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SOUTHERN NEVADA
WATER AUTHORITY

SNWA Monitoring, Management, and Mitigation Plan for Delamar, Dry Lake, and Cave Valleys, Nevada

June 2017

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ACRONYMS

BLM	Bureau of Land Management
DDC	Delamar, Dry Lake and Cave Valleys
DEM	Digital Elevation Model
GDP	Clark, Lincoln, and White Pine Counties Groundwater Development Project
NDOW	Nevada Department of Wildlife
NDWR	Nevada Division of Water Resources
NSE	Nevada State Engineer
NWR	National Wildlife Refuge
POD	Point of Diversion
PSZ	Pahranagat Shear Zone
SALR	Seasonally Adjusted Linear Regression
SNWA	Southern Nevada Water Authority
TRP	Technical Review Panel
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

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1.0 INTRODUCTION

This document presents the Southern Nevada Water Authority (SNWA) Monitoring, Management, and Mitigation Plan (3M Plan) for Delamar, Dry Lake, and Cave valleys (DDC), Nevada (Hydrographic Areas 182, 181, and 180, respectively). SNWA prepared this plan to meet conditions for SNWA groundwater permit numbers 53987 through 53992 granted by the Nevada State Engineer (NSE) in Rulings 6165, 6166 and 6167 (Nevada Division of Water Resources (NDWR), 2012a-c). These water rights are to be used for the SNWA Clark, Lincoln, and White Pine Counties Groundwater Development Project (GDP) (SNWA, 2012c).

1.1 Background

In 1989, the Las Vegas Valley Water District (LVVWD) filed six applications (53987 through 53992), for the appropriation of groundwater in DDC. By agreement with LVVWD on December 2, 2003, SNWA assumed full interest in these applications, which were the subject of NSE Rulings 6165-6167.

Rulings 6165-6167 presented the decisions of the NSE regarding these SNWA DDC applications. Application numbers 53987 and 53988 in Cave Valley were granted for a total of 5,235 acre-feet per annum (afa), application numbers 53989-53990 in Dry Lake Valley were granted for a total of 11,584 afa, and application numbers 53990-53991 in Delamar Valley were granted for a total of 6,042 afa. The permits were granted subject to specific conditions including, among other requirements, the implementation of a monitoring plan with a minimum of two years of biological and hydrologic baseline data collection (NDWR, 2012a, at pages 169-170; NDWR, 2012b, at page 163; NDWR, 2012c, at page 161).

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" (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 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).

In the process of securing federal rights-of-way for the main GDP pipeline and associated facilities, SNWA committed to following a staged groundwater development schedule in Cave Valley (SNWA, 2012b). SNWA requests that the NSE adopt a similar staged groundwater development schedule as part of the ruling issued for Cave Valley after the Remand Order hearings are complete. The staged groundwater development schedule is presented as part of the management and mitigation plan in Section 3.1.

This 3M Plan replaces the previous hydrologic monitoring and mitigation plan (SNWA, 2011b) and biological monitoring plan (Biologic Resources Team, 2011) that were approved by the NSE in Rulings 6165-6167 (NDWR, 2012a, at page170; NDWR, 2012b, at page 163; and NDWR, 2012c, at page 161). 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 DDC 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.

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

1. Mesic, shrubland, terrestrial woodland, and lake habitat types. Terrestrial woodland habitat does not occur within the DDC 3M Plan area.

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 Delamar, Dry Lake, Cave, southern White River, and Pahranagat 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] One area of focus in the adjacent basins is the inter-basin groundwater flow path from Cave Valley to southern White River Valley. As described in Ruling 6165, outflow from Cave Valley enters southern White River Valley via Shingle Pass, and then joins the south-trending flow in southern White River Valley (NDWR, 2012a, at pages 77-80). Within White River Valley this 3M Plan focuses on Flag and Butterfield springs and the downstream Sunnyside Creek, which are partially sourced from groundwater outflow from Cave Valley (Marshall et al., 2017, at Section 8.2.3).

Another area of focus in the adjacent basins is the regional springs in Pahranagat Valley. Effects from SNWA GDP pumping to senior water rights and environmental resources in Pahranagat Valley are unlikely, as discussed in the 3M Plan analysis report (Marshall et al., 2017, at Section 9.2.4). Nonetheless, Pahranagat Valley is included in the 3M Plan given the U.S. Fish and Wildlife Service (USFWS) determination that it could not rule out the possibility of measurable effects to federally endangered species in Pahranagat Valley, although it was unsure of the likelihood or magnitude of such effects (USFWS, 2012). 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 Rulings 6165-6167 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 DDC. 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.

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

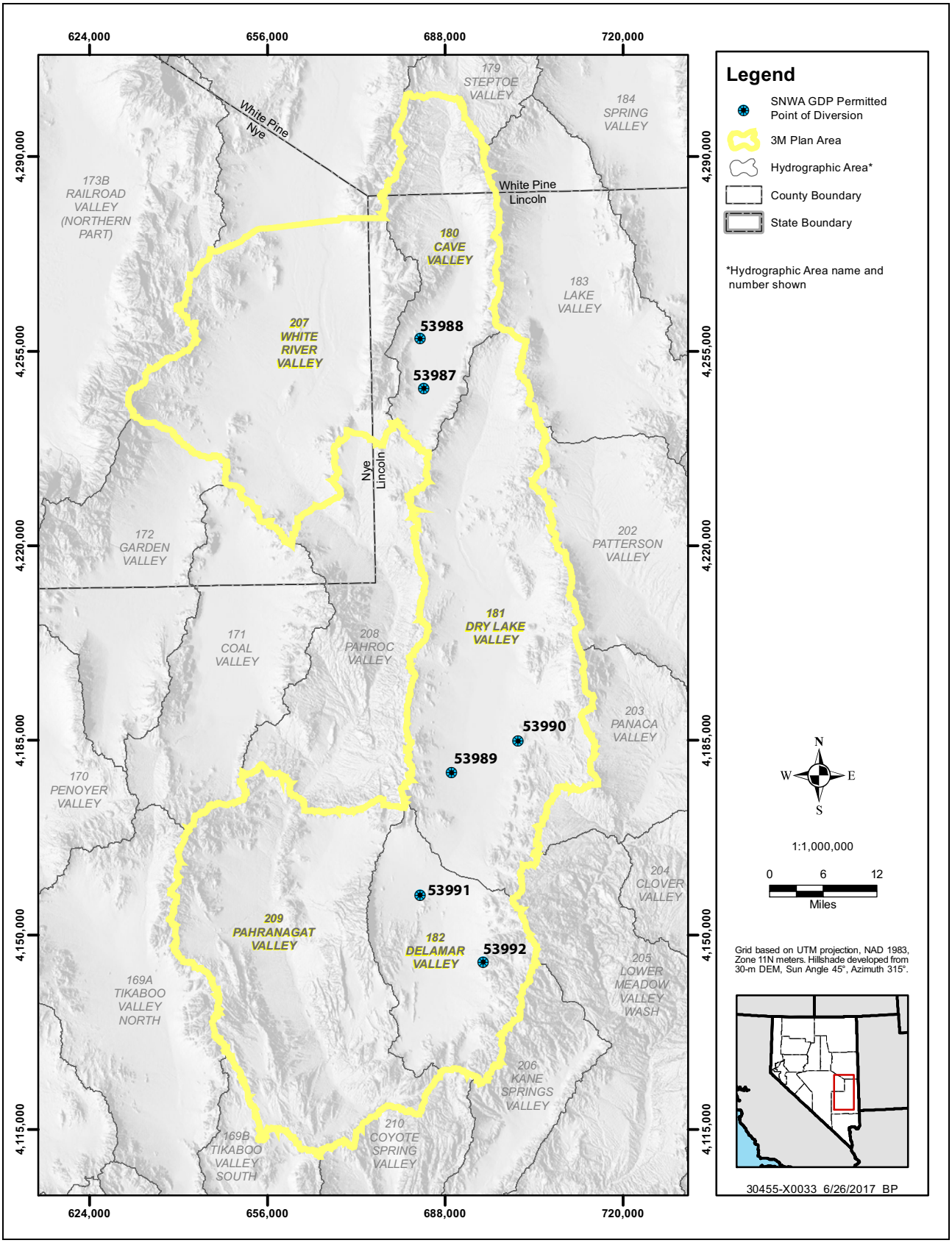


Figure 1-1
3M Plan Area for SNWA GDP Pumping in DDC

2.0 MONITORING PLAN

This section presents the hydrologic and environmental monitoring plan associated with SNWA GDP groundwater permits in DDC. 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 Section 2.1 and 2.2, respectively. Quality control and database management are presented in Section 2.3. 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 DDC 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 pumping 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, 8.2, and 9.2). Hydrologic thresholds, triggers, and management and mitigation actions are presented in Section 3.0.

Implementation of the hydrologic monitoring network and systematic baseline data collection began in 2006. The NSE approved the original DDC 3M Plan in 2009 (SNWA, 2009a) 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, 2010, 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 and water chemistry monitoring. The well and spring monitoring networks associated with the DDC 3M Plan are presented in

Figure 2-1. The hydrologic monitoring network sites are listed in Table 2-1. The location and descriptive information for each of the sites are included in Appendix A.

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

2.1.2 Senior Water Rights and Domestic Wells

SNWA performed queries of the NDWR on-line water rights and well log databases for all active water rights and domestic wells in Cave, Dry Lake, and Delamar valleys. Additional queries of senior water rights were also performed in adjacent White River and Pahranagat valleys. An analysis and listing of domestic wells located in White River and Pahranagat valleys using the NDWR on-line well log database was performed by Stanka Consulting, LTD, (Stanka, 2017a at Sections 5.9 and 11.9).

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.

2.1.2.1 Senior Water Rights

Senior water rights in Cave Valley identified using the analysis criteria described above are listed in Table B-1. The table also includes senior water rights in southeast White River Valley located downgradient of Shingle Pass which is the primary route of groundwater outflow from Cave Valley. 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. In addition, there are three domestic wells in Cave Valley which are listed in Table B-2.

The additional senior water rights located within the 3M Plan analysis area in southern White River Valley are listed in Table B-3. These include senior water rights in the central and western portion of southern White River Valley which are unlikely to be influenced by the SNWA GDP pumping because they are located outside of the effects of Cave Valley groundwater outflow from Shingle Pass and are sourced from northern or western White River Valley.

Senior water rights in Dry Lake and Delamar valleys identified using the analysis criteria are listed in Tables B-4 and B-5. Senior water rights on Hiko, Crystal, and Ash springs in Pahranagat Valley are presented in Table B-6. Additional senior water rights in the Pahranagat Valley including those dependent upon discharge from Hiko, Crystal, and Ash springs are listed in Table B-7.

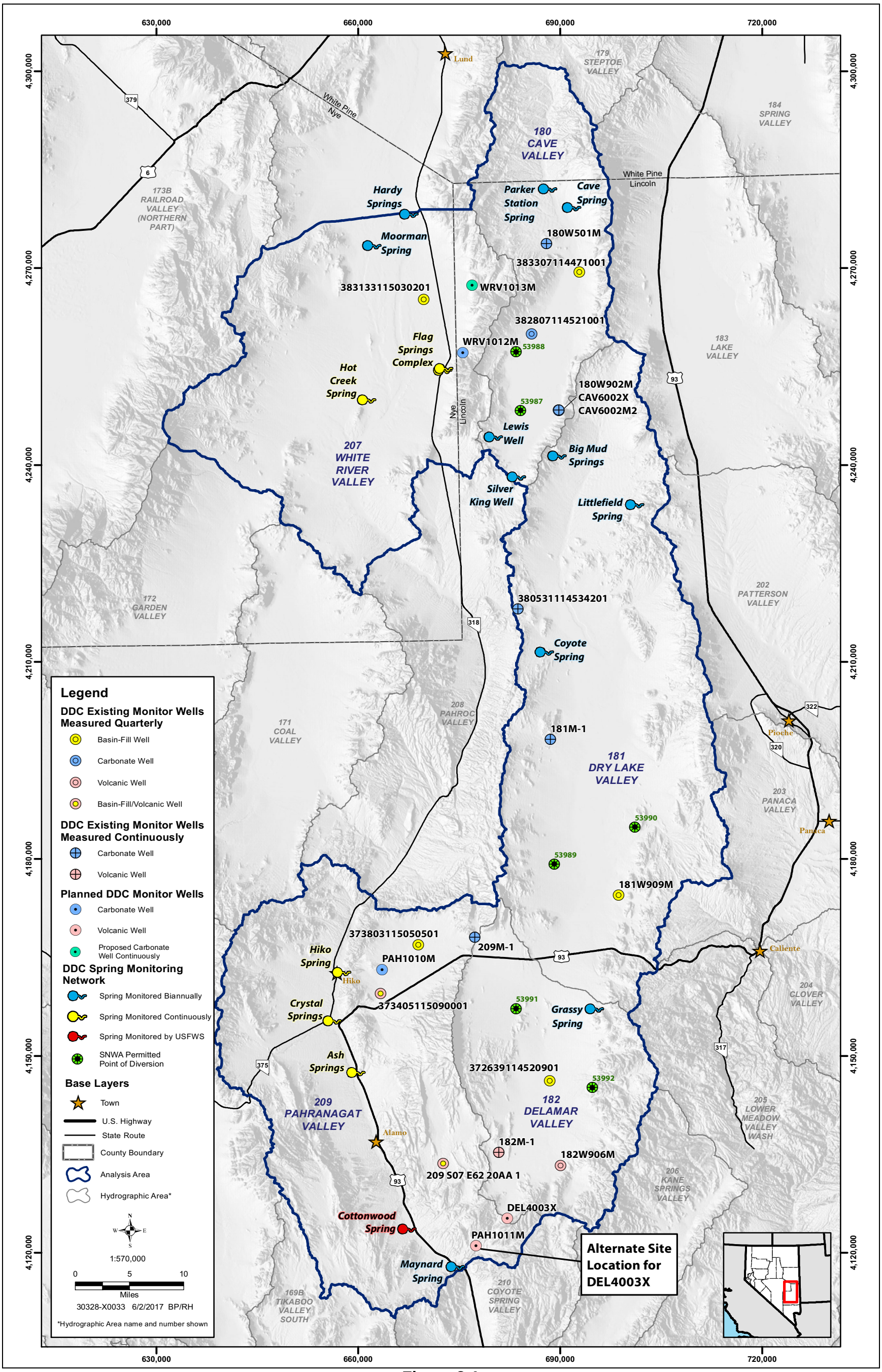


Figure 2-1
DDC 3M Plan Monitor Well and Spring Network

Table 2-1
DDC 3M Plan Hydrologic Monitoring Network
(Page 1 of 3)

