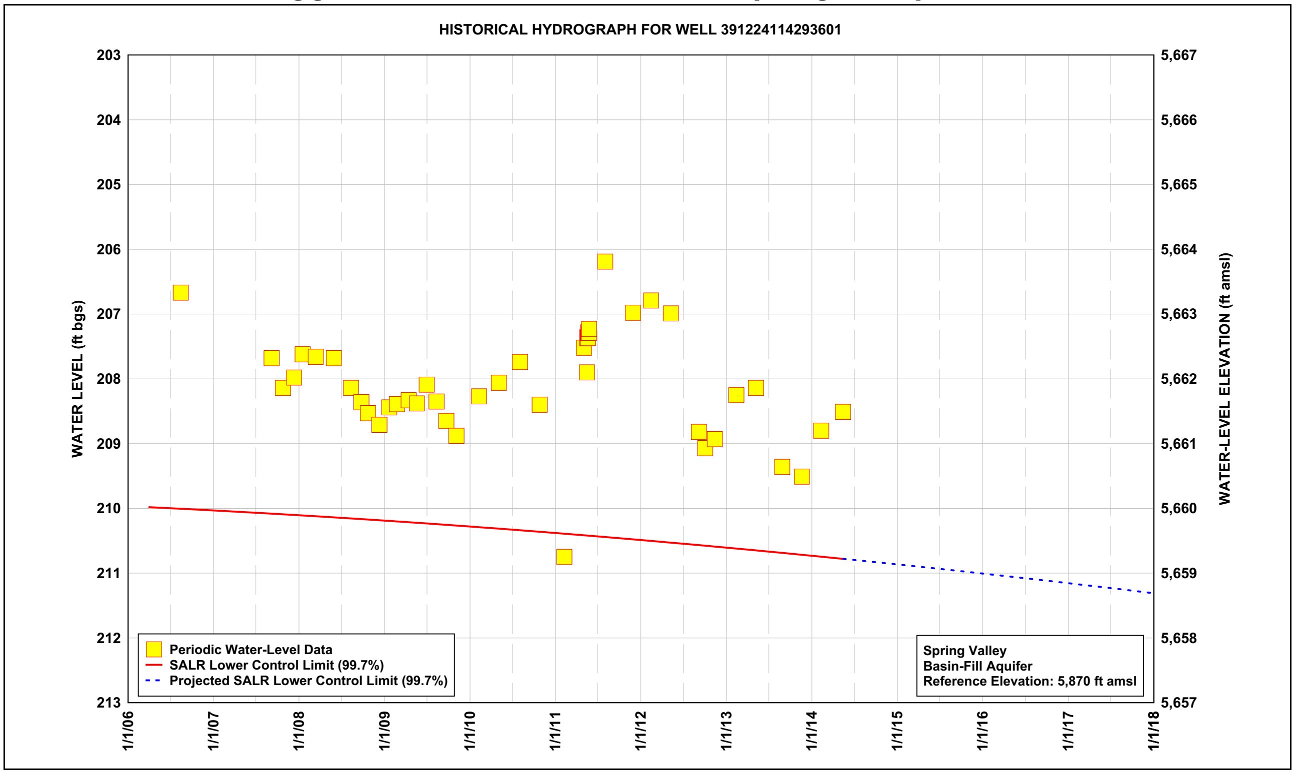

Figure C-24
Trigger, Well 391224114293601, Spring Valley Block 2

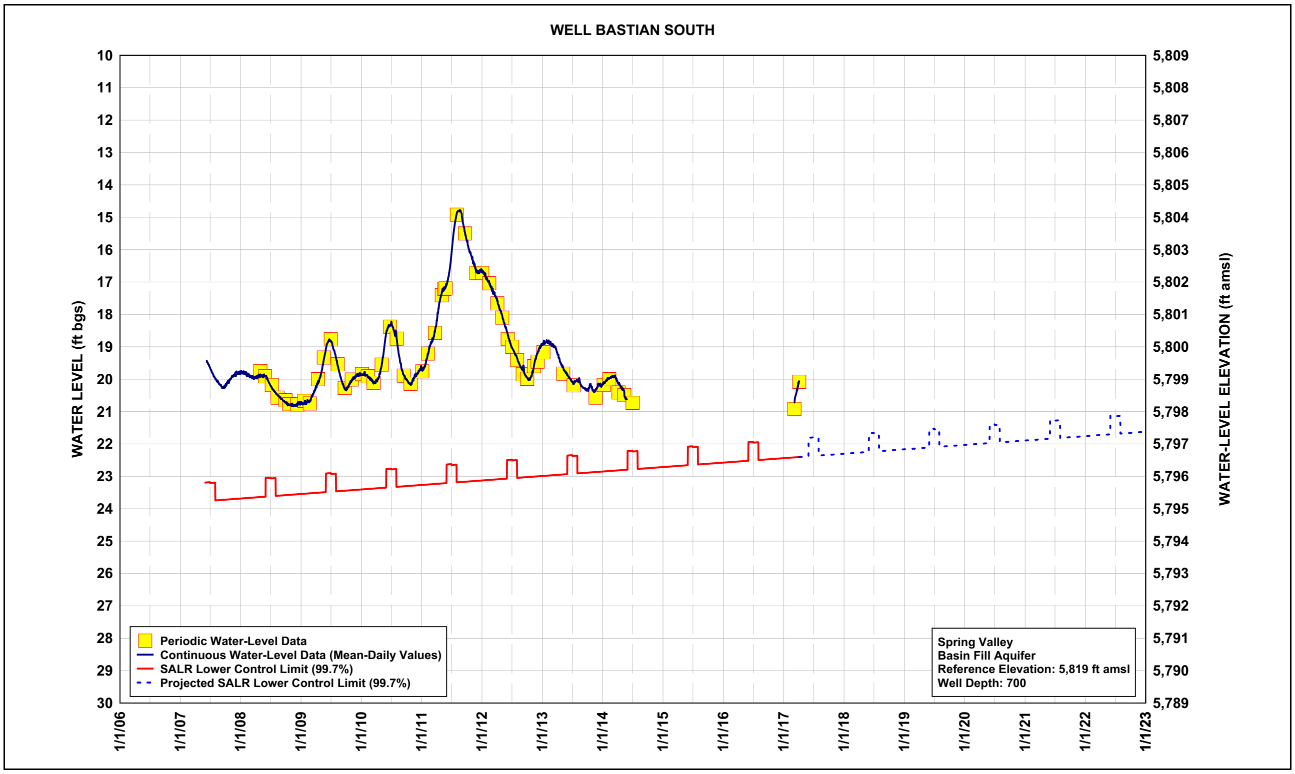

Figure C-25
Trigger, Bastian South Well, Spring Valley Block 2

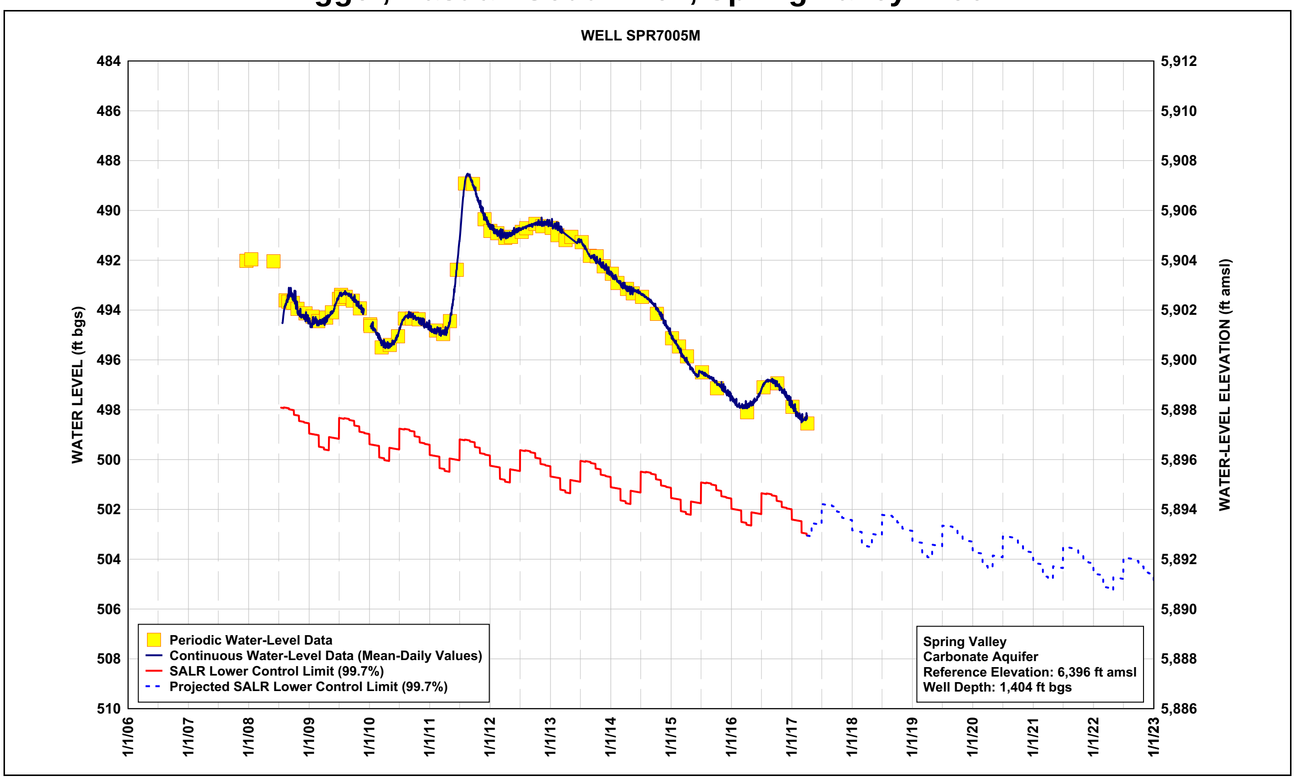

Figure C-26
Trigger, SPR7005M, Spring Valley Block 2