Site Type/ Completion	Primary Name	Purpose / Description	Begin POR	End POR	Monitoring Frequency	Monitoring/ Reporting Agency
CAVE VALLEY						
Well/Carbonate	180W902M	Monitor aquifer conditions (aquifer test performed)	12/22/2005	Current	Continuous	SNWA
Well/Carbonate	382807114521001	Monitor aquifer conditions near POD for permit #53988	3/21/1990	Current	Quarterly	SNWA
Well/Basin Fill	383307114471001	Monitor aquifer conditions	7/19/1996	Current	Quarterly	SNWA
Well/Carbonate	180W501M	Sentinel monitor well located in Shingle Pass	12/22/2005	Current	Continuous	SNWA
Well/Carbonate	CAV6002X	Test well (aquifer test performed)	11/8/2007	Current	Quarterly	SNWA
Well/Carbonate	CAV6002M2	Monitor aquifer conditions in southeast Cave Valley	10/19/2007	Current	Quarterly	SNWA
Spring	1800101	Cave Spring monitor spring discharge	6/23/2004	Current	Bi-Annual	SNWA
Spring	1800301	Parker Station Spring monitor spring discharge	5/14/2009	Current	Bi-Annual	SNWA
Spring	381624114540302	BLM/Silver King Well monitor discharge	5/14/2009	Current	Bi-Annual	SNWA
Spring	381943114562201	Lewis Well monitor discharge	5/14/2009	Current	Bi-Annual	SNWA
SOUTHERN WHITE RIVER VALLEY						
Well/Basin Fill	383133115030201	Upgradient monitor well in White River Valley	3/22/1990	Current	Quarterly	SNWA
Well/Carbonate	WRV1012M[a]	Sentinel monitor well for White River Valley	---	---	Continuous	SNWA
Well/Carbonate	WRV1013M[b]	Sentinel monitor well for White River Valley	---	---	Continuous	SNWA
Spring-Discharge	2070501	Hot Creek Spring near Sunnyside, Nevada	7/23/1982	Current	Continuous	USGS
Spring-Discharge	2071101	Moorman Spring monitor spring discharge	7/23/1982	Current	Bi-Annual	USGS
Spring-Discharge	2071501	Hardy Spring monitor spring discharge	9/14/2004	Current	Bi-Annual	SNWA
Spring-Discharge	2071301	Flag Spring 3 monitor spring discharge	7/24/1982	Current	Quarterly	SNWA
Spring-Discharge	2071302	Flag Spring 2 monitor spring discharge	7/24/1982	Current	Continuous	SNWA
Spring-Discharge	2071303	Flag Spring 1 monitor spring discharge	7/25/1982	Current	Quarterly	SNWA
DRY LAKE VALLEY						
Well/Carbonate	380531114534201	Monitor aquifer conditions	4/17/1983	Current	Continuous	SNWA/USGS
Well/Basin Fill	181W909M	Monitor aquifer conditions	1/9/2006	Current	Quarterly	SNWA
Well/Carbonate	181M-1	Monitor aquifer conditions	1/9/2006	Current	Continuous	SNWA
Spring	1810301	Littlefield Spring monitor spring discharge	6/3/2004	Current	Bi-Annual	SNWA
Spring	1810401	Coyote Spring monitor spring discharge	6/3/2004	Current	Bi-Annual	SNWA
Spring	1810501	Big Mud Spring monitor spring discharge	5/8/2008	Current	Bi-Annual	SNWA

Table 2-1
DDC 3M Plan Hydrologic Monitoring Network
(Page 2 of 3)

Site Type/ Completion	Primary Name	Purpose / Description	Begin POR	End POR	Monitoring Frequency	Monitoring/ Reporting Agency
DELAMAR VALLEY						
Well/Basin Fill	372639114520901	Monitor aquifer conditions	4/5/1993	Current	Quarterly	SNWA/USGS
Well/Volcanic	182W906M	Monitor aquifer conditions	1/9/2006	Current	Quarterly	SNWA
Well/Volcanic	182M-1	Monitor aquifer conditions	1/9/2006	Current	Continuous	SNWA
Spring	1820101	Grassy Spring monitor spring discharge	6/2/2004	Current	Bi-Annual	SNWA
PAHRANAGAT VALLEY						
Well/ Basin Fill//Volcanic	209 S07 E62 20AA 1	Sentinel Well for southern Pahranagat Valley	6/24/2003	Current	Quarterly	SNWA
Well/ Basin Fill/Volcanic	373405115090001	Monitor aquifer conditions	6/24/2003	Current	Quarterly	SNWA
Well/Basin Fill	373803115050501	Sentinel monitor well for northern Pahranagat Valley	6/24/2003	Current	Quarterly	SNWA
Well/Carbonate	209M-1	Sentinel monitor well for northern Pahranagat Valley	1/19/2006	Current	Continuous	SNWA
Well/Carbonate	PAH1010M[a]	Mitigation Trigger for northern Pahranagat Valley	---	---	Continuous	SNWA
Well/Volcanic	DEL4003X (PAH1011M)[a]	Planned sentinel well in southern Delamar Valley	---	---	Continuous	SNWA
Well/Not sited	Future Monitoring Well #4[a]	Additional future well in DDC analysis area not yet sited	---	---	Continuous	SNWA
Spring-Discharge	2090101	Hiko Spring monitor spring discharge	7/29/1982	Current	Continuous	SNWA
Spring-Discharge	2090201	Cottonwood Spring monitor spring discharge	5/24/2004	Current	Quarterly	USFWS
Spring	2090801	Maynard Spring monitor water level	5/12/2009	Current	Bi-Annual[c]	SNWA
Spring-Discharge	09415589	Crystal Spring Diversion near Hiko, NV monitor spring discharge	5/24/2004	Current	Continuous	USGS
Spring-Discharge	2090401	Crystal Springs near Hiko, NV monitor spring discharge	7/29/1982	Current	Continuous	USGS
Spring-Discharge	09415639	Ash Springs Diversion at Ash Springs, NV monitor spring discharge	12/3/2003	Current	Continuous	USGS
Spring-Discharge	2090501	Ash Springs Creek below Highway 93 at Ash Springs, NV monitor spring discharge	7/30/1982	Current	Continuous	USGS

Table 2-1
DDC 3M Plan Hydrologic Monitoring Network
(Page 3 of 3)

Site Type/ Completion	Primary Name	Purpose / Description	Begin POR	End POR	Monitoring Frequency	Monitoring/ Reporting Agency
REGIONAL PRECIPITATON STATIONS						
Precipitation	Currant	Measurement record includes over 60 years of water year data	10/7/1953	Current	Periodic	NDWR
Precipitation	Blue Eagle Ranch Hanks	Measurement record includes over 40 years of monthly data near DDC Hydrographic Study Area	4/1/1978	Current	Continuous	WRCC
Precipitation	Pioche[c]	Measurement record includes over 80 years of monthly data near DDC Hydrographic Study Area	1/1/1888	Current	Continuous	WRCC
Precipitation	Caliente[c]	Measurement record includes over 90 years of monthly data near DDC Hydrographic Study Area	4/1/1903	Current	Continuous	WRCC
Precipitation	Sunnyside[c]	Measurement record includes over 50 years of monthly data near the Flag Springs Complex	6/1/1891	Current	Continuous	WRCC
Precipitation	Lund	Measurement record includes over 60 years of monthly data near DDC Hydrographic Study Area	9/1/1957	Current	Continuous	WRCC
Precipitation	Hiko	Measurement record includes 29 years of monthly data inside DDC Hydrographic Study Area	9/1/1989	Current	Continuous	WRCC
Precipitation	Defiance Mines	High elevation precipitation gage near DDC Hydrographic Study Area	2011	Current	Continuous	NRCS (Snotel)
Precipitation	Corduroy Flat	High elevation precipitation gage near DDC Hydrographic Study Area	2011	Current	Continuous	NRCS (Snotel)
Precipitation	White River Nv	High elevation precipitation gage near DDC Hydrographic Study Area	2011	Current	Continuous	NRCS (Snotel)
Precipitation	Ward Mountain	High elevation precipitation gage near DDC Hydrographic Study Area	1980	Current	Continuous	NRCS (SnoTel)

[a] Planned SNWA Monitor Well
[b] Location to be determined
[c] Period of Record (POR) is not inclusive of all years between beginning and end dates.
Monitoring agencies: NDWR - Nevada Division of Water Resources; WRCC - Western Regional Climate Center; NRCS - Natural Resources Conservation Service; USGS - U.S. Geological Survey; USFWS - U.S. Fish and Wildlife Service

2.1.2.2 Domestic Wells

The analysis of domestic wells located in southern White River Valley using the NDWR on-line well log data base indicate 216 records in the entire valley that list a proposed use as domestic on the well logs (Stanka, 2017a at Section 5.9). One domestic well (Well Log No. 94562) is located near Butterfield Spring and monitored through the 3M Plan network. The other domestic wells in southern White River Valley are unlikely to be effected by the SNWA GDP pumping because of their location, hydrogeologic setting, distance from SNWA GDP PODs, and 3M Plan monitoring. They are also located outside of the effects of Cave Valley groundwater outflow from Shingle Pass.

The analysis of domestic wells located in Pahranagat Valley using the NDWR on-line well log data base indicate 133 records in the entire valley that list a proposed use as domestic on the well logs

(Stanka, 2017a at Section 11.9). The domestic wells in Pahranagat Valley are unlikely to be effected by the SNWA GDP pumping because of their location, hydrogeologic setting, distance from SNWA GDP PODs, and 3M Plan monitoring.

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 used in the SNWA GDP 3M program are described in Table 2-2 and illustrated in plan and profile view on Figures 2-2 and 2-3, respectively. The management categories focus additional monitoring and management activities on senior water right PODs located nearest to the SNWA GDP PODs. A more detailed discussion of the management categories is provided in the 3M Plan analysis report (Marshall et al., 2017, in 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 a 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 Dry Lake Valley). Management Category D is assigned to senior water rights located in an adjacent basin (southern White River and Pahranagat 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 the 3M Plan analysis report (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.

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.

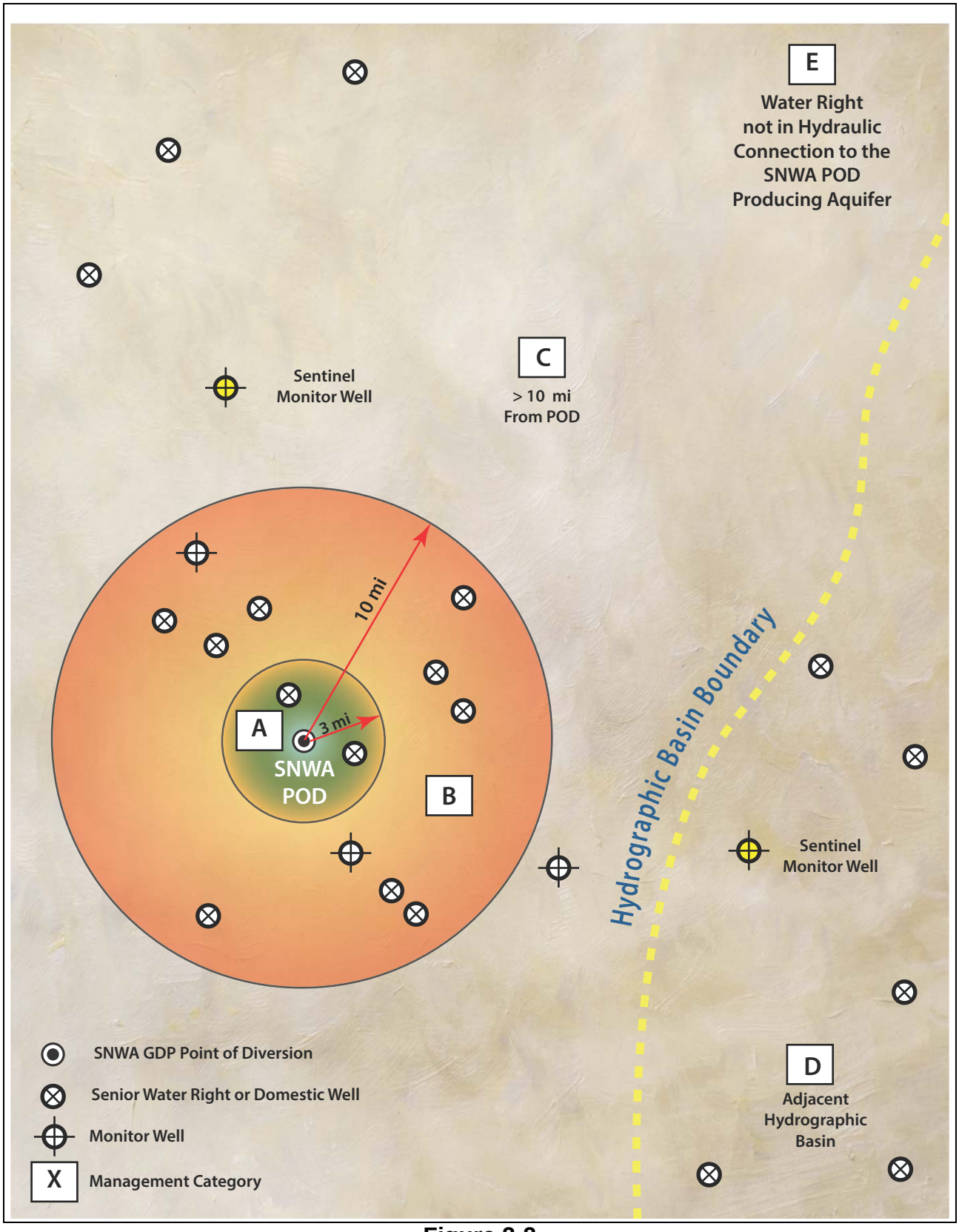


Figure 2-2
Plan View Illustration of Management Strategy Categories

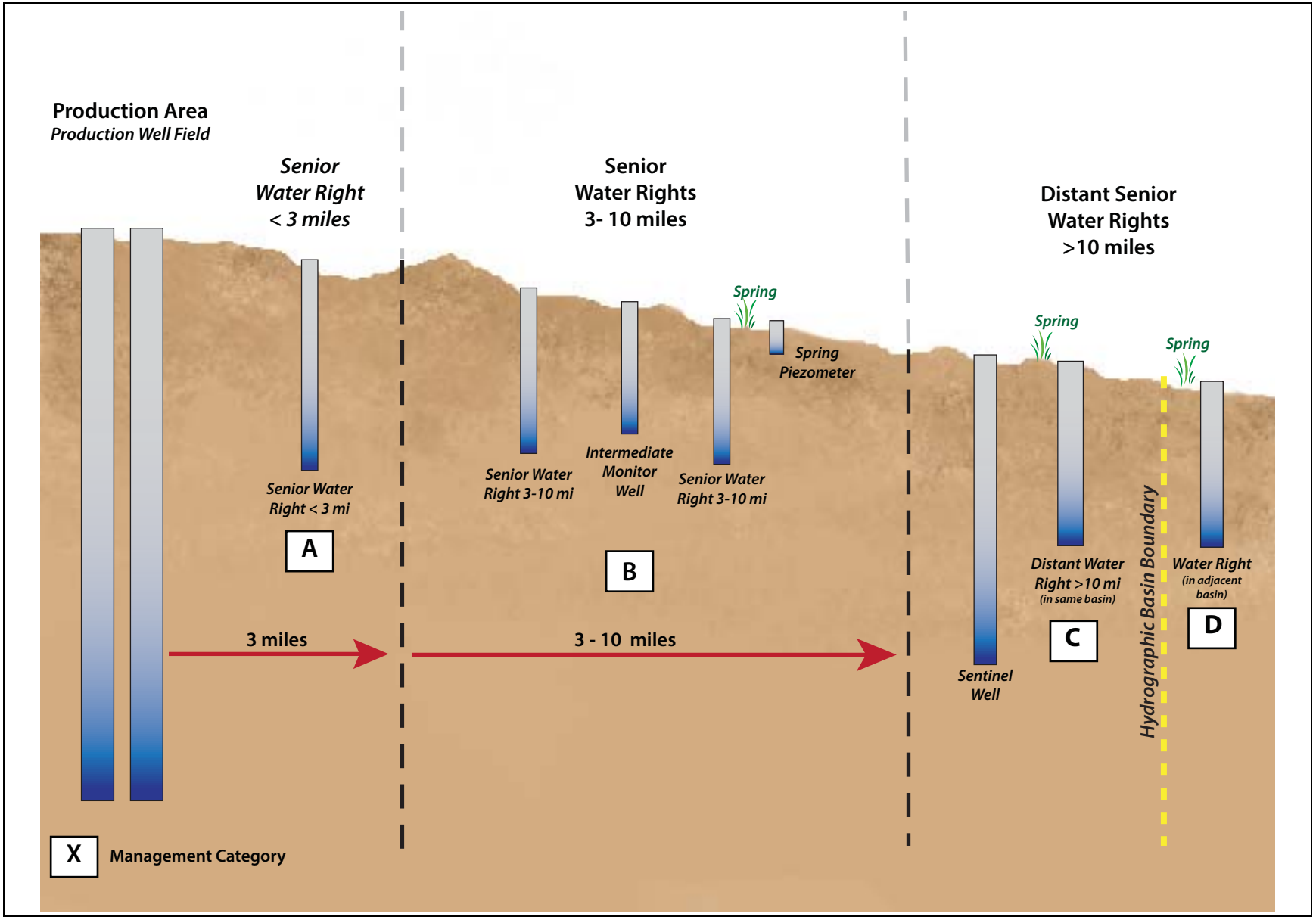


Figure 2-3
Profile Illustration of Management Strategy Categories

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.

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 DDC Hydrologic Monitoring

The monitoring activities related to wells, springs, and senior water right PODs are presented in two sections: Cave and southern White River valleys (Section 2.1.4) and Dry Lake, Delamar, and Pahranagat valleys (Section 2.1.5) to facilitate the description of the program. DDC senior water right POD monitoring sites are presented in Table 2-3. The other hydrologic monitoring program components, precipitation stations, aquifer characterization, and water chemistry, are presented in separate sections below.

2.1.4 Cave and Southern White River Valleys

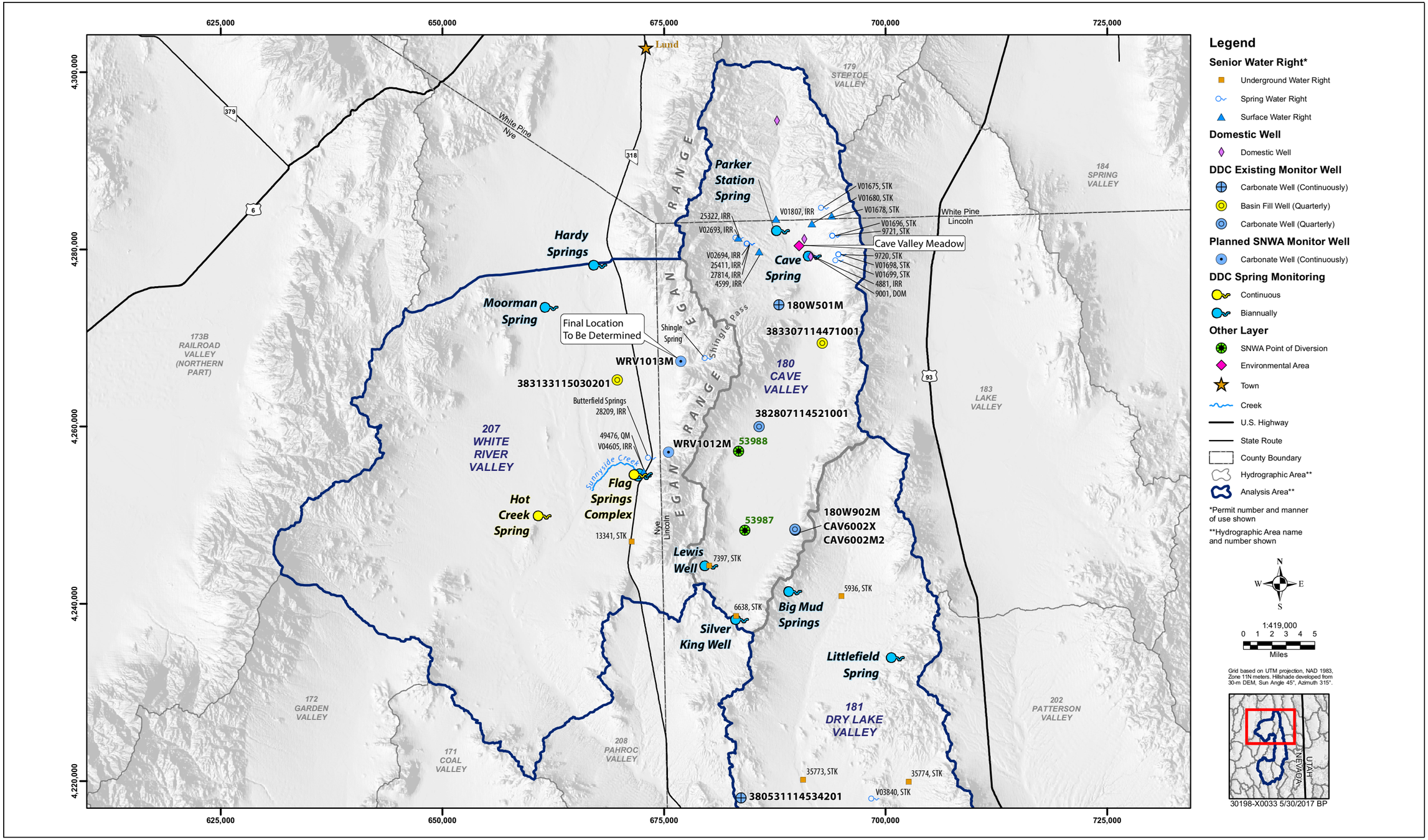
The hydrologic monitoring sites for Cave and southern White River valleys are listed in Table 2-1. Figure 2-4 and Figure 2-5 show SNWA GDP PODs, monitoring locations, and senior water rights in Cave and southern White River valleys, respectively. The senior water rights in Cave Valley are assigned Management Category E, as described in the 3M Plan analysis report (Marshall et al., 2017, at Section 8.2.2) because they are not in hydrologic connection with the producing aquifer for the SNWA permits in southern Cave Valley.

Even though no effects on water rights in Cave Valley are expected, the monitoring network includes six wells and four springs within the basin that are monitored at or between the senior water right PODs and the SNWA permit PODs to observe hydrologic conditions and verify that no impact occurs. Three monitor wells (382807114521001, 383307114471001, and 180W501M) are located between the SNWA permit PODs and northern Cave Valley and Shingle Pass to measure water levels and detect propagation of drawdown.

The primary contribution of groundwater outflow from Cave Valley to White River Valley is through Shingle Pass (Figure 2-4). The 3M Plan for senior water rights located in southern White River Valley focuses on the area south of Shingle Pass along the Egan Range in the southeastern portion of the valley including Butterfield and Flag springs which receives groundwater outflow from Cave Valley. Groundwater flow through White River Valley from north of Shingle Pass and local recharge from the western slope of the Egan Range may also contribute to the discharge at Butterfield and Flag springs.

Table 2-3
DDC Senior Water Right PODs - Monitoring Sites

Senior Water Right	Monitoring Site	Notes
Cave Valley/ Southern White River Valley		
28209, 49476, V04605	Sentinel Monitor Wells (180W501M, WRV1012M, WRV1013M) and direct monitoring at Flag and Butterfield Springs	Monitor groundwater outflow from Cave Valley and direct monitoring at Flag and Butterfield springs.
All other senior water rights in southern White River Valley Analysis Area	Sentinel Monitor Wells (180W501M, WRV1012M, WRV1013M), Hot Creek, Hardy and Moorman springs, and well 383133115030201	Monitor groundwater outflow from Cave Valley and aquifer conditions upgradient and in southwestern White River Valley.
Dry Lake Valley/ Delamar Valley		
18756	181M-1 proxy monitoring well and direct monitoring	Stock watering
5936, 35770, 35773, 35774	181M-1, 380531114534201	Stock watering
Pahranagat Valley		
Senior water rights in northern Pahranagat Valley	Sentinel Monitor Wells (209M-1 and PAH1010M), intermediate wells 373803115050501, 373405115090001 and direct monitoring at Hiko, Crystal, and Ash springs	Monitor groundwater outflow from northern Delamar Valley and direct monitoring at Hiko, Crystal and Ash springs.
Senior water rights in southern Pahranagat Valley	Sentinel Monitor Wells DEL4003X, 209S07E6220AA1 and direct monitoring at Maynard Spring	Monitor groundwater outflow from southern Delamar Valley and direct monitoring at Maynard Spring



Legend

Senior Water Right*
- Underground Water Right
- Spring Water Right
- Surface Water Right

Domestic Well
- Domestic Well

DDC Existing Monitor Well
- Carbonate Well (Continuously)
- Basin Fill Well (Quarterly)
- Carbonate Well (Quarterly)

Planned SNWA Monitor Well
- Carbonate Well (Continuously)

DDC Spring Monitoring
- Continuous
- Biannually

Other Layer
- SNWA Point of Diversion
- Environmental Area
- Town
- Creek
- U.S. Highway
- State Route
- County Boundary
- Hydrographic Area**
- Analysis Area**

*Permit number and manner of use shown

**Hydrographic Area name and number shown

N W E S

1:419,000
0 1 2 3 4 5
Miles

Grid based on UTM projection, NAD 1983, Zone 11N meters. Hillshade developed from 30-m DEM, Sun Angle 45°, Azimuth 315°.

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Figure 2-4
Cave Valley GDP PODs, Senior Water Rights, and Hydrologic Monitoring Network

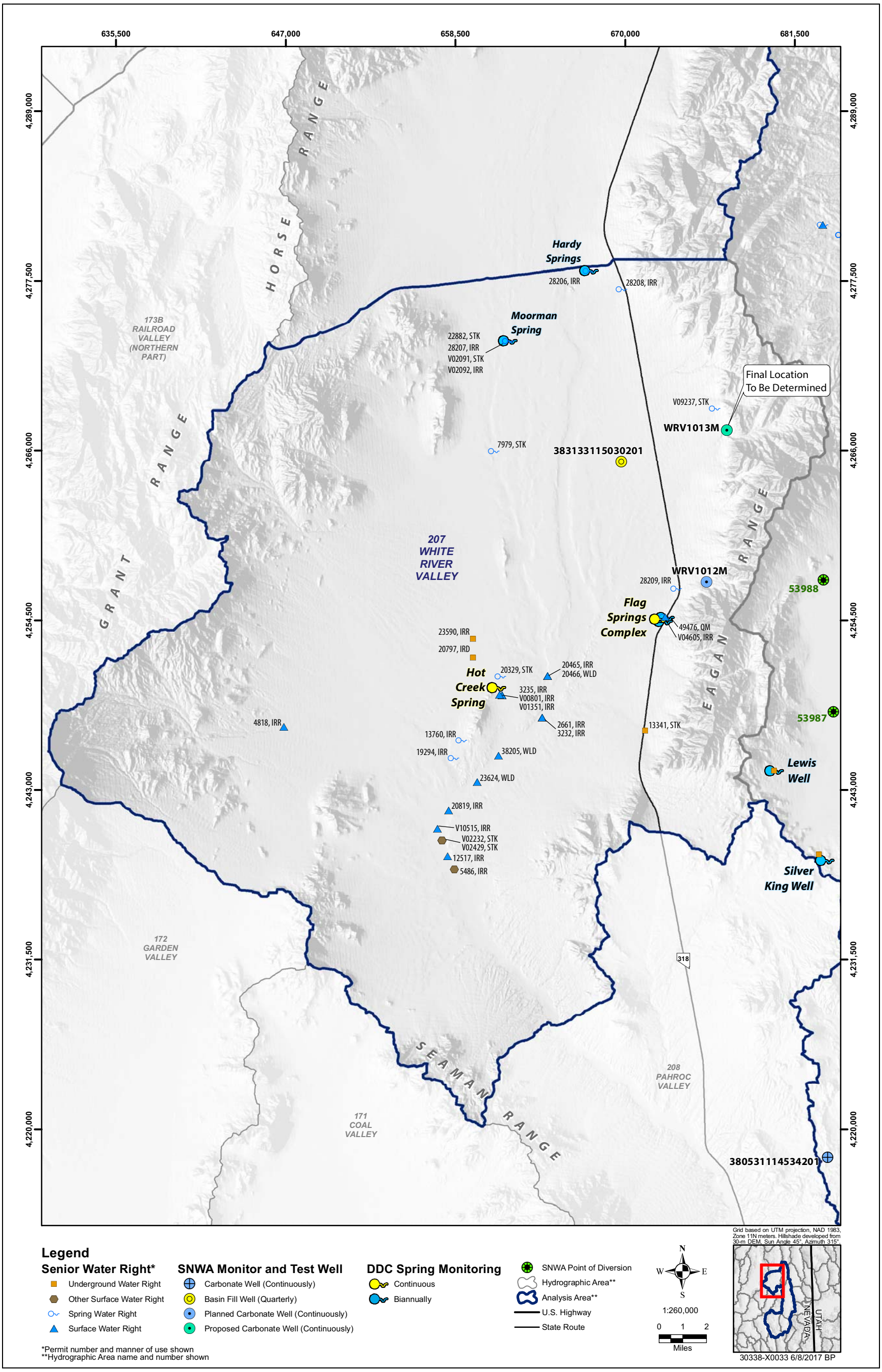

Figure 2-5
Southern White River Valley Senior Water Rights and Hydrologic Monitoring Network

Senior water rights in southern White River Valley are assigned Management Category D because they are located in an adjacent basin. The monitoring and management strategy for this category consists of using sentinel monitor wells and direct monitoring of Flag Springs complex and Butterfield Spring. The designation and purpose of sentinel wells is described in Section 3.3.1.1 and in the 3M Plan analysis report (Marshall et al., 2017, at Section 3.2.5). The sentinel wells are located between the SNWA PODs and the more distant senior water rights to identify and measure propagation of drawdown.

The four sentinel monitor wells associated with the relationship between Cave and White River valleys are located in central Cave Valley (existing well 383307114471001), within Shingle Pass (existing well 180W501M), at the base of Shingle Pass in White River Valley (WRV1013M proposed, not sited), and on the western slope of the Egan range (WRV1012M planned and sited). These sentinel monitor wells will detect changes in water level which may indicate propagation of drawdown from Cave Valley into southern White River Valley. The stratigraphy and structural orientation of the Egan Range makes it very unlikely for groundwater flow to occur directly across the range west to Flag Springs from Cave Valley. However, monitor well WRV1012M is planned to be constructed on the west slope of the Egan Range in the vicinity of Flag and Butterfield springs to identify drawdown propagation should it occur through the Egan Range.

Direct monitoring of Flag Springs complex and Butterfield Spring is ongoing. A continuous gaging station is maintained and operated by SNWA at Flag Spring No. 2. Physical periodic measurements are performed at Flag Spring Nos. 1 and 3 and Butterfield Springs. A description of the hydrogeologic setting and background on Flag Spring complex and Butterfield Spring is presented in 3M Plan analysis report (Marshall et al., 2017, at Section 8.2.3).

Two springs (Moorman and Hardy springs) and one monitoring well (383133115030201) located upgradient of Shingle Pass are included in the monitoring network to identify influences from northern White River Valley. Hot Creek Spring, located in west White River Valley, is outside the area of influence of SNWA GDP operations. However, the site is monitored continuously to document aquifer conditions in that area.

2.1.5 Dry Lake, Delamar, and Pahranagat Valleys

The hydrologic monitoring sites for Dry Lake, Delamar, and Pahranagat valleys are listed in Table 2-1. Figures 2-6 and 2-7 show SNWA GDP PODs, monitoring locations, and senior water rights in Dry Lake and Delamar valleys and Pahranagat Valleys, respectively.