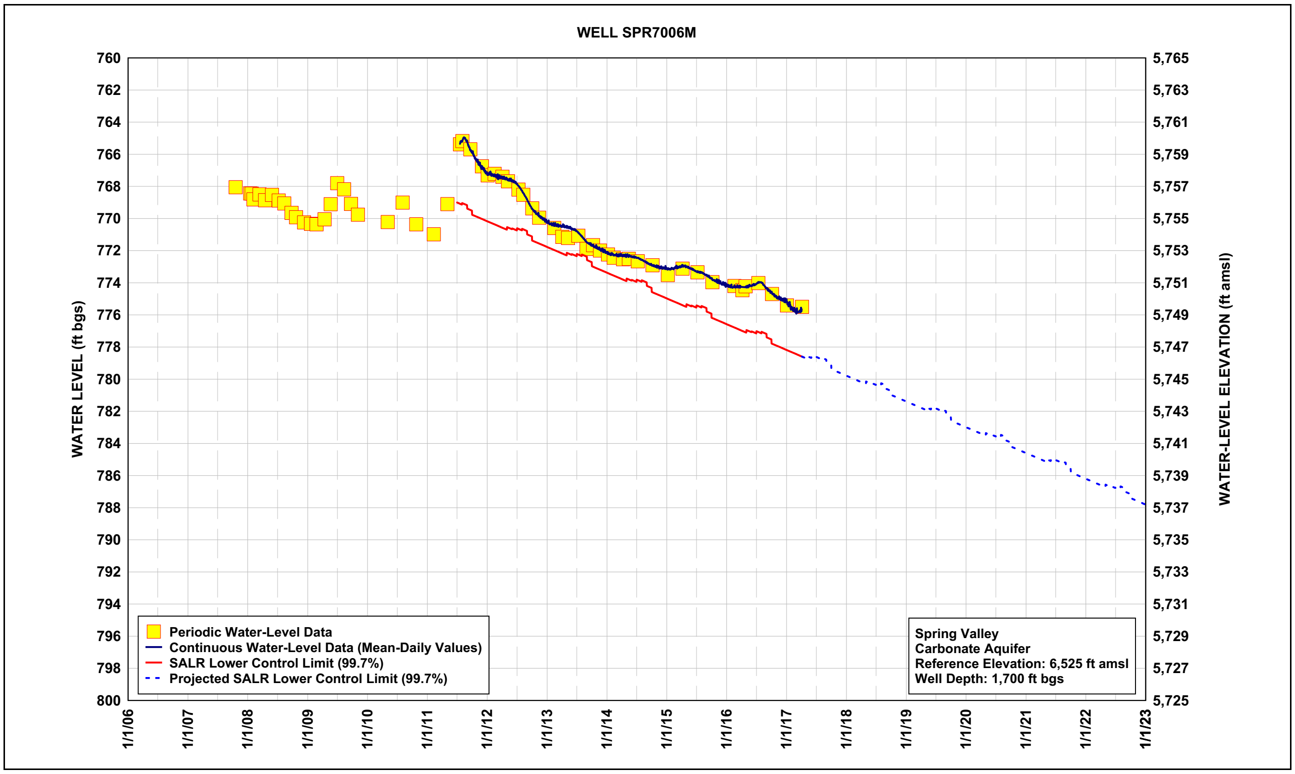

Figure C-27
Trigger, SPR7006M, Spring Valley Block 2

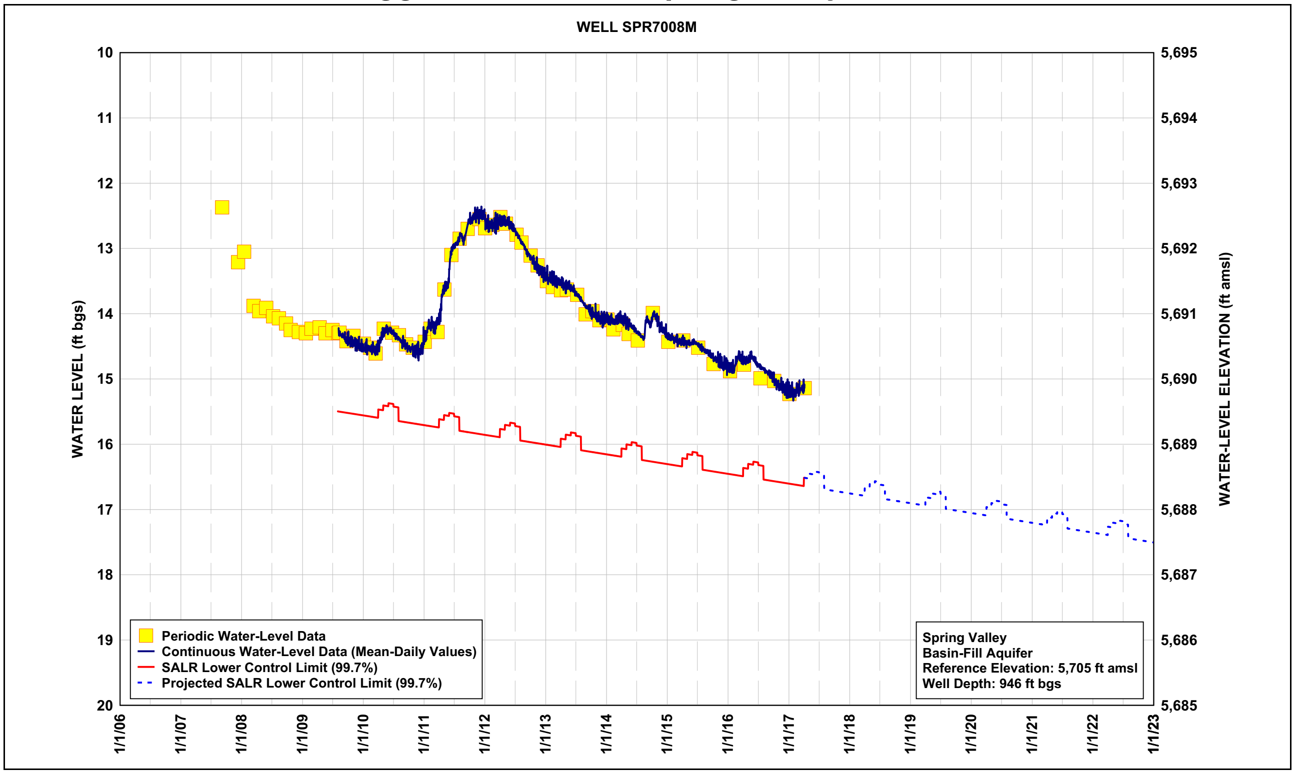

Figure C-28
Trigger, SPR7008M, Spring Valley Block 2

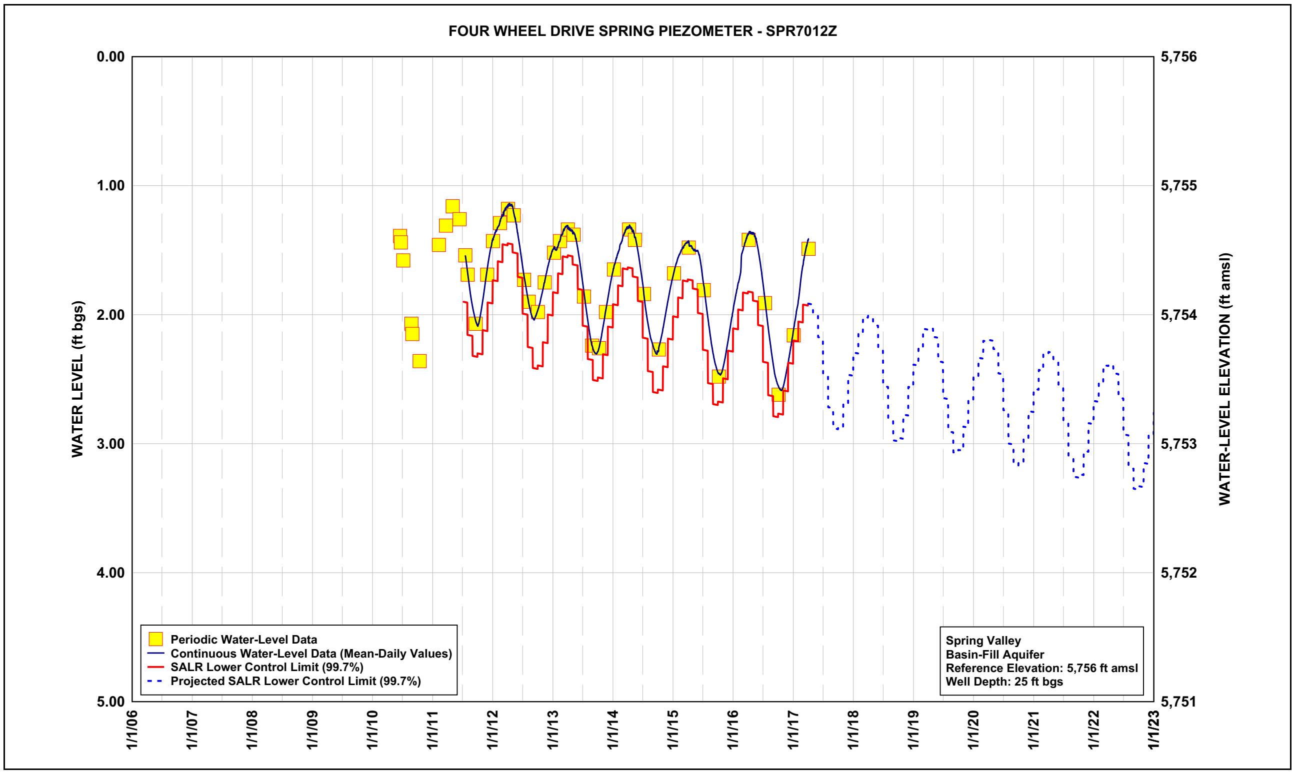

Figure C-29
Trigger, SPR7012Z, Spring Valley Block 2