Senior water rights in Dry Lake Valley include five certificated senior underground water rights, two certificated spring rights, and two spring vested claims. The underground rights are located at a distance of 10 to 35 miles from the closest SNWA GDP PODs and are assigned Management Category C. The monitoring strategy for this category consists of using monitor well 181M-1 to identify and measure the propagation of drawdown from the SNWA GDP pumping to northern Dry Lake Valley. Additional hydrologic monitoring sites (Well 380531114534201, Coyote Spring, Littlefield Spring, and Big Mud Spring) are measured to monitor hydrologic conditions in the northern portion of Dry Lake Valley. The senior spring water rights and vested claims in Dry Lake Valley are assigned Management Category E since they are not in hydraulic connection with the

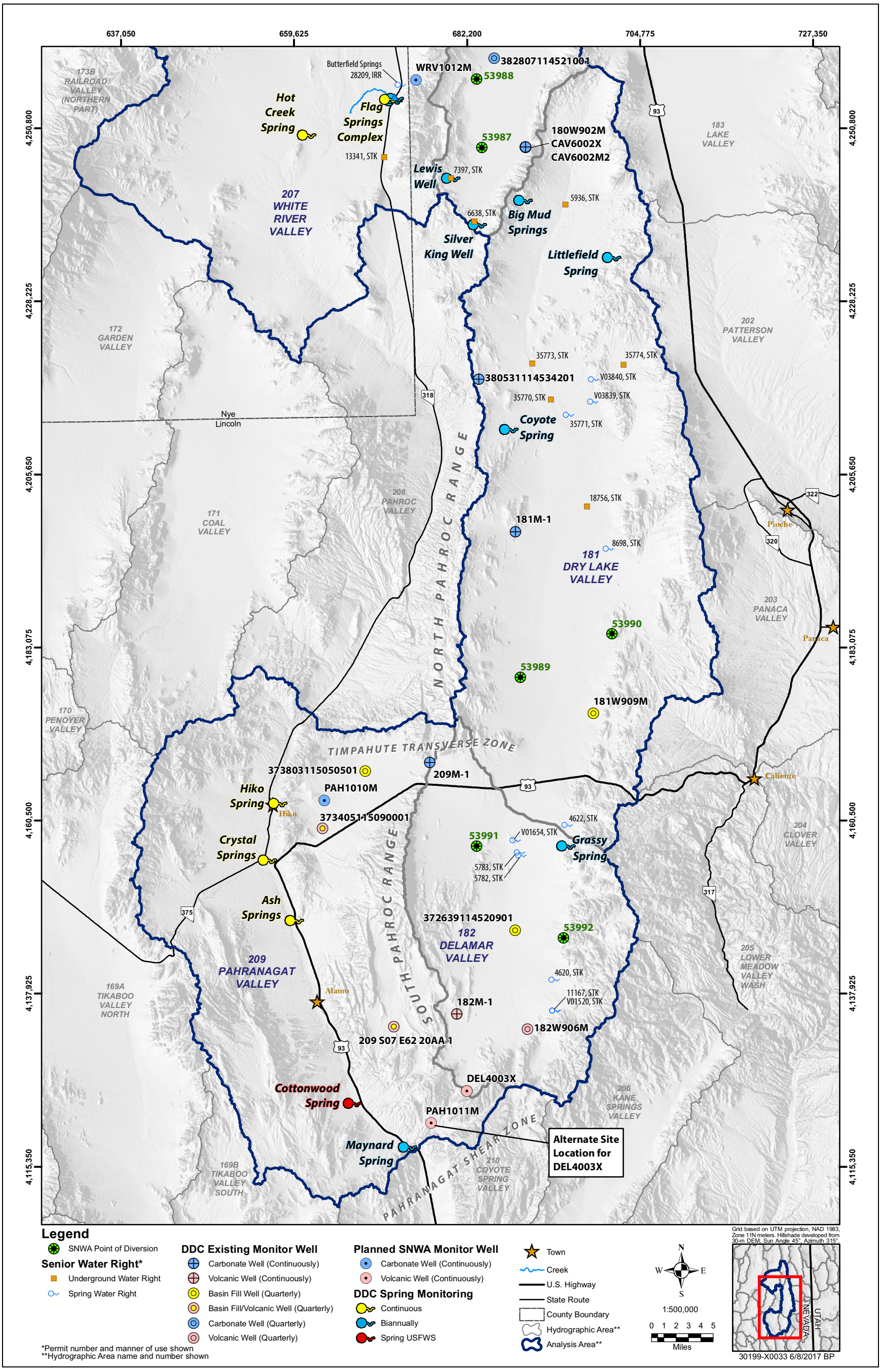

Figure 2-6
Dry Lake and Delamar Valley GDP PODs, Senior Water Rights, and Hydrologic Monitoring Network

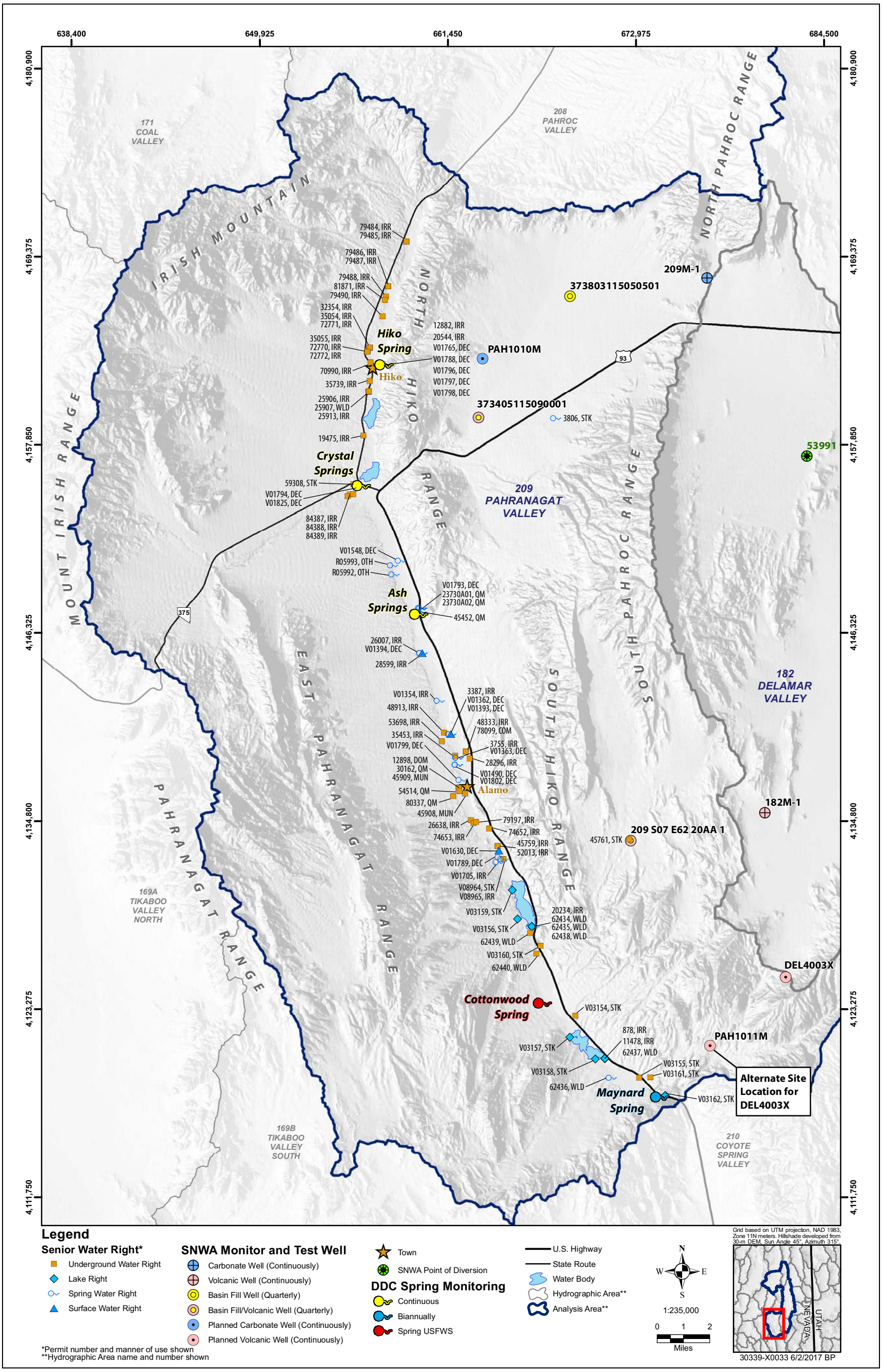

Figure 2-7
Pahranagat Valley Senior Water Rights and Hydrologic Monitoring Network

producing aquifer for the SNWA GDP permits due to the hydrogeologic setting and therefore would not be effected by SNWA GDP pumping.

Senior water rights in Delamar Valley are assigned Management Category E, because they are not in hydraulic connection with the producing aquifer for the SNWA permits. Impacts to these senior water rights within Delamar Valley are not expected due to the hydrogeologic setting and depth to groundwater in the producing aquifer for the SNWA permits due.

Groundwater levels within Delamar Valley are measured at existing monitor wells 372639114520901, 182M-1, and 182W906M to document aquifer conditions. An additional planned monitor well (DEL4003X or alternate site PAH1011M) is located in the Pahranagat Shear Zone (PSZ) at the southern end of the basin. Grassy Spring, a higher elevation spring modified with a collection system, is also included in the monitoring program even though it is not hydraulically connected to the producing aquifer.

Senior water rights in Pahranagat Valley are assigned Management Category D, because they are located in a basin adjacent to SNWA GDP pumping. The monitoring strategy for this category consists of using intermediate wells and three assigned sentinel monitor wells located between the SNWA PODs and the more distant senior water rights to detect and measure propagation of drawdown.

In northeast Pahranagat Valley, a sentinel well (209M-1) and a series of three other intermediate monitor wells are used to detect and measure the unlikely propagation of drawdown from northwestern Delamar Valley to Pahranagat Valley and the regional Hiko, Crystal, and Ash springs via the Timpahute Transverse Zone. The hydrogeologic setting of this area is described in the 3M Plan analysis report (Marshall et al., 2017, at Section 9.2.4). The four monitor wells between Delamar Valley and the regional springs consist of wells 209M-1 (carbonate), 373803115050501 (basin fill) and 373405115090001 (basin fill). A planned well, PAH1010M, will be constructed on the west slope of the Hiko Range in carbonate rock prior to SNWA GDP pumping to meet baseline data collection requirements.

SNWA will ensure operation of the gaging stations at Ash and Crystal springs, and the flow meter at Hiko Spring. The Ash and Crystal springs gages are currently operated through an SNWA joint funding agreement with the U.S. Geological Survey. The Hiko Spring flow meter is operated by SNWA directly with permission from the Hiko Irrigation District.

The South Pahroc Range forms the north-south hydrographic boundary between Delamar and Pahranagat valleys and terminates to the south at the Pahranagat Shear Zone (PSZ). Basin fill material and range front faults which parallel the South Pahroc Range provide the dominant pathway of groundwater flow through Delamar Valley. The PSZ provides structural features orientated to the southwest which provide a flow pathway from Delamar Valley through the southern edge of Pahranagat Valley and into Coyote Spring Valley.

Aquifer conditions in central and southern Delamar Valley are currently monitored at well 372639114520901. No significant groundwater flow is expected across the South Pahroc Range from Delamar Valley to Pahranagat Valley. However, water levels have been measured at monitor well

209S07E6220AA1 to detect propagation of drawdown across the range if it occurs. Monitoring of this well was suspended because baseline record has been stable. Monitoring of well 209S07E6220AA1 will resume three years prior to SNWA GDP pumping. Monitor well DEL4003X is planned to be installed near the boundary between Delamar and Pahranagat valleys within the PSZ. The right-of-way has been granted by the Bureau of Land Management (BLM) along with an alternative site (PAH1011M) in Pahranagat Valley. These three wells will be used to monitor groundwater conditions and detect drawdown propagation outside the basin to the south and west if it occurs.

In southern Pahranagat Valley, Maynard Spring is monitored using shallow piezometers installed by USFWS as part of the DDC 3M Plan. The spring consists of ponded water and no measurable discharge has been recorded. The water source for Maynard Spring may be associated with underflow originating from surface water at the Pahranagat National Wildlife Refuge (NWR) based on the hydrogeologic setting. Other springs in southern Pahranagat Valley are likely sourced from local recharge. The source for these springs will be further evaluated during the water chemistry sampling program element of the DDC 3M Plan. USFWS monitors Cottonwood Spring located in western Pahranagat Valley. There is no current evidence that groundwater outflow from Delamar Valley contributes to the discharge at these springs, and effects from SNWA GDP pumping are unlikely. However the monitoring network provided the ability to detect propagation of drawdown to southern Pahranagat valley if it occurs.

2.1.6 Precipitation

SNWA will compile and report data from selected precipitation stations with an established historical record in the vicinity of the study area as long as the data are available and the stations are in operation. The precipitation network will assist in assessing climate variability in the vicinity of DDC. The current precipitation network stations are presented in Table 2-1 and shown on Figure 2-8.

2.1.7 Aquifer Characterization

A constant-rate pumping test will be performed on each future production test well to evaluate aquifer properties. Aquifer-testing results will be used to assess well performance, provide data for the numerical groundwater flow model, and assist in evaluating potential future pumping influence.

Well-performance step test and 72-hour constant-rate tests have been performed on SNWA Test Well CAV6002X and Monitor Well 180W902M located in Cave Valley. A hydrologic data analysis report including hydrologic and water chemistry data, well performance information, and aquifer test analysis results was prepared for the site (Prieur et al., 2011) and provided to the NSE.

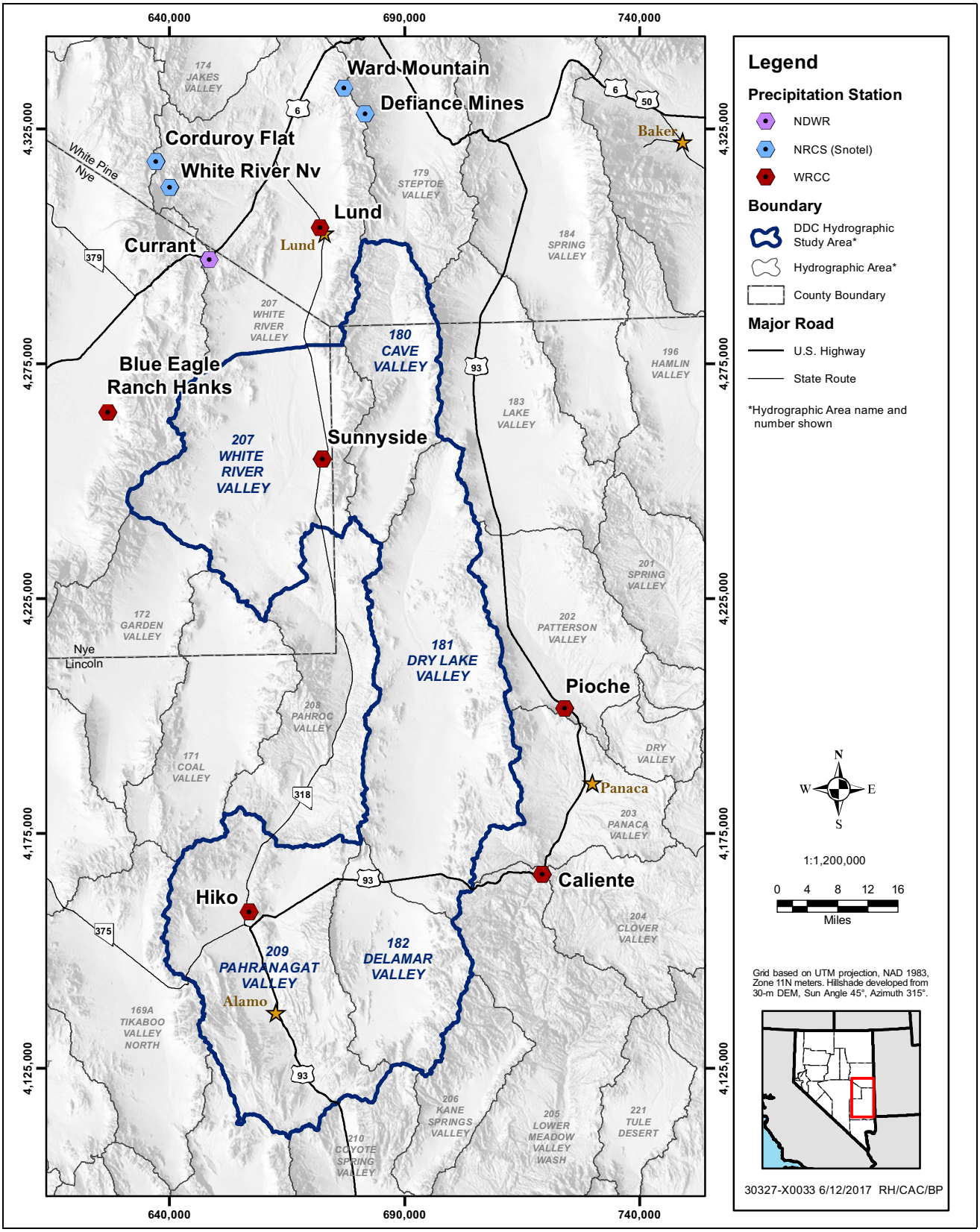

Figure 2-8
DDC Regional Precipitation Station Locations

2.1.8 Water Chemistry

Monitoring of groundwater and surface-water chemistry is performed to establish baseline conditions. The sampling program consists of the collection of samples from 12 representative spring and/or well locations approved by the NSE. Two sampling events will be performed at 6-month intervals to collect baseline data. The first sampling event will occur after installation of the planned monitor wells listed in Table 2-1. SNWA will collect and submit samples for chemical analysis for the water-chemistry parameters listed in Table 2-4. The water chemistry sample locations are presented in Table 2-5. Chemistry parameters and locations may be modified with approval of the NSE. Subsequent sampling will be performed once every 5 years following the start of groundwater production by SNWA.

Table 2-4
Water-Chemistry Parameters

Field Parameters	Major Ions	Isotopes	Minor and Trace Elements
Water temperature	TDS	Oxygen-18	Arsenic
Air temperature	Calcium	Deuterium	Barium
pH	Sodium	Tritium	Cadmium
Electrical conductivity	Potassium	Chlorine-36[a]	Chromium
Dissolved oxygen	Chloride	Carbon-14[a]	Lead
	Bromide	Carbon-13[a]	Mercury
	Fluoride	Strontium-87[a]	Selenium
	Nitrate	Uranium-238[a]	Silver
	Phosphate		Manganese
	Sulfate		Aluminum
	Alkalinity		Iron
	Silica		Bromide
	Magnesium		Fluoride

[a]These parameters will be included only in the first sampling event and will not be included in any further water-chemistry sampling performed pursuant to this Monitoring and Mitigation Plan.

Table 2-5
DDC 3M Plan Water Chemistry Sampling Locations

Cave Valley	Southern White River Valley	Dry Lake and Delamar Valleys	Pahranagat Valley
180W501M	Flag Spring #2	181W909M	Well 209M-1
382807114521001	WRV1013M	372639114520901	Hiko Spring
		DEL4003X	Crystal Spring
			Ash Spring
			Maynard Spring

2.2 Environmental Monitoring

This section describes the environmental monitoring element for the DDC 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, 8.3, and 9.3). Thresholds, triggers, and management and mitigation actions are presented in Section 3.0.

Reporting of environmental monitoring in support of SNWA GDP water rights in DDC began in 2012. The previous DDC biological monitoring plan (Biologic Resources Team, 2011) was approved by the NSE in Rulings 6165-6167 (NDWR, 2012a, at page170; NDWR, 2012b, at page 163; and NDWR, 2012c, at page 161). Annual reports for that plan were submitted to the NSE (SNWA, 2013b, 2014b, 2015b, 2016b, 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.

Environmental monitoring is described for southern White River and Pahranagat valleys. No environmental monitoring is needed in DDC due to lack of hydraulic connectivity between the environmental resources and the producing aquifer in which SNWA GDP production wells are installed (see discussion in Marshall et al., 2017, at Section 9.3).

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 southern White River and Pahranagat valleys. Additional environmental monitoring is presented below.

2.2.1 Southern White River Valley

The environmental resources for which monitoring is established in southern White River Valley to ensure avoidance of unreasonable effects include one federally listed species and eight native aquatic-dependent special status animal species. 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.

Federally listed species and native aquatic-dependent special status animal species: Environmental monitoring in southern White River Valley focuses on Flag and Butterfield Springs and the downstream Sunnyside Creek (Figure 2-9) (see discussion in Marshall et al., 2017, at Section 8.3)[1].

1. No monitoring is needed for the remaining environmental resources in southern White River Valley, as described in the 3M Plan analysis report (Marshall et al., 2017, at Section 8.3.2).

The federally listed species and native aquatic-dependent special status animal species at these sites are listed below. [1]

- Federally listed species:
  - White River spinedace (*Lepidomeda albivallis*) (Flag Springs, Sunnyside Creek)
- Native aquatic-dependent special status animal species:
  - White River speckled dace (*Rhinichthys osculus*) (Butterfield Springs, Flag Springs, Sunnyside Creek)
  - White River desert sucker (*Catostomus clarki*) (Flag Springs, Sunnyside Creek)
  - White River sculpin (*Cottus* sp.) (Butterfield Springs)
  - Butterfield pyrg (*Pyrgulopsis lata*) (Butterfield Springs)
  - Hardy pyrg (*Pyrgulopsis marcida*) (Butterfield Springs)
  - Flag pyrg (*Pyrgulopsis breviloba*) (Flag Springs)
  - White River Valley pyrg (*Pyrgulopsis sathos*) (Flag Springs)

Monitoring activities: Monitoring for these species is conducted if the hydrologic investigation trigger at sentinel well WRV1012M or WRV1013M (Figure 2-9) is activated as a result of SNWA pumping as described in Section 3.4.1. SNWA supports the Nevada Department of Wildlife Resources (NDOW) with its native fish surveys at Flag and Butterfield springs and Sunnyside Creek, which verify the continued status of the listed and other special status fish species. SNWA's support ensures that these fish surveys are conducted on a regular basis, and that they incorporate presence/absence surveys of the other native aquatic-dependent special status animal species to verify their continued existence at these sites.[2] SNWA also participates on the White River Valley Native Fishes Recovery Implementation Team. These efforts are conducted as long as the investigation trigger is activated at monitor well WRV1012M or WRV1013M, the hydrologic mitigation trigger is activated at Flag Springs as described in Section 3.4.1, or as long as mitigation actions for the species are being conducted for the SNWA GDP.

Hydrologic monitoring is conducted at Flag Springs, Butterfield Springs (which is the POD for senior water right Permit Number 28209), sentinel wells WRV1012M and WRV1013M, and other sentinel and intermediate wells between this area and SNWA GDP PODs in Cave Valley (Section 2.1.4). Flag

1. Descriptions of the species' status are provided in the 3M Plan analysis report (Marshall et al., 2017, at Section 5.3).
2. The fish surveys are part of NDOW's regular monitoring efforts for native fish populations under the Nevada State's Native Aquatic Species Program. The surveys at Flag Springs and Sunnyside Creek are typically biannual (spring and fall), and the surveys at Butterfield Spring are typically biennial (every other year). Surveys on private land require landowner permission.

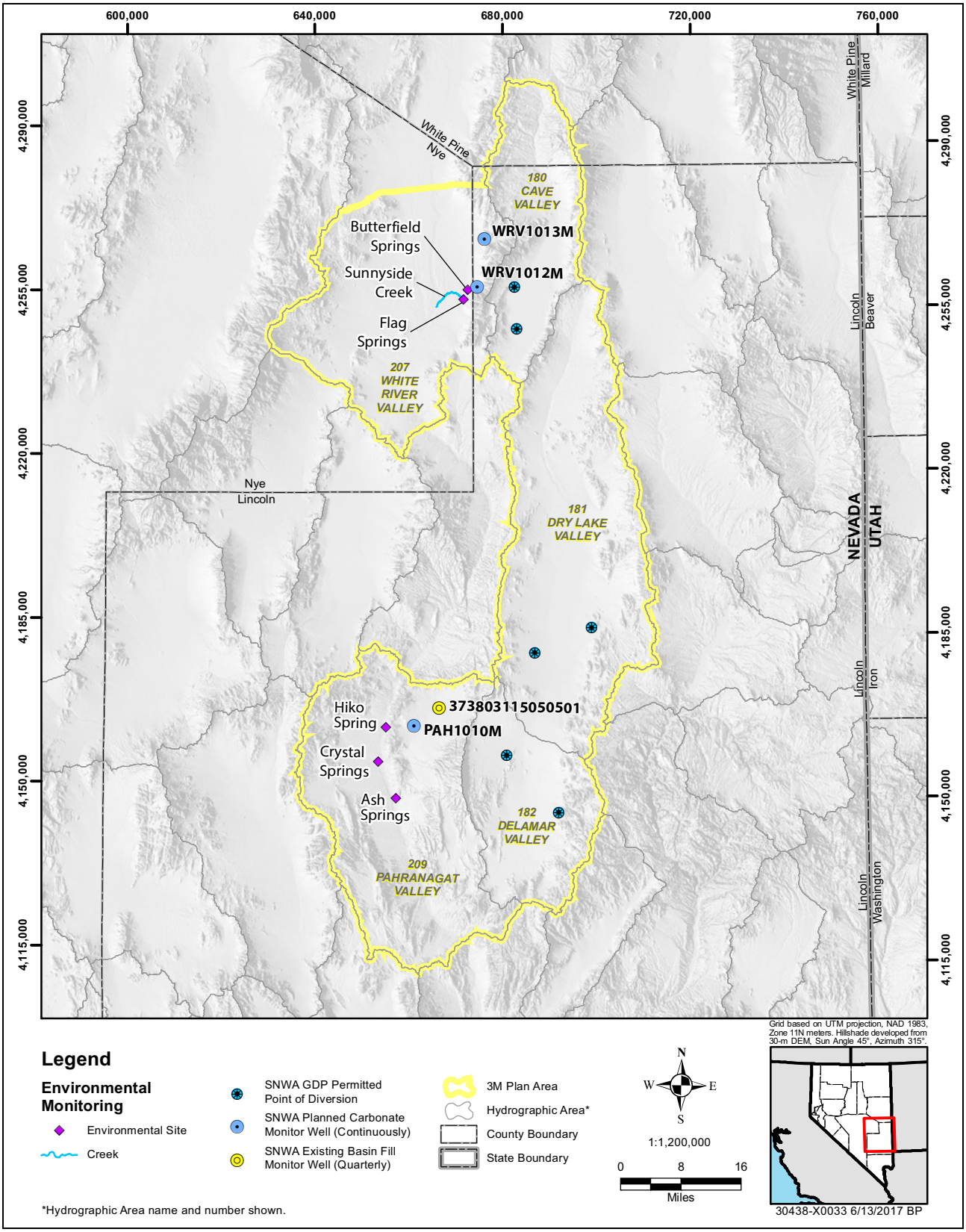

Figure 2-9
Environmental Monitoring Sites in Southern White River and Pahranagat Valleys

Spring No. 2 is also used as a proxy monitor site for Butterfield Springs and Sunnyside Creek (Sunnyside Creek is the POD for NDOW vested claim number V04605) (Section 2.1.4). Changes in water levels at the sentinel wells and spring flows at Flag Spring No. 2 are used to trigger hydrologic investigation and management actions for the senior water rights. Changes in spring flows at Flag Spring No. 2 are used to trigger mitigation actions for the senior water rights and species listed above (Section 3.4.2).

2.2.2 Pahranagat Valley

The environmental resources for which monitoring is established in Pahranagat Valley to ensure avoidance of unreasonable effects include two federally listed species and five native aquatic-dependent special status animal species. Monitoring for these resources is described below. Thresholds, triggers, and management and mitigation actions for these environmental resources are presented in Section 3.5.2.

Federally listed species and native aquatic-dependent special status animal species: Environmental monitoring in Pahranagat Valley focuses on Hiko, Crystal, and Ash springs (Figure 2-9) (see discussion in Marshall et al., 2017, at Section 9.3)[1]. The federally listed species and native aquatic-dependent special status animal species at these sites are listed below.[2]

- Federally listed species:
  - Hiko White River springfish (*Crenichthys baileyi grandis*) (Hiko and Crystal springs)
  - White River springfish (*Crenichthys baileyi baileyi*) (Ash Springs)
- Native aquatic-dependent special status animal species:
  - Pahranagat pebblesnail (*Pyrgulopsis merriami*) (Ash Springs)
  - Grated tryonia (*Tryonia clathrata*) (Ash Springs)
  - Ash Springs riffle beetle (*Stenelmis lariversi*) (Ash Springs)
  - Pahranagat naucorid bug (*Pelocoris biimpressus shoshone*) (Ash Springs)
  - Hubbs Pyrg (*Pyrgulopsis hubbsi*) (Crystal Springs)

Other federally listed and native aquatic dependent special status species occur in downstream habitat supported by the Crystal and Ash spring flows, including the federally listed Pahranagat roundtail chub (*Gila robusta jordani*), southwestern willow flycatcher (*Empidonax traillii extimus*), and

1. No monitoring is needed for the remaining environmental resources in Pahranagat Valley, as described in the 3M Plan analysis report (Marshall et al., 2017, at Section 9.3).
2. Descriptions of the species' status are provided in the 3M Plan analysis report (Marshall et al., 2017, at Section 5.3).

western yellow-billed cuckoo (*Coccyzus americanus*).[1] These species are not monitored, but are protected by this 3M Plan (see discussion in Section 3.5.2 and Marshall et al., 2017, at Section 9.3).

Monitoring activities: Monitoring for these species is conducted if the hydrologic investigation trigger at the sentinel well 373803115050501 (Figure 2-9) is activated as a result of SNWA pumping as described in Section 3.5.1. SNWA supports NDOW with its native fish surveys at Hiko, Crystal, and Ash springs, which verify the continued status of the listed fish species. SNWA's support ensures that these fish surveys are conducted on a regular basis, and that they incorporate presence/absence surveys of the other native aquatic-dependent special status animal species to verify their continued existence at these sites.[2] SNWA also participates on the Pahranagat Valley Native Fishes Recovery Implementation Team. These efforts are conducted as long as the investigation trigger is activated at sentinel well 373803115050501, the hydrologic mitigation trigger is activated at monitor well PAH1010M (Figure 2-9) as described in Section 3.5.1, or as long as mitigation actions for the species are being conducted for the SNWA GDP.

Hydrologic monitoring is conducted at Hiko, Crystal, and Ash springs (which are PODs for multiple senior spring water rights), monitor wells 373803115050501 and PAH1010M, and other sentinel and intermediate wells between this area and SNWA GDP PODs in Delamar Valley (Section 2.1.5). Changes in water levels at the sentinel wells are used to trigger hydrologic investigation and management actions for the senior water rights. Changes in water levels at monitor well PAH1010M are used to trigger mitigation actions for the senior water rights and species listed above (Section 3.5.2).

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

1. Description of the species' status and their occurrences in Pahranagat Valley are provided in the 3M Plan analysis report (Marshall et al., 2017, at Section 5.3).
2. The fish surveys are part of NDOW's regular monitoring efforts for native fish populations under the Nevada State's Native Aquatic Species Program. The surveys at Hiko and Crystal springs are typically biannual (spring and fall), and the surveys at Ash Springs are typically biennial (every other year). Surveys on private land require landowner permission.

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.

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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 DDC. The management and mitigation elements 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 Cave Valley Staged Development

This 3M Plan uses a staged development approach in Cave Valley. The staged groundwater development schedule is presented in Table 3-1. SNWA committed to following a similar schedule for Stages 1-3 during the process of securing federal rights-of-way for the main GDP pipeline and associated facilities (SNWA, 2012b).

In Ruling 6165, the NSE reserved 7,300 afa of Cave Valley groundwater for the purpose of protecting White River Valley spring flows (NDWR, 2012a, at page 80). The NSE determined the perennial yield of Cave Valley to be equal to the basin recharge of 12,900 afa minus the reserved amount of 7,300 afa. The NSE re-established the perennial yield of Cave Valley to be 5,600 acre-feet, of which 5,235 afa was granted to SNWA for appropriation.

While Ruling 6165 reserved 7,300 afa, the estimated outflow from Cave Valley to White River Valley was only 3,800 afa (Burns and Drici, 2011). The Stage 4 pumping volume of 3,500 afa is the difference between the amount reserved for outflow and the estimated outflow. Including the additional 3,500 afa as the fourth stage provides the same level of protection as reserving 7,300 afa during the first 15 years of SNWA GDP pumping. NSE authorization is required to advance from Stage 3 to pump this additional water.

The staged-development approach limits GDP pumping while aquifer response data is collected. Data collected during these stages will provide additional information on aquifer properties, which will be used to calibrate the transient-state numerical flow model and refine other predictive analytical tools (Section 4.0). The revised model or other predictive tools will provide estimates of future drawdown with distance and time under various pumping scenarios with greater certainty. Monitoring data and results of the model projections will be evaluated by the NSE for approval to advance to the next

Table 3-1
Cave Valley Staged Development Schedule

Stage	Incremental Volume (afa)	Total Volume (afa)	Time Period (Years)
1[a]	2,600	2,600	0 - 5
2[a]	1,300	3,900	5 - 10
3[a]	1,335	5,235	10-15
4	3,500	8,375	>15

[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 five years. Data from those five years of pumping and updated numerical groundwater flow modeling results will be submitted to the NSE as part of the DDC 3M Plan annual report. The NSE will then make a determination as to whether SNWA can proceed to the next development stage.

stage of development. The model and tools will continue to be refined in an iterative manner as data are collected through the life of the SNWA GDP.

3.2 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 3.1), 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 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.