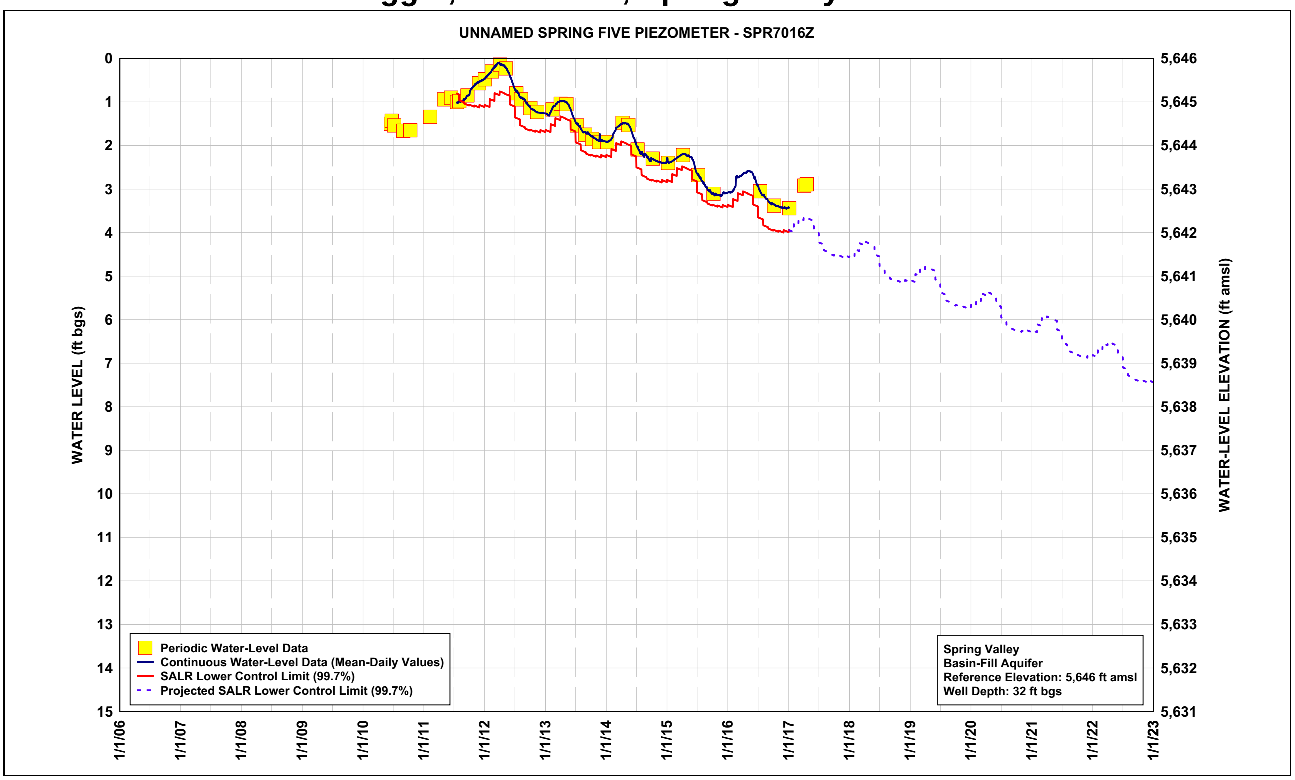

Figure C-30
Trigger, SPR7016Z, Spring Valley Block 2

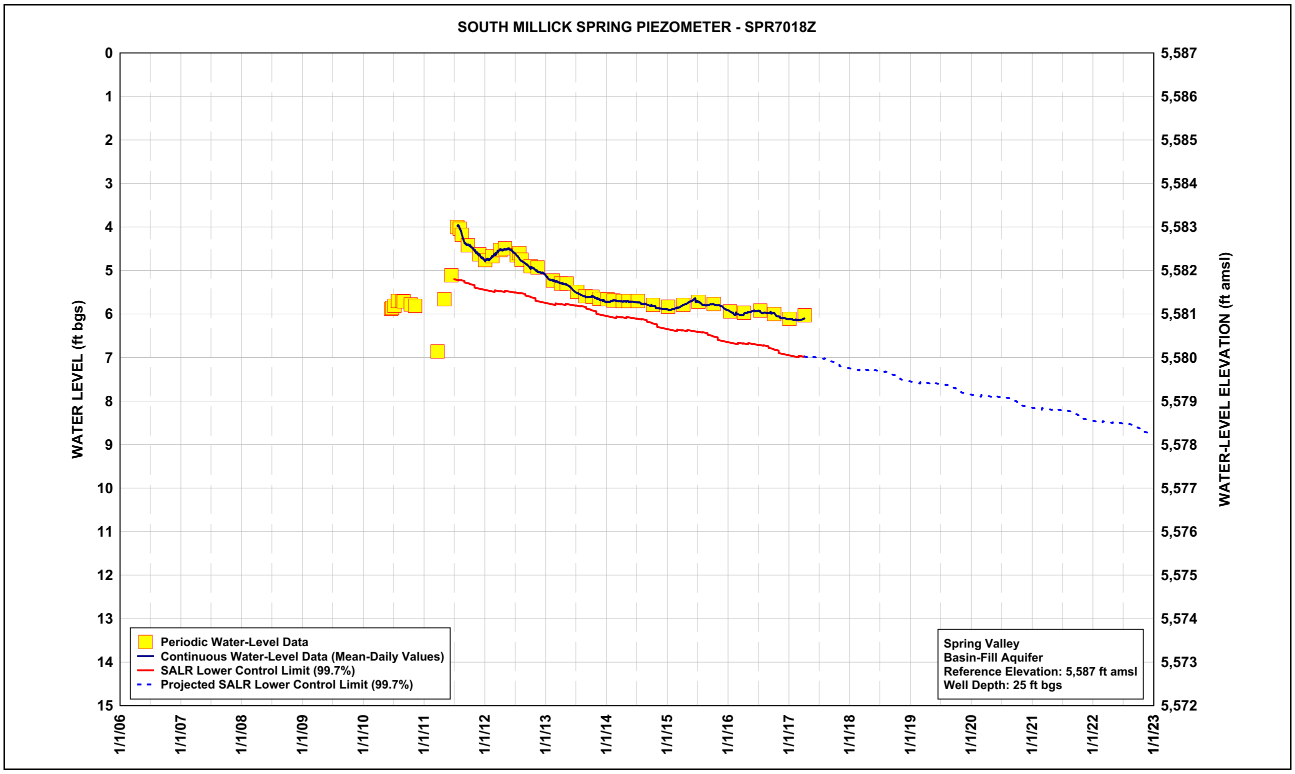

Figure C-31
Trigger, SPR7018Z, Spring Valley Block 2

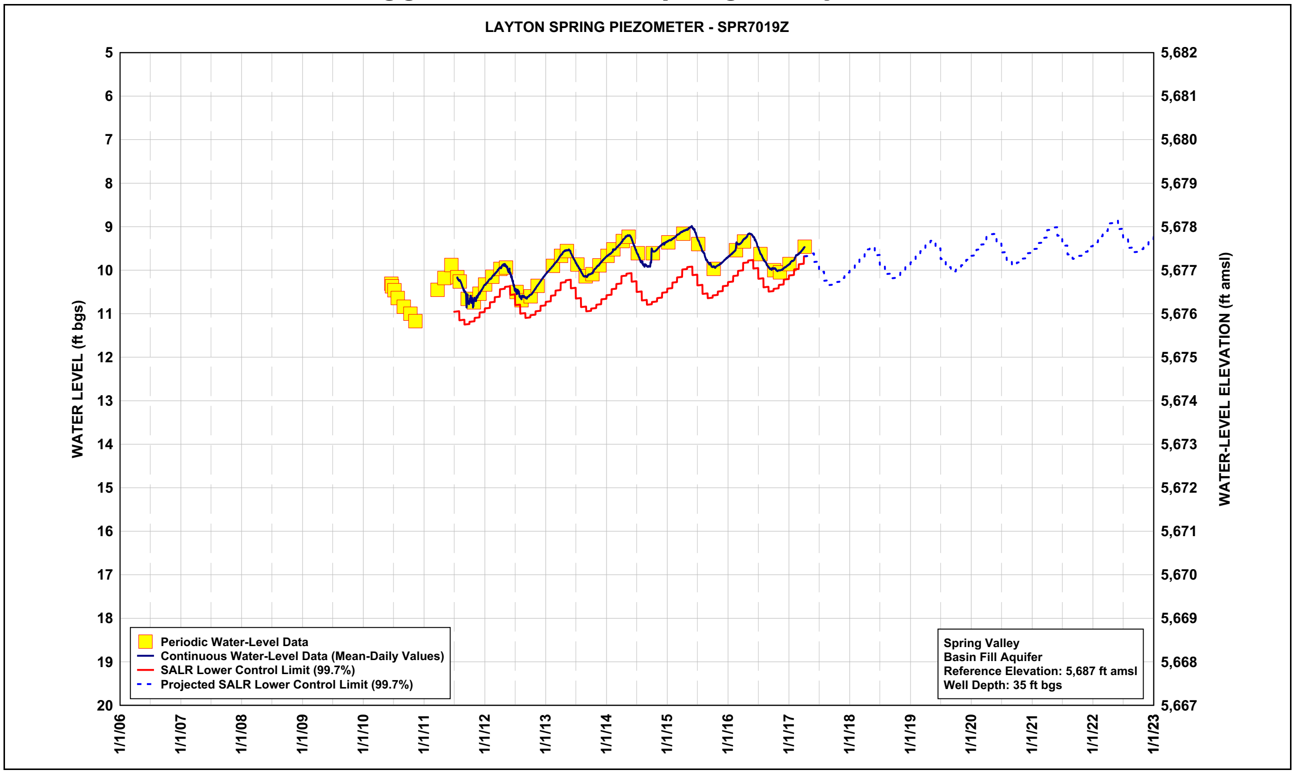

Figure C-32
Trigger, SPR7019Z, Spring Valley Block 2

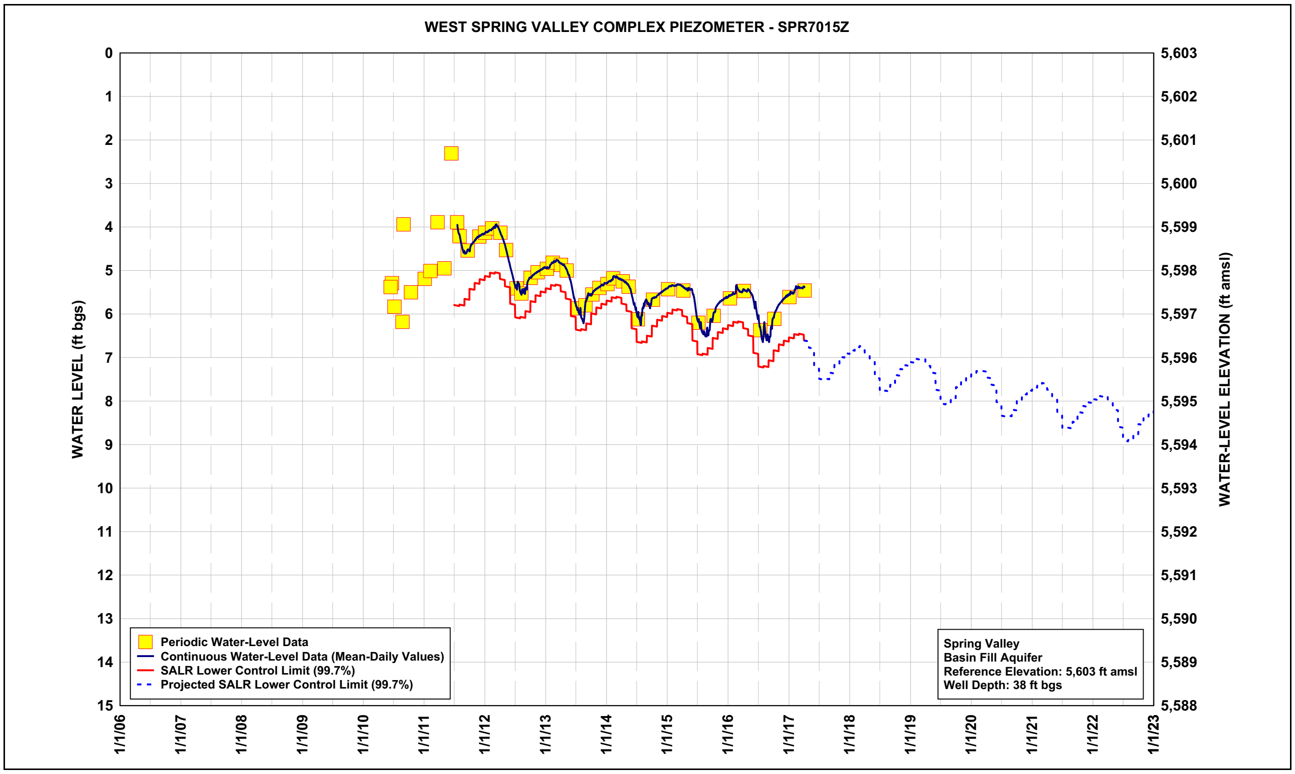