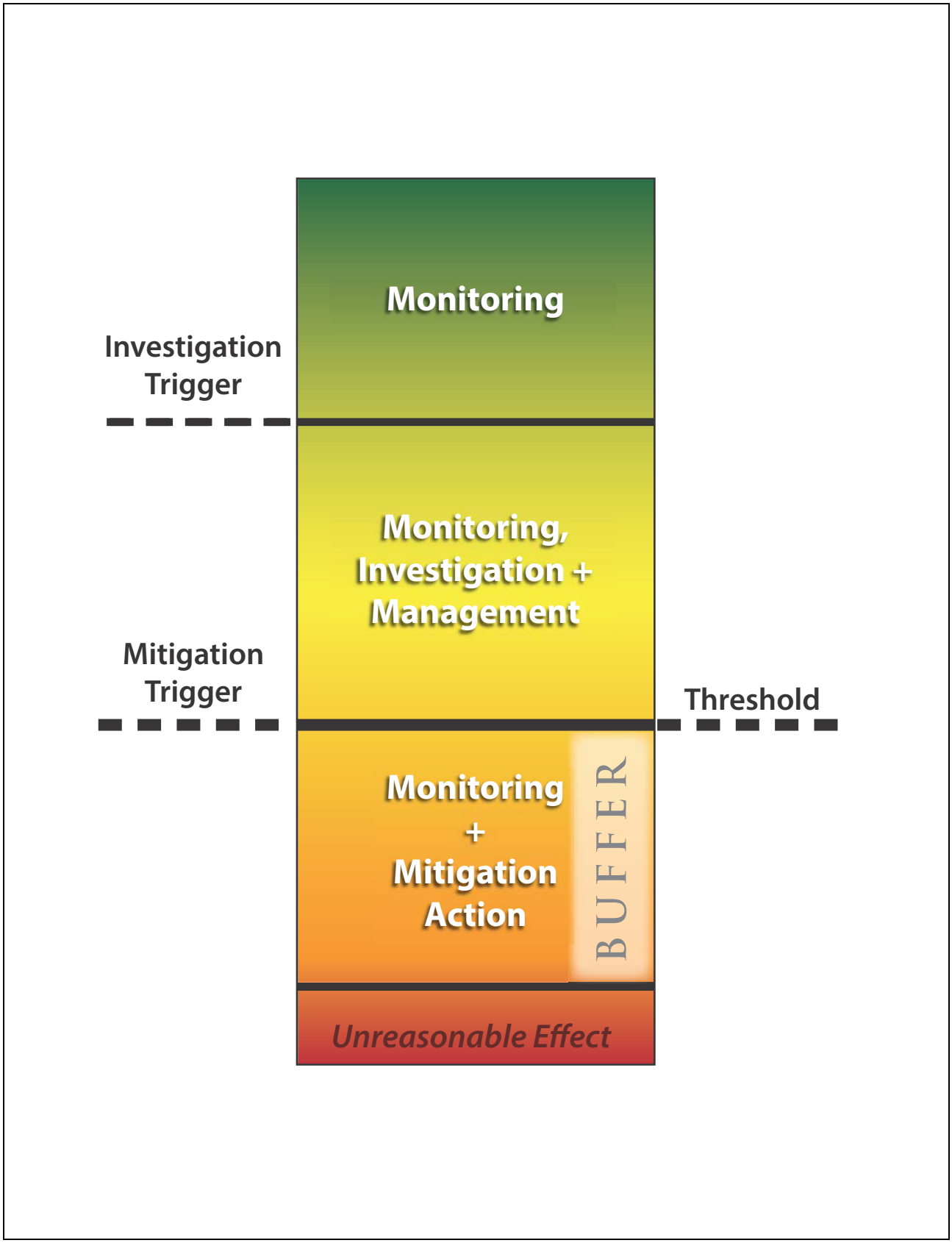

Figure 3-1
Threshold, Trigger, and Monitoring, Management, and Mitigation Approach

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.

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

- 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.

3.3 Approach for Senior Water Rights and Environmental Resources

Section 3.3.1 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 Section 3.4.1 and 3.5.1. Section 3.3.2 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 3.4.2 and 3.5.2.

3.3.1 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.

3.3.1.1 Investigation Trigger

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 3.3.2, 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 8.0 and 9.0). 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 Delamar and Pahranagat 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.

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.

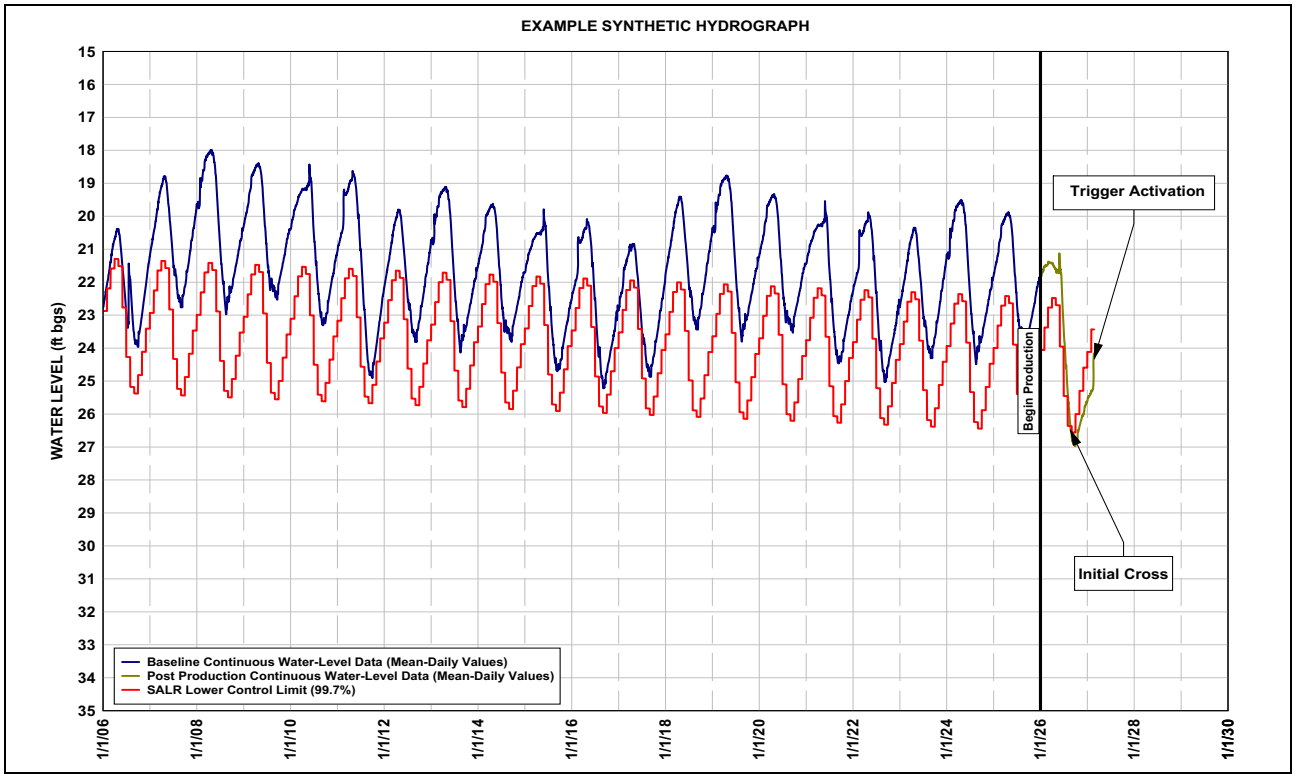

Figure 3-2
Example of Trigger Activation - Strong Seasonality

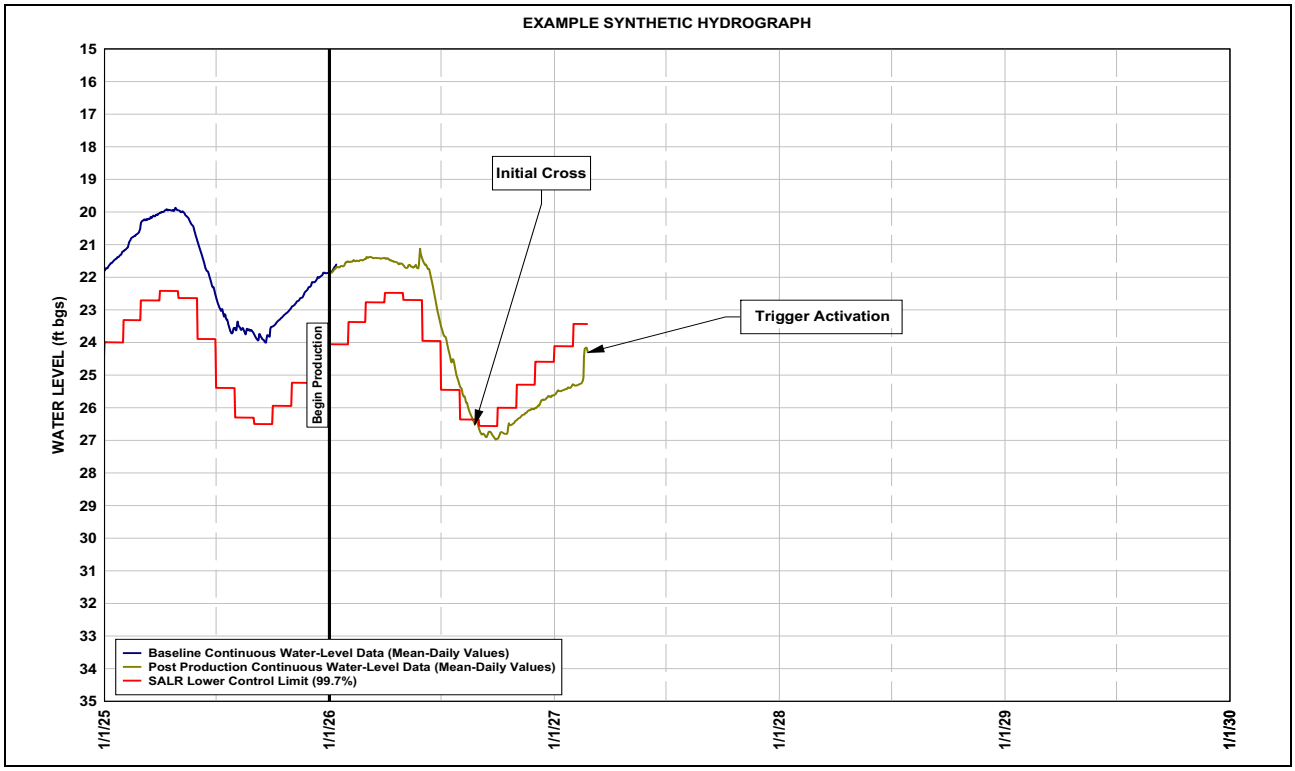

Figure 3-3
Example of Trigger Activation - Close up of Figure 3-2 Example

3.3.1.2 Investigation Methodology

Investigations are conducted when an investigation trigger is activated, or at the request of the NSE (Section 3.3.1.2). 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 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 3.4.2.

3.3.1.3 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 3.3.1.4.
- Preemptively implement a mitigation action prior to reaching a mitigation trigger.

3.3.1.4 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.

The SNWA GDP 3M Plan uses a staged development approach in Cave Valley. 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.

3.3.1.5 Senior Underground Water Right Mitigation Trigger

As described in Section 3.3.1.5, 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 foot (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 assigned Management Categories C 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.

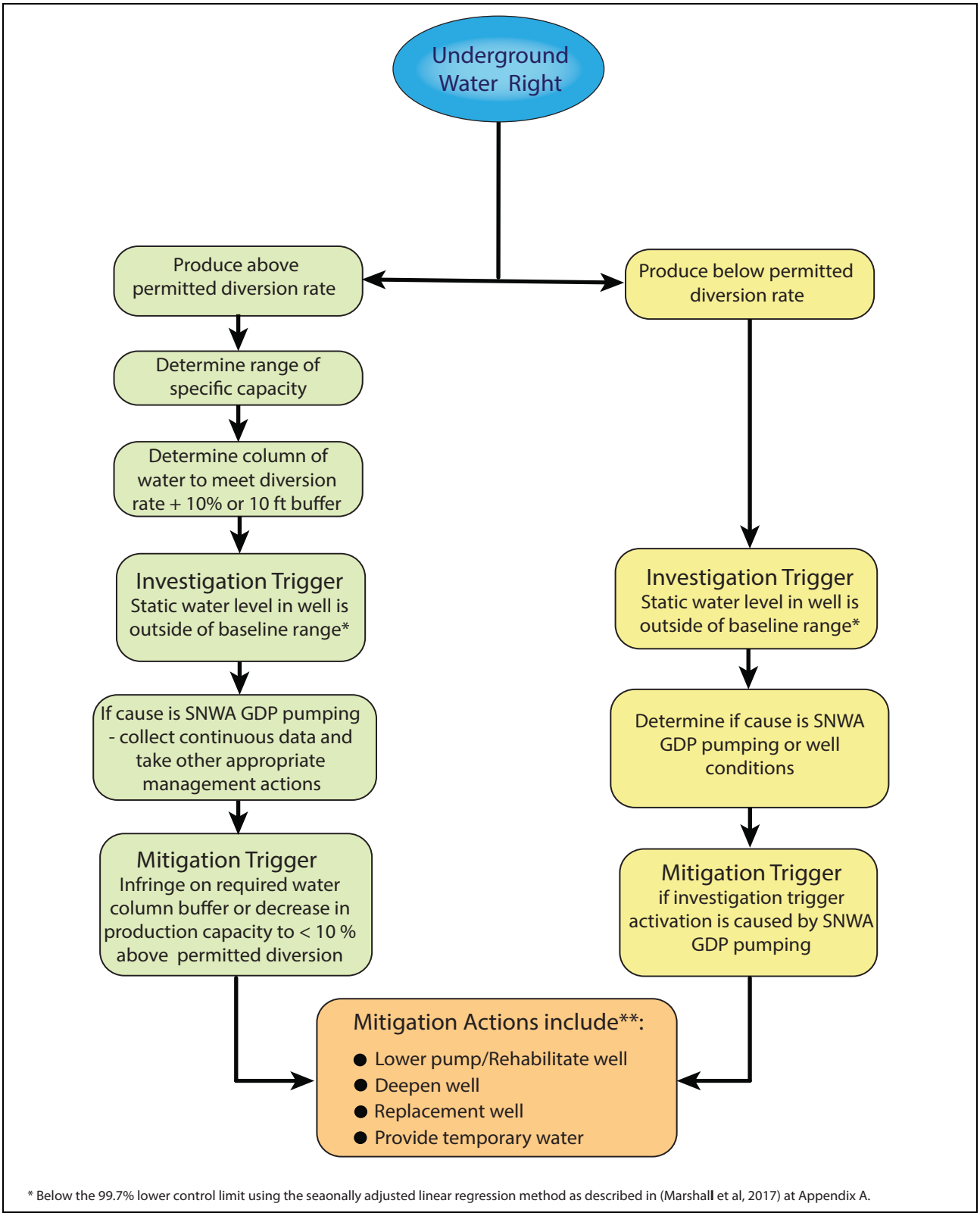

Figure 3-4
Management and Mitigation Flow Chart for Senior Underground Water Right

**Additional Mitigation actions are presented in Section 3.3.1.7

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.

3.3.1.6 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.

3.3.1.7 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 3.4.1, SNWA will submit a technical 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.

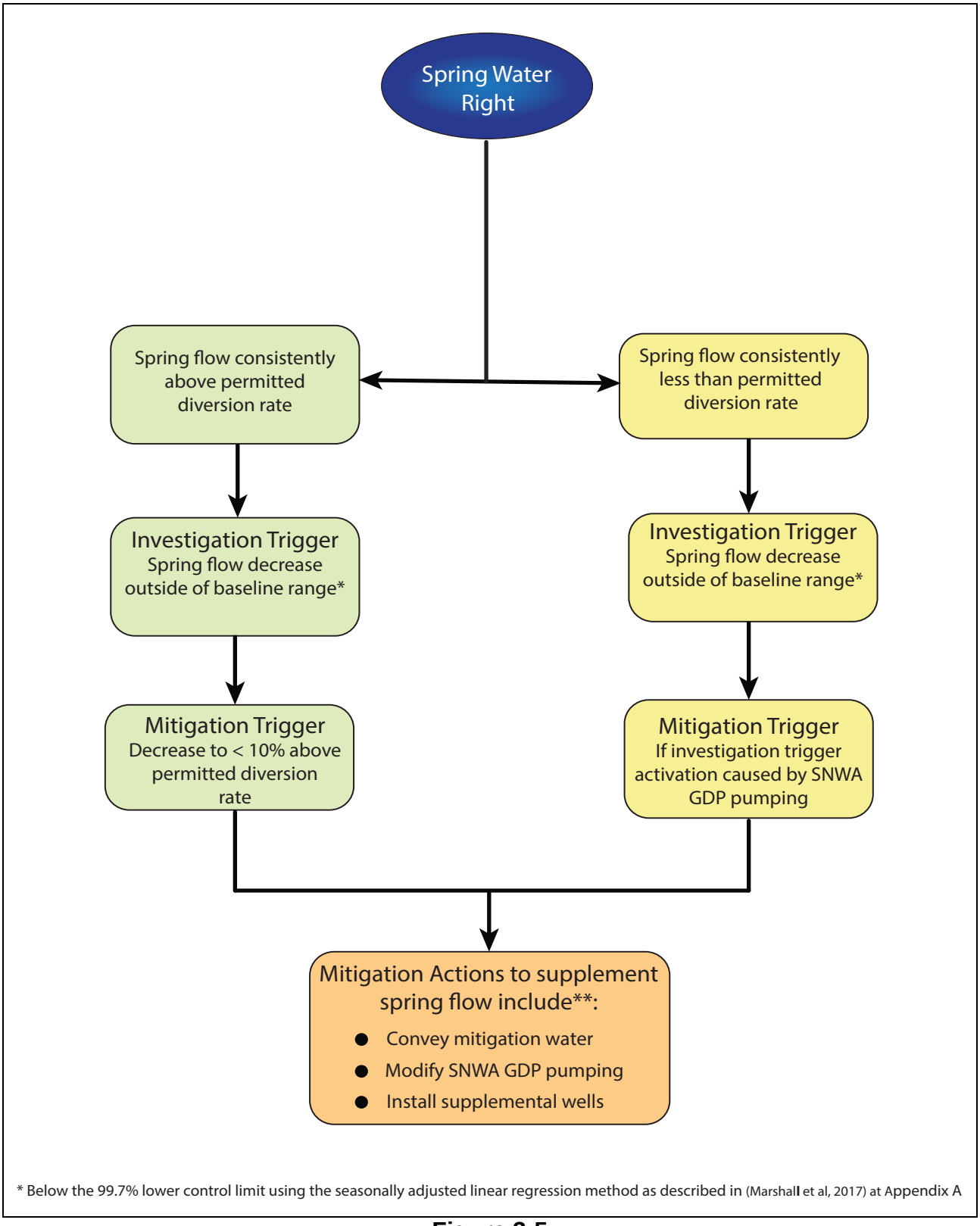

Figure 3-5
Management and Mitigation Flow Chart for Senior Spring or Stream Water Right

**Additional mitigation actions are presented in Section 3.3.1.7

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 senior water rights in the DDC analysis area are presented in summary tables in Section 3.4 and Section 3.5 and in the 3M Plan analysis report (Marshall et al., 2017, at Sections 8.0 and 9.0). 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 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 is 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.

3.3.2 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 southern White River Valley and Pahranagat Valley groundwater discharge areas occur at sites with senior water rights. The approach to avoid jeopardizing the federally listed species thus primarily relies on avoiding unreasonable effects to the senior water rights. By avoiding unreasonable effects to senior water rights, the water that the species depends on will continue to be available. As described in detail in Section 3.3.1, this approach includes investigation triggers established at intermediate wells between SNWA GDP PODs and the senior water rights, preemptive management actions to avoid or minimize the risk of activating the mitigation triggers at the senior water right PODs, and mitigation actions to avoid conflicts with senior water rights. Environmental mitigation actions are also included in the approach to ensure that unreasonable effects to the federally listed species are avoided.

- Avoiding unreasonable effects to senior water rights also helps avoid extirpation of the native aquatic-dependent special status animal species from the White River Valley and Pahranagat Valley groundwater discharge areas. Environmental mitigation actions are also included in the approach to ensure that unreasonable effects to the species are avoided. Although other wildlife are not specifically addressed in this 3M Plan, their needs are protected by avoiding unreasonable effects to senior water rights and federally listed species and native aquatic-dependent special status animal species with which they are generally co-located.

- No triggers or management or mitigation actions are needed for DDC environmental resources due to lack of hydraulic connection between them and the producing aquifer in which SNWA GDP production wells will be installed (Marshall et al., 2017, at Sections 8.3.1 and 9.2).

Mitigation actions will be prepared in advance of activating a mitigation trigger. 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.

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 3.4.2 (southern White River Valley) and Section 3.5.2 (Pahranagat Valley).

3.4 Cave and Southern White River Valleys Triggers and Management and Mitigation Actions

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 Cave and southern White River valleys. The rationale and analyses supporting these triggers and actions are presented in the 3M Plan analysis report (Marshall et al., 2017, at Section 8.0).

No triggers or management or mitigation actions are needed for Cave Valley senior water rights or environmental resources due to lack of hydraulic connection between them and the producing aquifer in which SNWA GDP production wells will be installed (Marshall et al., 2017, at Section 8.3.1).

As stated in Section 1.2, within southern White River Valley, this 3M Plan focuses on Flag and Butterfield springs and the downstream Sunnyside Creek, which are partially sourced from groundwater outflow from Cave Valley. Given the staged groundwater development, reserved groundwater, and management plan described in Section 3.4.1 to protect flows at Flag and Butterfield springs, effects in southern White River Valley from SNWA GDP pumping are unlikely. Nonetheless, triggers and mitigation actions are established to ensure unreasonable effects in southern White River Valley are avoided.

3.4.1 Senior Water Rights

The management strategy for Butterfield and Flag springs and other senior rights in southern White River Valley consists of the following:

- The sentinel monitor wells 383307114471001, 180W501M, WRV1012M, and WRV1013M located between the SNWA GDP PODs and senior water right PODs in southern White River Valley (Figure 2-4) will be monitored for water-level trends deviating from the baseline record.

- Monitoring in southern White River Valley will include the gaging station at Flag Spring No. 2, and collecting miscellaneous discharge measurements at Flag Spring No. 1, Flag Spring No. 3, and Butterfield Springs. A baseline record for these sites currently monitored already exists.

- An investigation trigger would be activated at any of the sentinel wells when ground water level decreases below the 99.7 percent lower control limit for a continuous period of six months using the SALR method. The baseline period of record hydrograph for wells 383307114471001 and 180W501M and current triggers based on the 99.7 percent level lower control limit are presented in Appendix C.

- The numerical groundwater flow model and other predictive tools will be updated and calibrated as part of the evaluation initiated as a result of activating the investigation trigger. Aquifer response data will be incorporated to reduce the uncertainty of simulation results predicting the potential for impacts on Flag and Butterfield springs. The evaluation includes an estimate of drawdown propagation with time and evaluates the influence of changing the rate and distribution of pumping on the propagation of drawdown with distance and time. The model will be updated every five years after GDP initiation or when an investigation trigger is activated. Model results will be verified by future monitoring data.

- Should projections of drawdown using the data from the sentinel wells indicate a mitigation trigger may be activated in the future, modification of the temporal and spatial distribution of Cave Valley production to avoid activating a mitigation trigger level will be evaluated.

- An investigation trigger is also set directly at the continuous gaging station at Flag Spring No. 2. The gaging station is also a proxy for Butterfield Spring. An investigation trigger at Flag Spring No. 2 is activated if the spring discharge decreases below the 99.7 percent lower

control limit for a continuous period of six months. The period of record hydrograph and current trigger for Flag Springs No. 2 is presented in Appendix C.

- An investigation of a monitoring location or area can be requested at any time by the NSE.

- The activation of an investigation trigger will result in an evaluation of causation and significance of the change, as described in Section 3.3.1.2, and will include analysis of regional hydrologic conditions and other monitor wells in the project area. Spring discharge will be compared to historical regional hydrologic conditions, spring discharge at locations upgradient of Shingle Pass (e.g. Hardy Spring), water levels in monitor wells, and the magnitude and spatial distribution of drawdown throughout the analysis area.

The mitigation trigger at the Flag Springs Complex will be activated if: (1) the evaluation associated with the investigation trigger determines the cause of the change to be SNWA GDP pumping; and (2) the combined discharge at Flag Springs Complex is less than 10 percent above the permitted diversion if adjudicated, or the vested claim if not adjudicated.

Additional background information and the management and mitigation plan for Cave and southern White River valleys including mitigation triggers and actions is summarized in Marshall et al., 2017 at Section 8.2.3) and in Table 3-2 below.

3.4.2 Environmental Resources

This section presents the triggers and management and mitigation actions to avoid unreasonable effects to environmental resources in southern White River Valley. Effects to environmental resources in southern White River Valley from SNWA GDP pumping are unlikely given the staged development, reserved groundwater, and management plan to protect spring flows at Flag and Butterfield springs (Marshall et al., 2017, at Section 8.3.2). Nonetheless, environmental triggers and management and mitigation actions are established to ensure that unreasonable effects to environmental resources in southern White River Valley are avoided.

Multiple lines of evidence indicate that there is no hydraulic connection between the producing aquifer in which SNWA GDP production wells will be installed in southern Cave Valley and the environmental resources in northern Cave Valley (see Marshall et al., 2017, at Section 8.2.2) or the shrubland habitat in southern Cave Valley (where depth to water is greater than 150 ft below ground surface; see Marshall et al., 2017, at Section 4.2.1). Because effects to these resources from SNWA GDP pumping are thus improbable, triggers and mitigation actions are not established for environmental resources in Cave Valley.

Environmental management and mitigation actions for southern White River Valley are presented below. The environmental monitoring activities in southern White River Valley are presented in Section 2.2.1.

Unreasonable effect to avoid: Jeopardy to the continued existence of federally listed species, and extirpation of native aquatic-dependent special status animal species from the White River Valley groundwater discharge area.

Approach: Avoid unreasonable effects to senior water rights, and protect the habitat for the listed species and native aquatic-dependent special status animal species in Butterfield and Flag springs and Sunnyside Creek (Figure 2-9 in Section 2.2.1).

- Federally listed species:
  - White River spinedace (Flag Springs and the downstream Sunnyside Creek)
- Native aquatic-dependent special status animal species:
  - White River speckled dace (Butterfield Springs, Flag Springs, Sunnyside Creek)
  - White River desert sucker (Flag Springs, Sunnyside Creek)
  - White River sculpin (Butterfield Springs)
  - Butterfield pyrg (Butterfield Springs)
  - Hardy pyrg (Butterfield Springs)
  - Flag pyrg (Flag Springs)
  - White River Valley pyrg (Flag Springs)

The rationale and analyses supporting this approach are provided in the 3M Plan analysis report (Marshall et al., 2017, at Section 8.3.2). A summary is provided below.

Environmental management and mitigation in southern White River Valley is focused on Flag and Butterfield springs and the downside Sunnyside Creek, which are partially sourced from groundwater outflow from Cave Valley (Marshall et al., 2017, at Section 8.2.3). The remaining southern White River Valley habitats and species analyzed in the 3M Plan analysis report are supported by south-trending groundwater flow through the basin and/or local recharge and not inflow from Cave Valley (Marshall et al., 2017, at Section 8.2.3). Given the improbability of effects from SNWA GDP pumping, no further management and mitigation actions are required to avoid unreasonable effects in southern White River Valley.

The approach primarily relies on avoiding unreasonable effects to senior water rights. As discussed in Section 3.3.1, 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. NDOW's vested claim on Sunnyside Creek (V04605) is approximately equivalent to the combined flow at the three Flag Spring orifices (Nos. 1, 2, and 3), which provide the primary source of water for White River spinedace. Given the number and spatial distribution of monitor wells and senior water rights, the general co-location of senior water rights with environmental resources, and the staged groundwater development and reserved groundwater in Cave Valley (discussed in Section 3.1), this approach also helps prevent unreasonable effects to the species listed above. Environmental management and mitigation actions are also included in the approach to

ensure that unreasonable effects to the species are avoided. This approach also protects other wildlife that occur at Flag and Butterfield springs and Sunnyside Creek (Marshall et al., 2017, at Section 8.3). If the mitigation trigger is activated, at least one of the mitigation actions identified in Table 3-2 will be implemented within no more than 30 days.

The environmental management and mitigation plan for southern White River Valley is presented in Table 3-2, and the monitoring plan is presented in Section 2.2.1.

Table 3-2
Cave and Southern White River Valleys Management and Mitigation Plan
(Page 1 of 4)

Unreasonable Effect	Conflict with a senior water right; jeopardy to the continued existence of federally threatened and endangered species; and extirpation of native aquatic-dependent special status animal species from a hydrographic basin's groundwater discharge area.
Investigation Trigger	The investigation trigger for sentinel monitor wells 383307114471001, 180W501M, WRV1012M, and WRV1013M 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 for Flag Spring No.2 continuous gage is a decrease in spring discharge below the 99.7 percent lower control limit using the SALR method for 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:** The hydrologic investigation triggers at monitor wells WRV1012M and WRV1013M trigger environmental monitoring and management.actions.
Management Actions	**Senior Water Rights:** If investigation indicates the cause of water level change at sentinel monitor wells or spring discharge at Flag Spring No. 2 is the result of SNWA GDP pumping, management actions may include the following: • Install additional monitor wells in study area, if needed. • Modify SNWA pumping rates, durations, and/or distribution to avoid activating a mitigation trigger. • Adjudicate NDOW vested claim at Sunnyside Creek. • Prepare mitigation actions for implementation, including purchasing equipment, establishing contracts, obtaining any necessary land owner permissions and permits. • 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. **Environmental Resources:** If investigation indicates cause of water level change at monitor well WRV1012M or WRV1013M is the result of SNWA GDP pumping, SNWA will: • Support NDOW with its native fish surveys at Flag and Butterfield springs and Sunnyside Creek, and incorporate presence/absence surveys of the other native aquatic-dependent special status animal species. • Continue to participate on the White River Valley Native Fishes Recovery Implementation Team.

Table 3-2
Cave and Southern White River Valleys Management and Mitigation Plan
(Page 2 of 4)

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. **Environmental Resources:** The hydrologic mitigation trigger at Flag Spring No. 2 is the mitigation trigger for federally listed species and native aquatic-dependent special status animal species at Flag and Butterfield springs and Sunnyside Creek.

Table 3-2
Cave and Southern White River Valleys Management and Mitigation Plan
(Page 3 of 4)

Mitigation Action	**Senior Water Rights:** ***Senior Underground Water Rights:*** Mitigation actions for senior underground water rights will include 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 spring(s) flow. Construction of well(s) located south of the Flag and Butterfield springs area with acceptable water chemistry to supplement spring flow. • 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 3-2
Cave and Southern White River Valleys Management and Mitigation Plan
(Page 4 of 4)

Mitigation Action	**Environmental Resources:** In addition to the mitigation actions identified for senior water rights, mitigation actions for federally listed species and native aquatic-dependent special status animal species at Flag and Butterfield springs and Sunnyside Creek will include at least one of the following: • Collaborate with the private landowners and water right holders and fund measures to ensure water is available to support the species and their habitats. • Collaborate with private landowners and NDOW and/or the White River Valley Native Fishes Recovery Implementation Team and fund improvements to improve existing habitat (e.g., thinning of dense aquatic vegetation increases suitable fish habitat). • Collaborate with NDOW and fund expansion of habitat, creation of suitable habitat, and/or establishment of additional populations of the listed fish species.

3.5 Dry Lake, Delamar, and Pahranagat Valleys Triggers and Management and Mitigation Actions

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 Dry Lake, Delamar, and Pahranagat valleys. The rationale and analyses supporting these triggers and actions are presented in the 3M Plan analysis report (Marshall et al., 2017, at Section 9.0).

No triggers or management or mitigation actions are needed for Delamar Valley senior water rights, and Dry Lake and Delamar valley environmental resources, due to lack of hydraulic connection between them and the producing aquifer in which SNWA GDP production wells will be installed (Marshall et al., 2017, at Sections 9.2.2 and 9.2.3).