Figure C-33
Trigger, SPR7015Z, Spring Valley Block 3

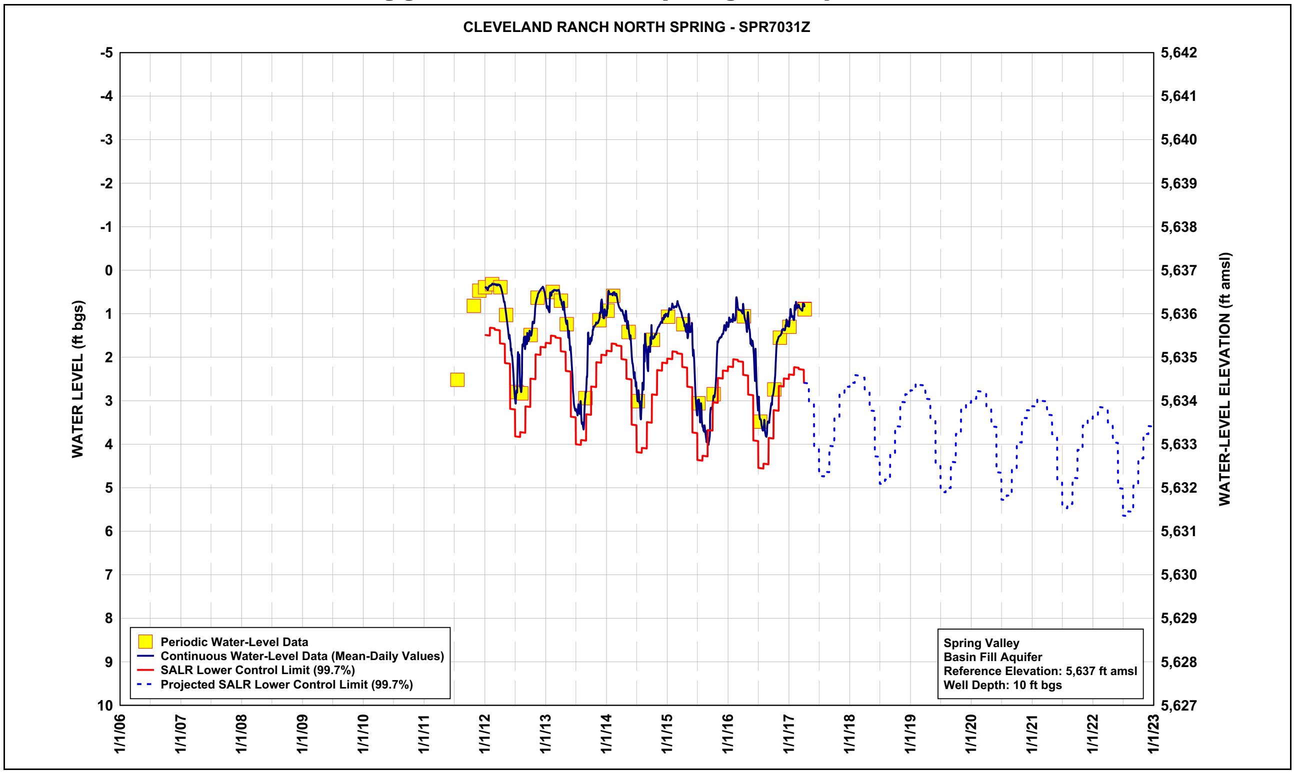

Figure C-34
Trigger, SPR7031Z, Spring Valley Block 3

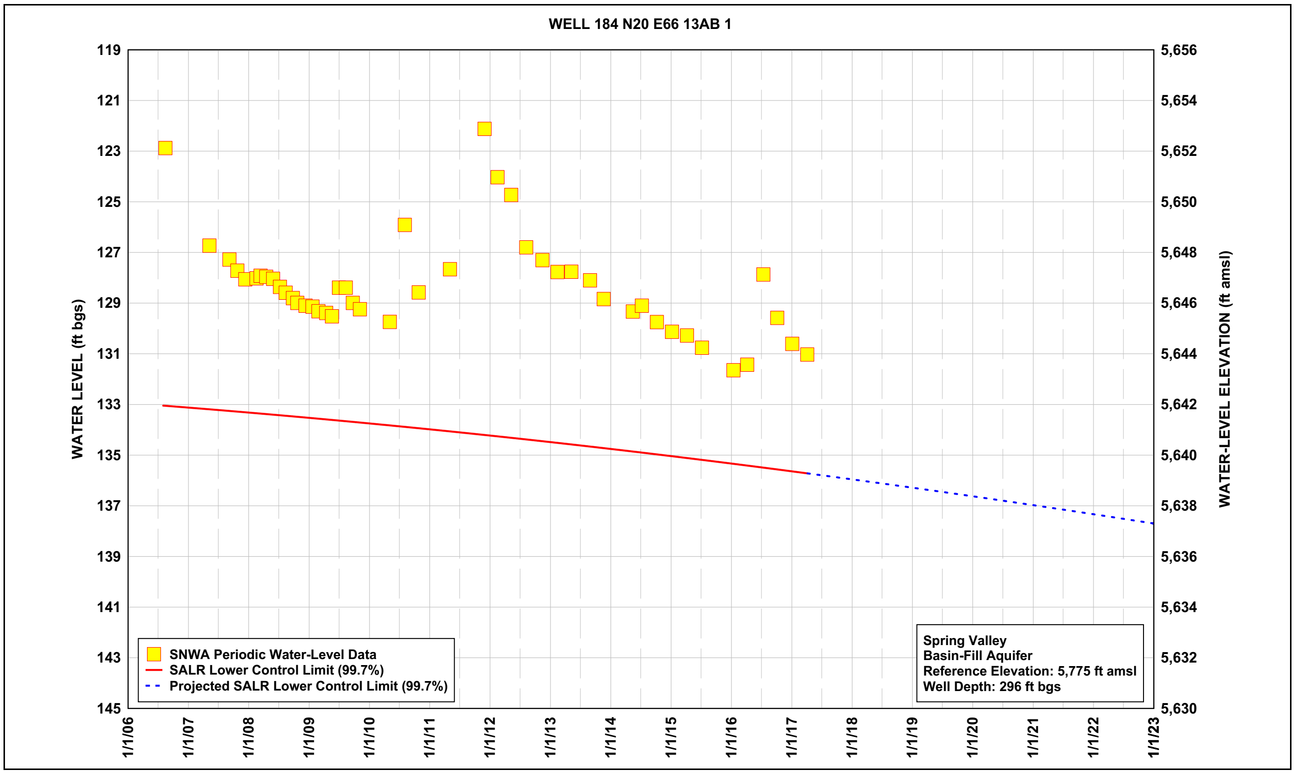

Figure C-35
Trigger, Well 184 N20 E88 13AB 1, Spring Valley Block 4

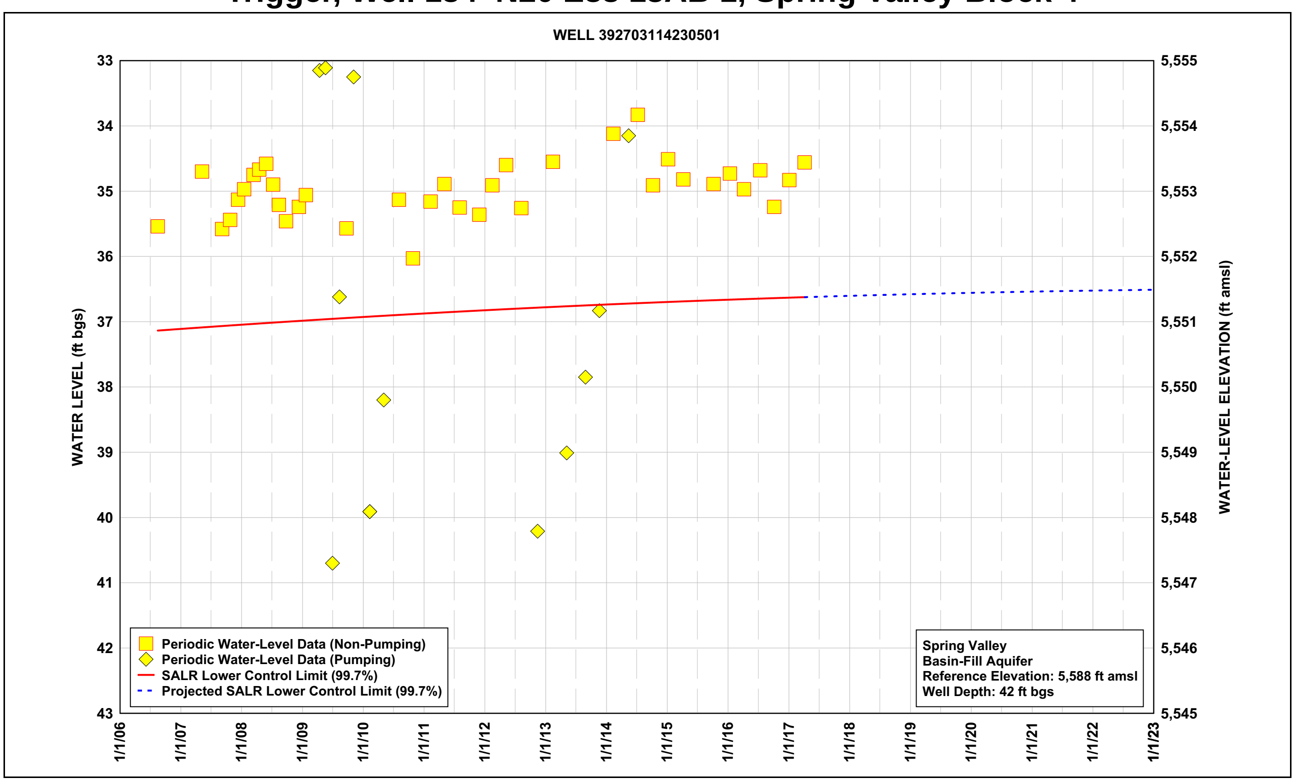

Figure C-36
Trigger, Well 392703115230501, Spring Valley Block 4

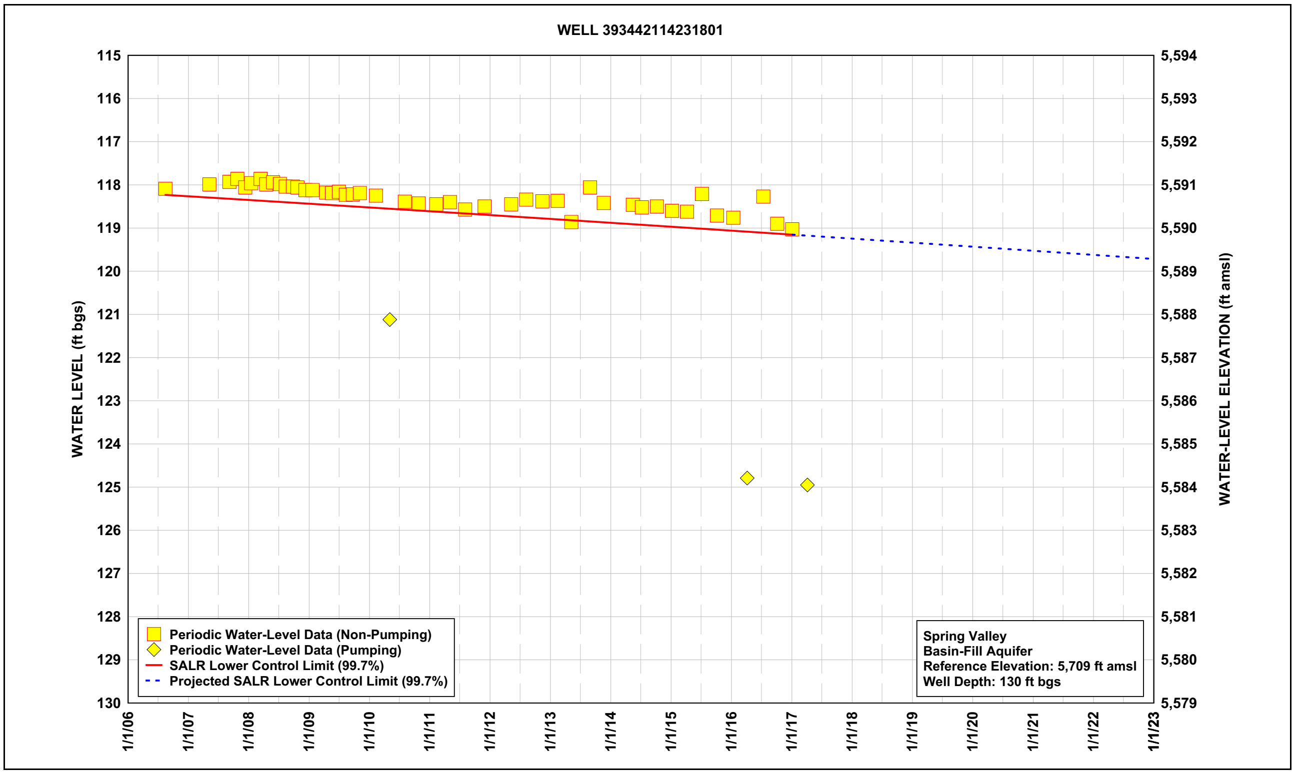

Figure C-37
Trigger, Well 393442114231801, Spring Valley Block 4

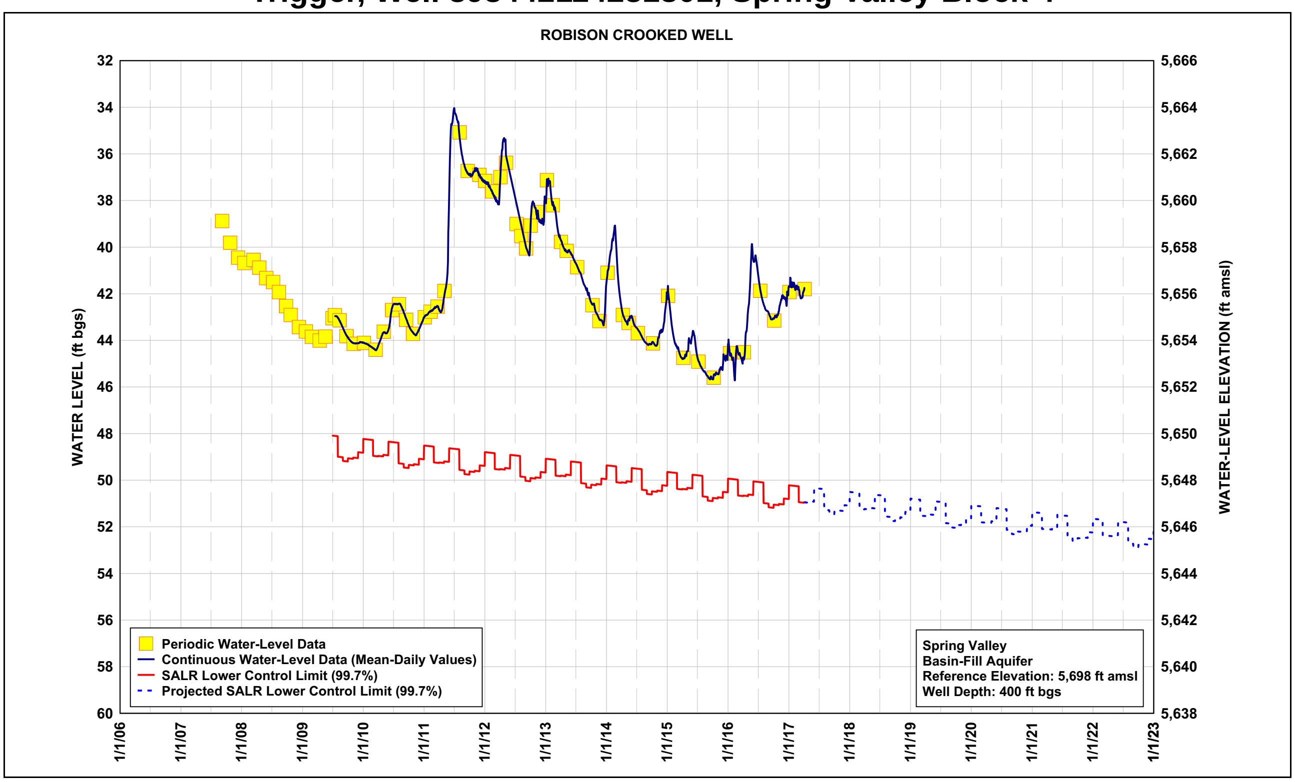

Figure C-38
Trigger, Robison Crooked Well, Spring Valley Block 4

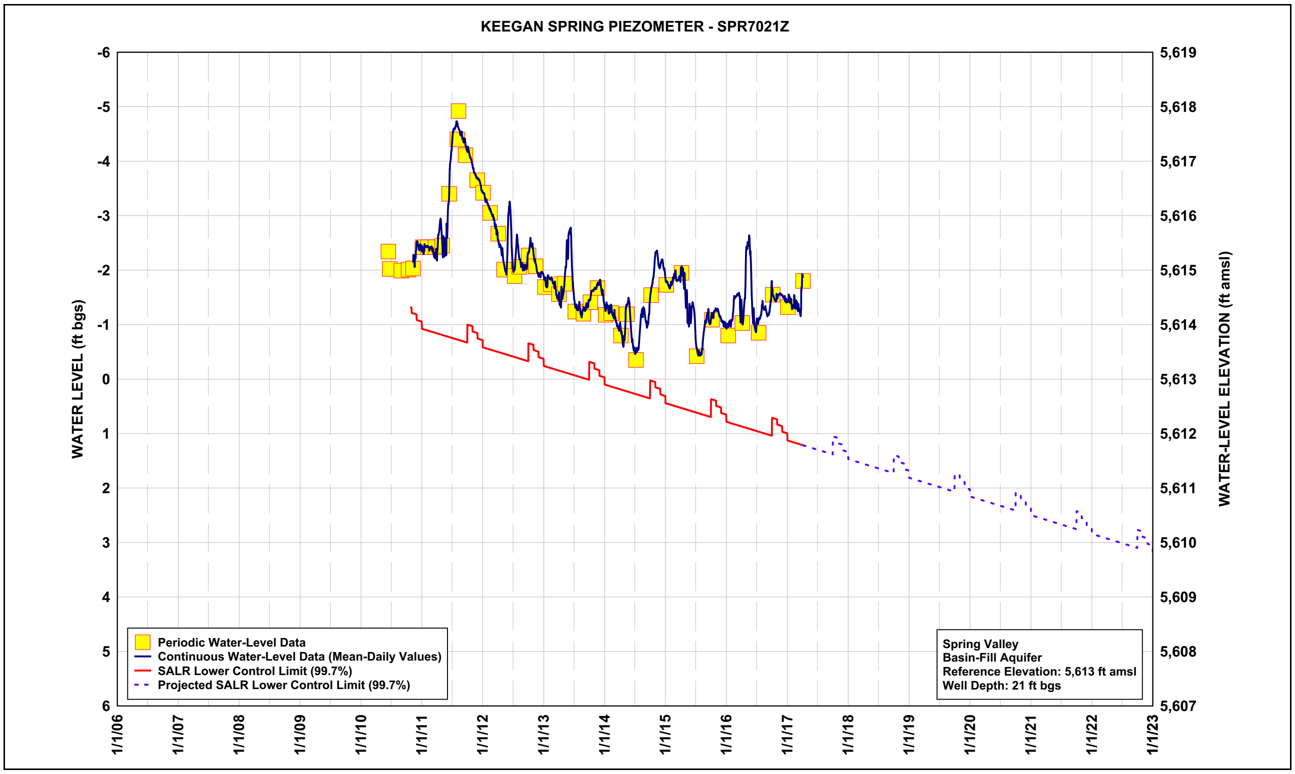

Figure C-39
Trigger, Well SPR7021Z, Spring Valley Block 4

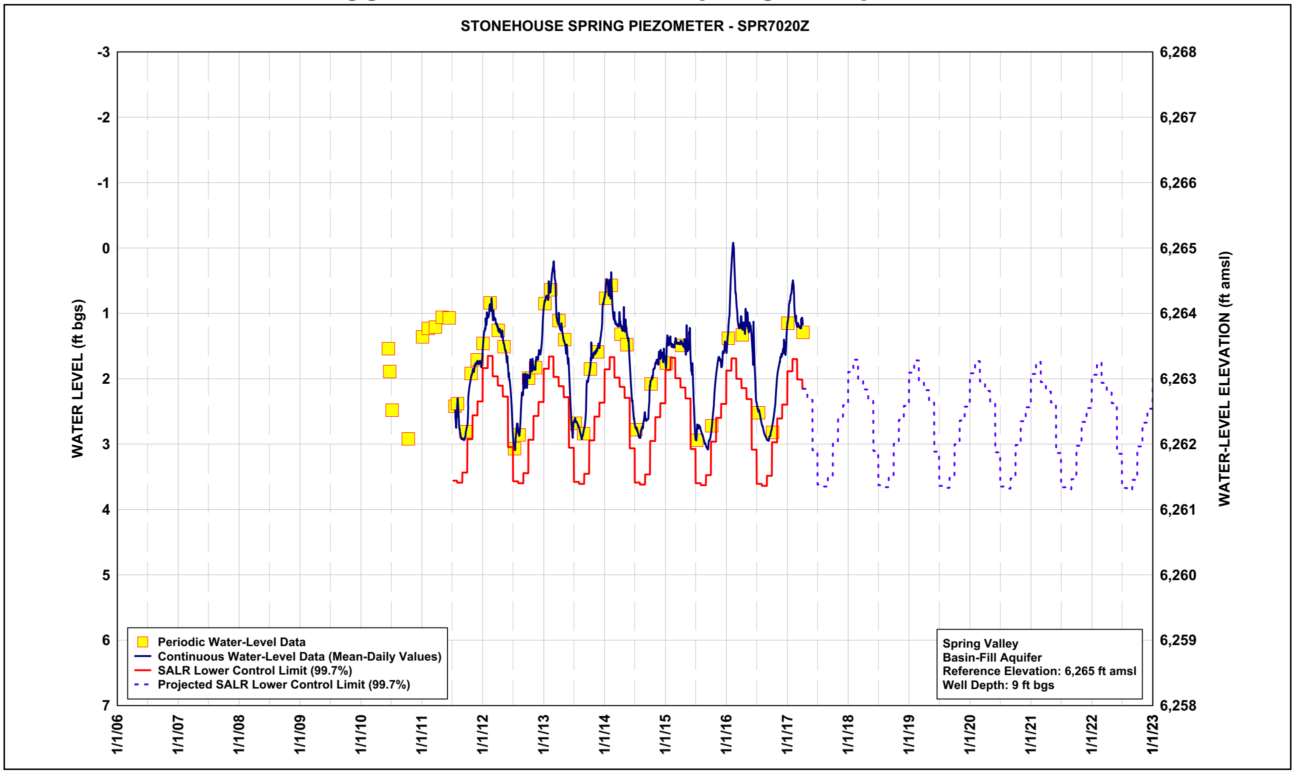

Figure C-40
Trigger, Well SPR7020Z, Spring Valley Block 5

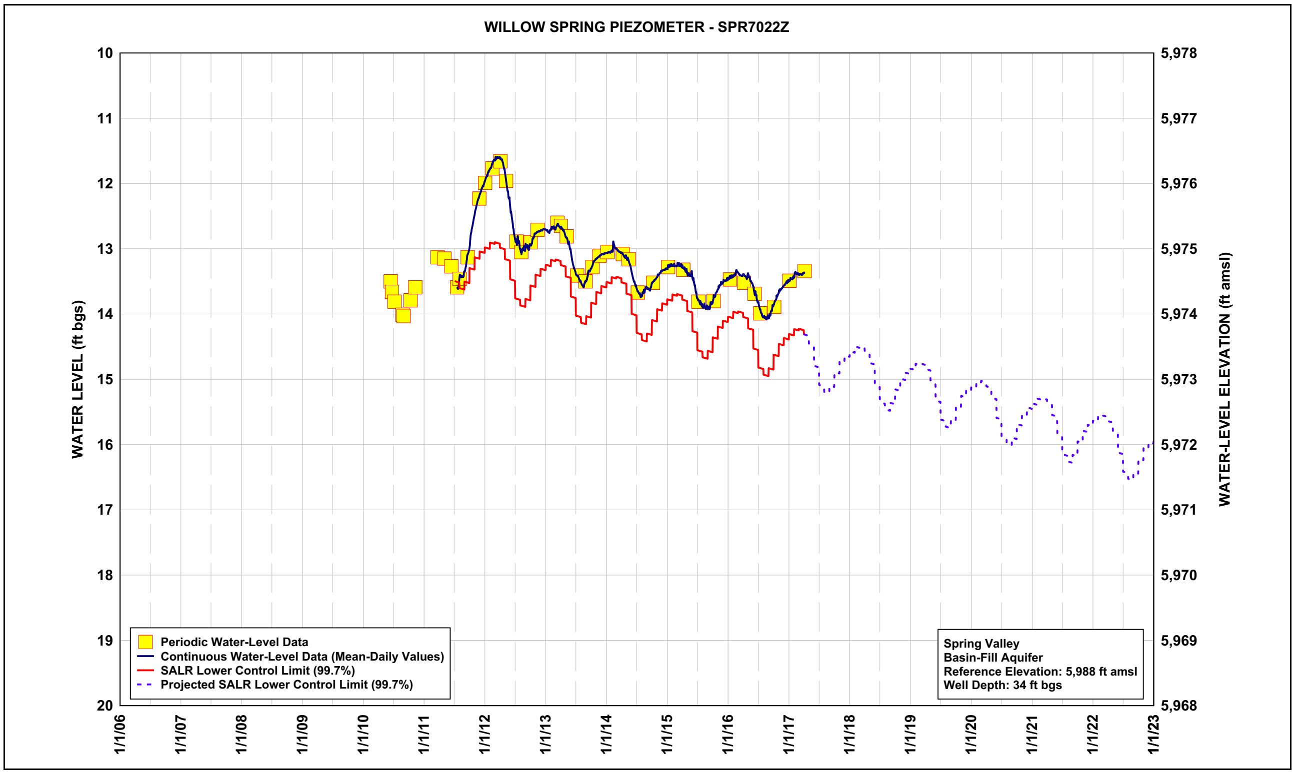

Figure C-41
Trigger, Well SPR7022Z, Spring Valley Block 5

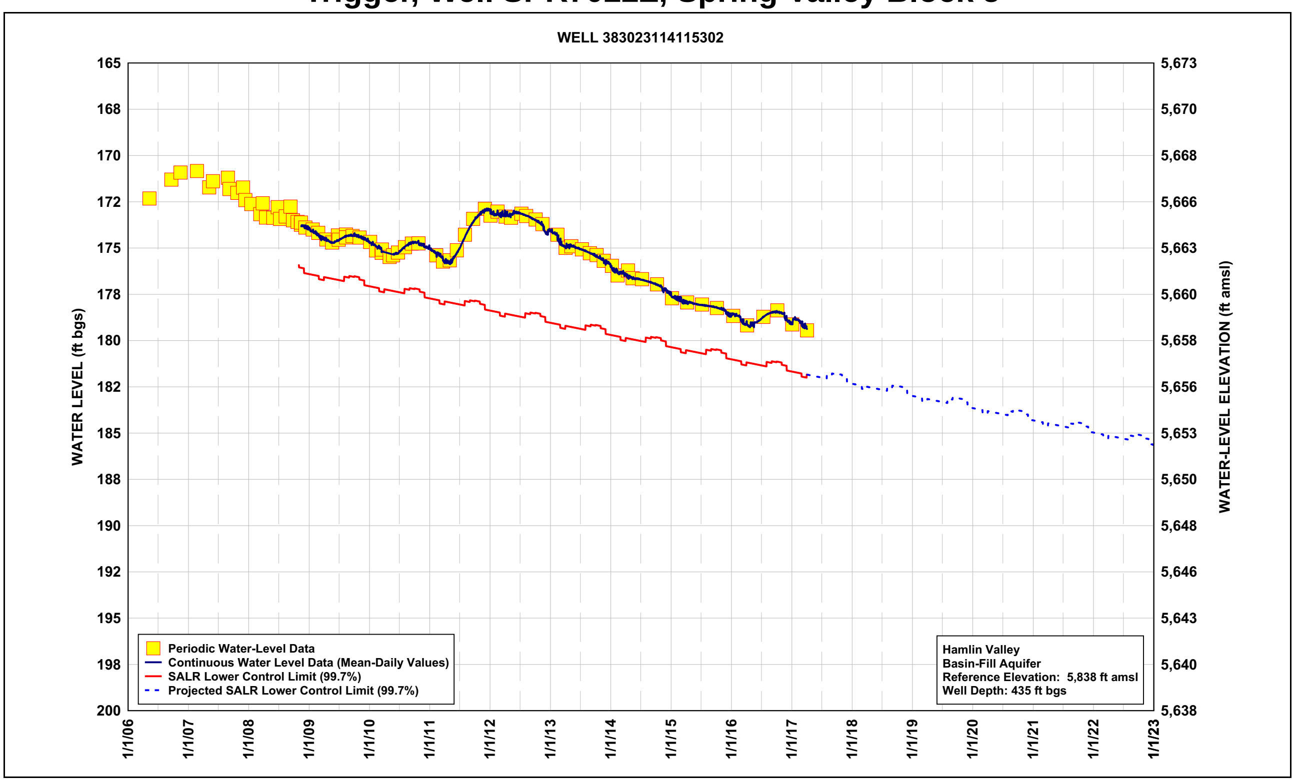

Figure C-42
Trigger, Well 383023114115302 (Hamlin MX), Hamlin Valley

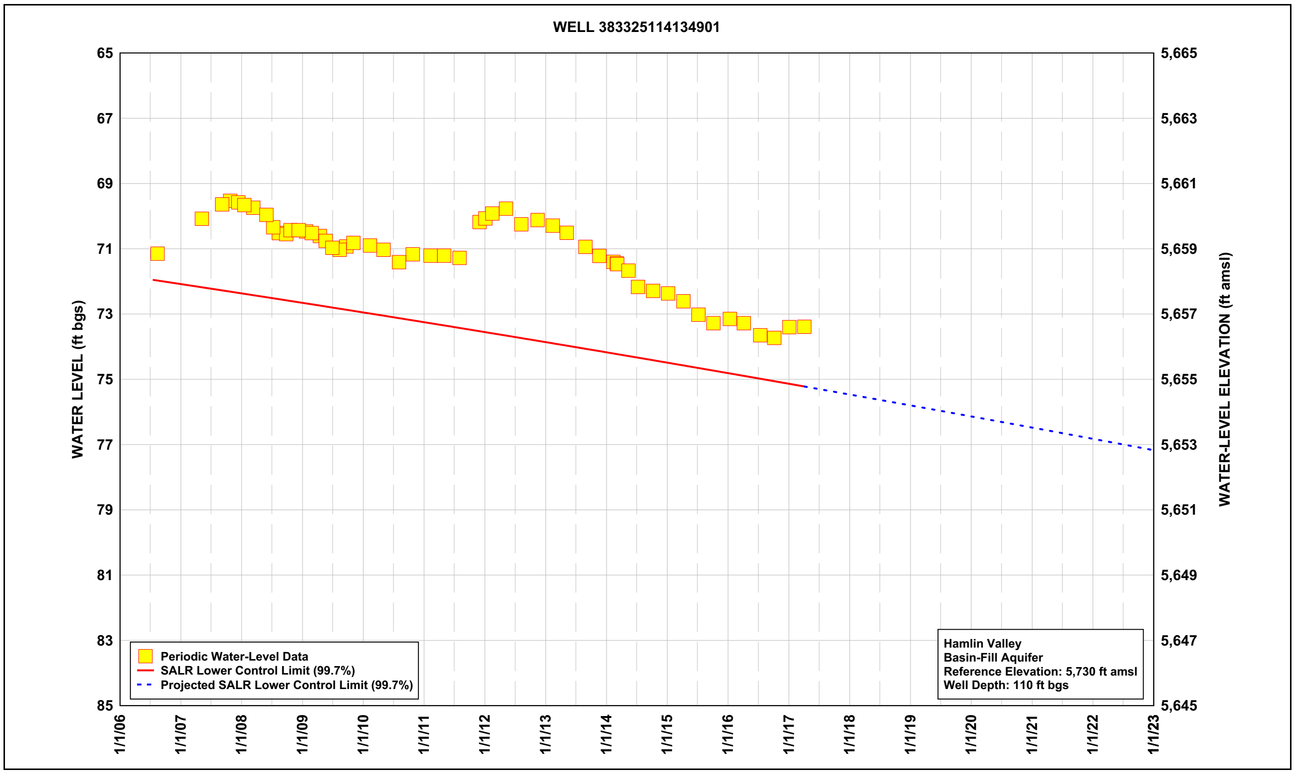

Figure C-43
Trigger, Well 383325114134901, Hamlin Valley

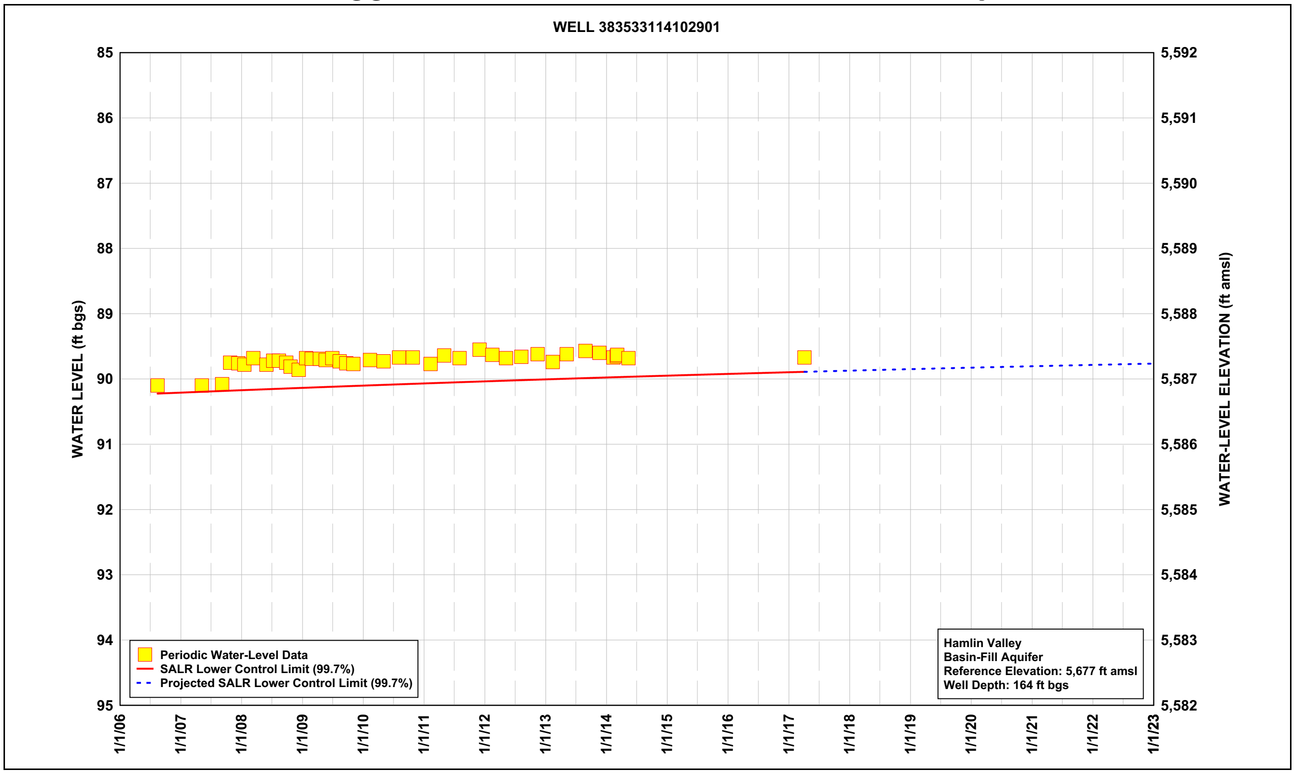

Figure C-44
Trigger, Well 383533114102901, Hamlin Valley

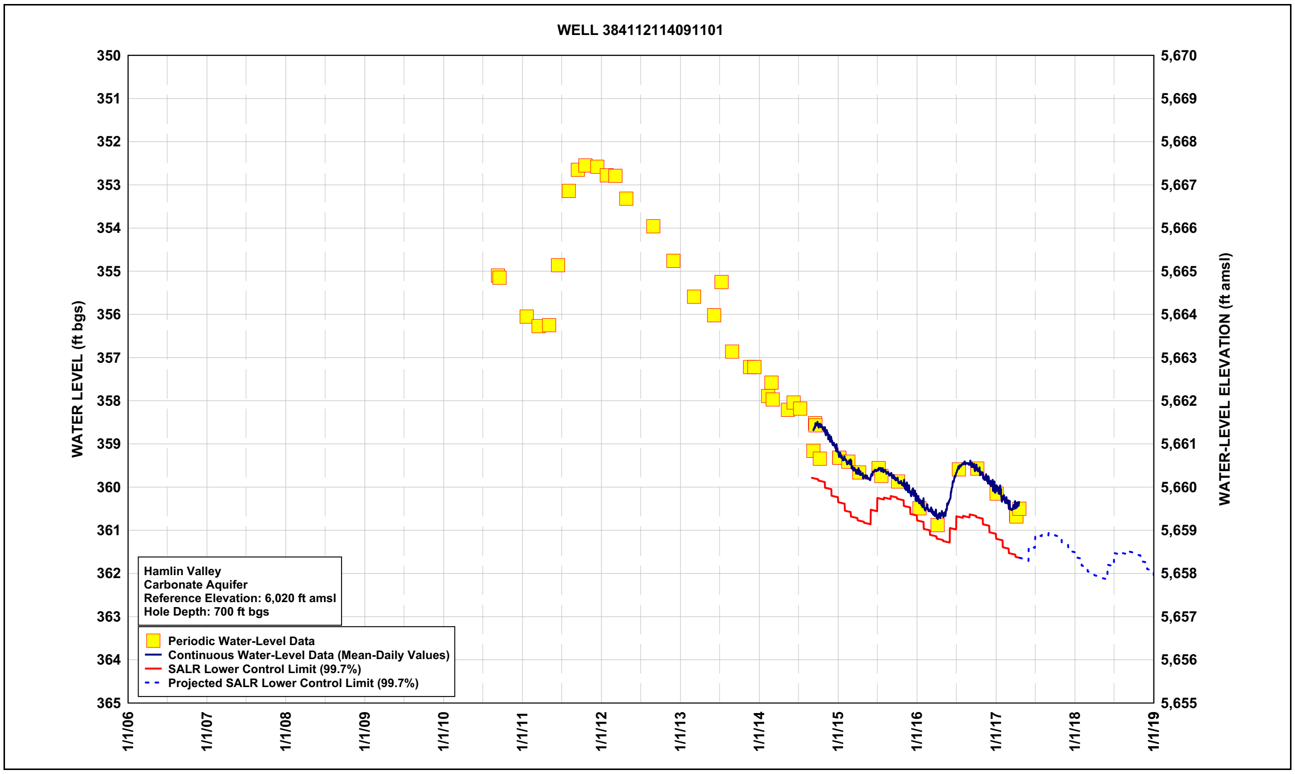

Figure C-45
Trigger, Well 384112114091101, Hamlin Valley

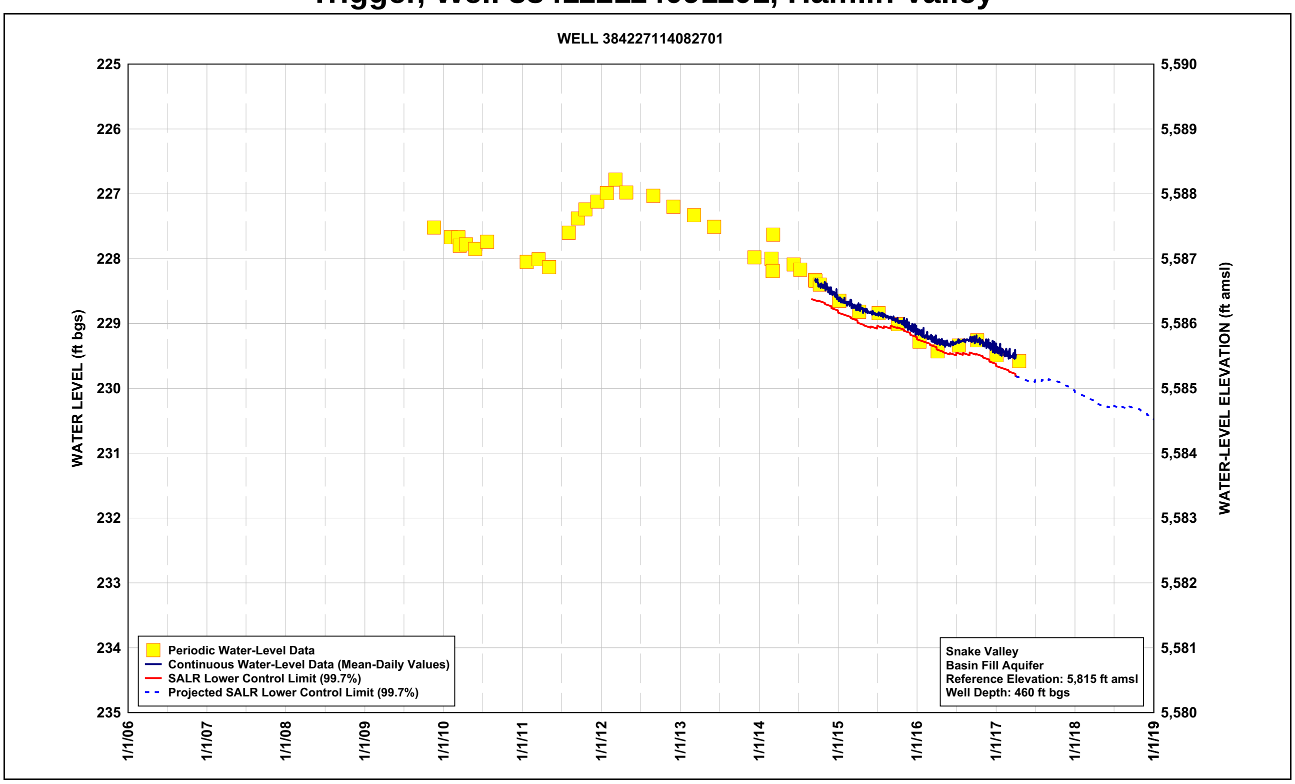

Figure C-46
Trigger, Well 384227114082701, Snake Valley

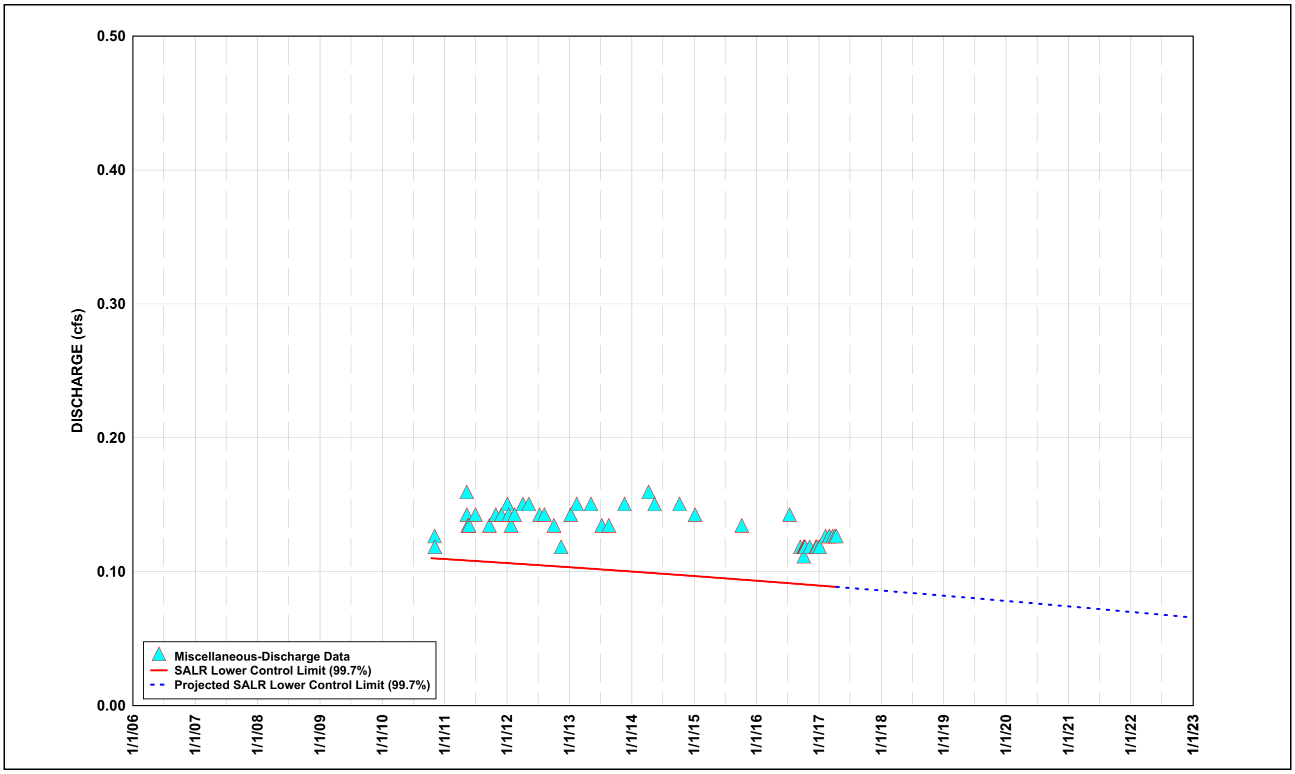

Figure C-47
Trigger, Well Cleveland Ranch Spring South - 1848501, Snake Valley