As stated in Section 1.2, within Pahranagat Valley, this 3M Plan focuses on the regional springs. Effects from SNWA GDP pumping to senior water rights and environmental resources in Pahranagat Valley are unlikely, as discussed in the 3M Plan analysis report (Marshall et al., 2017, at Section 9.2.4). Nonetheless, Pahranagat Valley is included in the 3M Plan given the USFWS determination that it could not rule out the possibility of measurable effects to federally endangered species in Pahranagat Valley, although it was unsure of the likelihood or magnitude of such effects (USFWS, 2012). Further discussion is provided in the 3M Plan analysis report (Marshall et al., 2017, at Section 4.0).

3.5.1 Senior Water Rights

3.5.1.1 Dry Lake Valley

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 Dry Lake

Valley. The senior spring water rights and vested claims in Dry Lake Valley are not in hydraulic connection with the producing aquifer in which SNWA GDP production wells will be installed (Section 2.1.5; Marshall et al., 2017, at Section 9.2.2). The underground rights in Dry Lake Valley are located 10 to 35 miles from the closest SNWA GDP PODs and are assigned Management Category C (Section 2.1.5).

The senior water rights in Delamar Valley are not in hydraulic connection with the producing aquifer in which SNWA GDP production wells will be installed (Section 2.1.5; Marshall et al., 2017, at Section 9.2.3). Because effects to these senior water rights from SNWA GDP pumping are thus improbable, triggers and mitigation actions are not presented for senior water rights in Delamar Valley.

The management and mitigation plan for the Dry Lake Valley underground senior water rights are presented in Table 3-3. The hydrologic monitoring activities are presented in Section 2.1.

Table 3-3
Dry Lake and Delamar Valleys Management and Mitigation Plan
(Page 1 of 3)

Unreasonable Effect	Conflict with a senior water right.
Investigation Trigger	The investigation trigger for monitor wells 181M-1, and 181W909M within Dry Lake Valley and DEL4003X in Delamar Valley 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. 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 flow. (No investigation trigger for environmental resources in Dry Lake or Delamar valleys due to improbability of effects.)
Management Actions	If investigation indicates cause of water level change at sentinel or other designated monitor wells is the result of SNWA GDP pumping, management actions 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) or increase monitoring frequency. • Prepare mitigation actions for implementation, including purchasing equipment, establishing contracts, obtaining any necessary land owner permissions and permits.

Table 3-3
Dry Lake and Delamar Valleys Management and Mitigation Plan
(Page 2 of 3)

Mitigation Trigger	**Senior Underground Water Rights in Dry Lake Valley:** **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. (No Senior underground water rights in Delamar Valley and no spring rights in hydraulic connection with the producing aquifer in which SNWA GDP production wells will be installed in Dry Lake or Delamar valleys.) (No mitigation trigger for environmental resources in Dry Lake or Delamar valleys due to improbability of effects.)

Table 3-3
Dry Lake and Delamar Valleys Management and Mitigation Plan
(Page 3 of 3)

Management/ Mitigation Actions	**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 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. 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).

3.5.1.2 Pahranagat Valley

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 Pahranagat Valley. The hydrologic monitoring activities are presented in Section 2.1.

Triggers are established on intermediate and sentinel monitor wells in both Dry Lake and Delamar valleys to protect water rights and environmental resources in Pahranagat Valley (Figure 2-7**)**. Well 209M-1 is designated as the sentinel monitor well to monitor groundwater conditions between Dry Lake and Delamar valleys and northern Pahranagat Valley. This well and intermediate wells 373803115050501 and 373405115090001will detect propagation of drawdown, if any, along the Timpahute transverse zone toward northern Pahranagat Valley. An investigation trigger will be activated if the water level in the wells decrease below the 99.7 percent lower control limit using the SALR method, as described in the 3M Plan analysis report (Marshall et al., 2017, at Appendix A), for a continuous period of six months. The current trigger and baseline hydrograph for the currently existing monitor wells are presented in Appendix C.

Activation of an investigation trigger at monitor well 209M-1 or the other intermediate monitor network wells in northern Pahranagat Valley will result in an evaluation to determine the cause and significance of the water level change observed using protocols described in Section 3.3.1.2. Should the cause of the water level change be attributed to SNWA GDP pumping, the following management actions may be taken:

- Prepare to implement mitigation actions, including for the senior spring water right permit number 3806 by purchasing equipment, establishing contracts, and obtaining any necessary landowner permissions and permits.

- Update and recalibrate the numerical groundwater flow model and other predictive tools with aquifer response data. The model will be used to predict drawdown with distance and time under different pumping scenarios to evaluate if and when a mitigation trigger would be activated at a distant senior water right in Pahranagat Valley.

- Continue to monitor water levels in the sentinel and other intermediate wells to verify model projections.

- Increase monitoring frequency in wells being monitored quarterly.

- Evaluate the addition of other existing production wells downgradient of the sentinel wells for inclusion into the monitoring network.

- Request adjudication of vested claims associated with Hiko, Crystal and Ash springs.

- Adjust SNWA GDP pumping rates, durations, and/or distribution to avoid activating a mitigation trigger at monitor well PAH1010M or distant senior water right locations further down gradient in Pahranagat Valley.

The management actions would provide additional data that can be use to avoid activating the mitigation triggers in Pahranagat Valley.

A mitigation trigger for northern Pahranagat Valley is set at monitor well PAH1010M. This carbonate monitor well will be located on the east side of the Hiko Range seven miles downgradient of well 209M-1 and five miles upgradient from Hiko Spring to detect propagation of drawdown toward the senior water rights in northern Pahranagat Valley. BLM right-of-way has been acquired for this well site and the well will be installed at least three years prior to SNWA GDP pumping to develop a baseline record. The mitigation trigger at PAH1010M will be activated with departure of water levels continuously for six months below the 99.7 percent lower control limit caused by SNWA GDP pumping.

The sentinel monitor well 209M-1 and intermediate monitor well 373803115050501 provide a large early advance warning of potential effects to Hiko, Crystal, and Ash springs. The data from the sentinel wells and mitigation action at PAH1010M will provide sufficient time to avoid unreasonable effects at Hiko, Crystal, and Ash springs and associated senior water rights in northern Pahranagat

Valley. Mitigation triggers determine when a mitigation action is implemented, if the cause of the trigger being activated is SNWA GDP pumping.

Two additional monitor wells, one on the west side of the South Pahroc Range 209S07E6220AA1 and one at the southern edge of Delamar Valley (DEL4003X), are designated as the sentinel monitor wells to monitor changes in water level which may indicate propagation of drawdown into southern Pahranagat Valley.

The management and mitigation plan for Pahranagat Valley is summarized in Table 3-4 below.

3.5.2 Environmental Resources

This section presents the triggers and management and mitigation actions to avoid unreasonable effects to environmental resources in Pahranagat Valley. As discussed in the 3M Plan analysis report (Marshall et al., 2017, at Section 9.2.4), effects from SNWA GDP pumping to environmental resources in Pahranagat Valley are unlikely. Nonetheless, environmental triggers and management and mitigation actions are established to ensure unreasonable effects to environmental resources in Pahranagat Valley are avoided.

No environmental resources in Dry Lake and Delamar valleys are hydraulically connected to the producing aquifer in which SNWA GDP production wells will be installed, as no groundwater discharge areas occur in the basins (Burns and Drici, 2011, at page 5-1). Because effects from SNWA GDP pumping are improbable, triggers and mitigation actions are not established for environmental resources in Dry Lake and Delamar valleys.

Environmental management and mitigation actions for Pahranagat Valley are presented below. The environmental monitoring activities in Pahranagat Valley are presented in Section 2.2.2.

Unreasonable effect to avoid: Jeopardy to the continued existence of federally listed species, and extirpation of native aquatic-dependent special status animal species from the Pahranagat Valley groundwater discharge area.

Approach: Avoid unreasonable effects to senior water rights, and protect the habitat for the listed species and native aquatic-dependent special status animal species in Hiko, Crystal, and Ash springs (Figure 2-9 in Figure 2.2.1).

- Federally listed species:
  - Hiko White River springfish (Hiko and Crystal springs)
  - White River springfish (Ash Springs)
- Native aquatic-dependent special status animal species:
  - Pahranagat pebblesnail (Ash Springs)

- Grated tryonia (Ash Springs)
- Ash Springs riffle beetle (Ash Springs)
- Pahranagat naucorid bug (Ash Springs)
- Hubbs Pyrg (Crystal Springs)

The rationale and analyses supporting this approach are provided in the 3M Plan analysis report (Marshall et al., 2017, at Section 9.3). A summary is provided below.

Environmental management and mitigation in Pahranagat Valley is focused on regional springs Hiko, Crystal, and Ash. The remaining southern Pahranagat Valley habitats and species analyzed in the 3M Plan analysis report are supported by south-trending groundwater flow through the basin, underflow originating from surface water at the Pahranagat NWR, and/or local recharge, and not inflow from Delamar Valley (Marshall et al., 2017, at Section 9.2.4). Given the improbability of effects from SNWA GDP pumping, no further management and mitigation actions are required to avoid unreasonable effects in Pahranagat Valley.

The approach primarily relies on avoiding unreasonable effects to senior water rights. As discussed in Section 3.3.1, 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 species listed above. Environmental management and mitigation actions are also included in the approach to ensure that unreasonable effects to the species are avoided. This approach also protects other federally listed and native aquatic dependent special status species that occur in downstream habitat supported by the regional spring discharge (including the federally listed Pahranagat roundtail chub, southwestern willow flycatcher, and western yellow-billed cuckoo), and other wildlife that occur in the regional springs and their downstream flows (Marshall et al., 2017, at Section 9.3). If the mitigation trigger is activated, at least one of the mitigation actions identified in Table 3-4 will be implemented within no more than 30 days.

The environmental management and mitigation plan for Pahranagat Valley is summarized in Table 3-4, and the monitoring plan is presented in Section 2.2.2.

Table 3-4
Pahranagat Valley Management and Mitigation Plan
(Page 1 of 4)

Unreasonable Effect	Conflict with a senior water right; jeopardy to the continued existence of federally threatened and endangered species; and extirpation of native aquatic-dependent special status animal species from a hydrographic basin's groundwater discharge area.
Investigation Trigger	Northern Pahranagat Valley: The investigation trigger for sentinel monitor well 209M-1 is a decrease in water level for six continuous months below the 99.7 percent lower control limit using the SALR method for the baseline data. If the investigation trigger is activated, investigate cause, determine significance, revise predictive tools, and apply appropriate management actions. Southern Pahranagat Valley: The investigation trigger for 209 S07 E62 20AA 1 and DEL4003X (or alternative PAH1011M) 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. 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:** The hydrologic investigation trigger at monitor well 373803115050501 trigger environmental monitoring and management.actions.
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 will include one of the following or another effective alternative: • 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) in southern Pahranagat Valley, if needed. • Adjudicate selected vested claims in the analysis area. • 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. **Environmental Resources:** If investigation indicates cause of water level change at monitor well 373803115050501 is the result of SNWA GDP pumping, SNWA will: • Support NDOW with its native fish surveys at Hiko, Crystal, and Ash springs, and incorporate presence/absence surveys of the other native aquatic-dependent special status animal species. • Continue to participate on the Pahranagat Valley Native Fishes Recovery Implementation Team.

Table 3-4
Pahranagat Valley Management and Mitigation Plan
(Page 2 of 4)

Mitigation Trigger	**Senior Water Rights:** A special mitigation trigger is established for PAH1010M to avoid unreasonable effects in Pahranagat Valley. The trigger is a decrease 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:** 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. **Environmental Resources:** The hydrologic mitigation trigger at PAH1010M is the mitigation trigger for federally listed species and native aquatic-dependent special status animal species at Hiko, Crystal, and Ash springs.

Table 3-4
Pahranagat Valley Management and Mitigation Plan
(Page 3 of 4)

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. • Replace the well. • Modify SNWA pumping rates, duration, and/or distribution. • Temporary storage tank to supplement the well production until a permanent 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. 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. • 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 by pumping the impacted well for a longer period of time at a lower pumping rate, by a truck delivering water, 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 3-4
Pahranagat Valley Management and Mitigation Plan
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Mitigation Action	**Environmental Resources:** In addition to the mitigation actions identified for senior water rights, mitigation actions for federally listed species and native aquatic-dependent special status animal species at Hiko, Crystal, and Ash springs will include at least one of the following: • Collaborate with private landowners and water right holders and fund measures to ensure water is available to support the species and their habitats. • Collaborate with private landowners and NDOW and/or the Pahranagat Valley Native Fishes Recovery Implementation Team and fund measures to improve existing habitat, (e.g., thin dense aquatic vegetation to increase suitable fish habitat). • Collaborate with NDOW and fund expansion of habitat, creation of suitable habitat, and/or establishment of additional populations of the listed fish species.

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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 Rulings 6165-6167, SNWA will update the NSE approved numerical groundwater flow model once before groundwater pumping begins, and at least every five years thereafter, and provide predictive results for 10-year, 25-year, and 100-year periods (NDWR, 2012a at page 170; NDWR, 2012b, at page 163; and NDWR, 2012c, at pages 161-162). SNWA will also evaluate updating the model as aquifer response data becomes available or as a management action associated with a investigation trigger.

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, 2009c). In accordance with the previous Rulings, the NSE requires SNWA to improve and use its model as a management tool (NDWR, 2012a, at page 92; NDWR, 2012b, at page 90; and NDWR, 2012c, at page 89).

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 DDC.

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

Monitoring Network Site Locations and Attributes

Table A-1
Existing SNWA DDC Test Wells

Site Number	Station Local Number	Location[a]		Surface Elevation[b] (ft amsl)	Completion Date	Drill Depth (ft bgs)	Well Depth (ft bgs)	Well Casing Diameter (in.)	Screened Interval (ft bgs)	Open Interval (ft bgs)	Aquifer	Monitor Frequency
		UTM Northing (m)	UTM Easting (m)									
CAV6002X	CAV6002X	4,248,307.58	689,819.01	5,987.97	10/28/2007	917	901	20	219-901	50-917	Basin Fill/ Carbonate	Quarterly
CAV6002M2	CAV6002M2	4,248,365.83	689,782.96	5,982.81	10/13/2007	893	885	6	159-882	50-893	Basin Fill/ Carbonate	Quarterly

[a]Professional survey complete on location and elevation. All coordinates are UTM, NAD83, Zone 11.
[b]Elevations are NAVD88.
Note: Well-construction data are based upon best available information from well logs.

Table A-2
DDC Existing-Well Monitoring Network

Site Number	Station Local Number	Location[a]		Surface Elevation[b] (ft amsl)	Completion Date	Drill Depth (ft bgs)	Well Depth (ft bgs)	Well Casing Diameter (in.)	Screened Interval (ft bgs)	Open Interval (ft bgs)	Aquifer	Monitor Frequency
		UTM Northing (m)	UTM Easting (m)									
180W902M	180W902M	4,248,355.59	689,816.08	5,984.89	10/19/2005	917	903	12	195-882	77-917	Carbonate	Continuous
382807114521001	180 N07 E63 14BADD 1 USGS-MX	4,259,963.15	685,737.56	6,012.39	9/30/1980	460	460	10	210-250, 375-435	40-460	Carbonate[c]	Quarterly
383307114471001	180 N08 E64 15BCBC1 USBLM (Harris Well)	4,269,378.23	692,859.57	6,162.55	---	---	---	7	---	---	Basin Fill	Quarterly
180W501M	180W501M	4,273,712.79	687,971.03	6,428.63	9/23/2005	1,215	1,212	6	788-1,192	54-1,215	Carbonate	Continuous
182W906M	182W906M	4,133,304.57	690,065.21	4,796.96	9/2/2005	1,735	1,703	6	1,275-1,678	130-1,735	Volcanic	Quarterly
182M-1	182M-1	4,135,293.37	680,867.32	4,597.78	7/10/2005	1,345	1,331	12	1,006-1,290	58-1,345	Volcanic	Continuous
372639114520901	182 S06 E63 12AD 1 USGS-MX	4,146,220.24	688,472.41	4,706.30	5/10/1980	1,215	1,195	10	920-980, 1,040-1,180	40-1,215	Basin Fill	Quarterly[d]
181W909M	181W909M	4,174,462.59	698,676.17	4,799.41	10/16/2007	1,285	1,260	12	637-1,240	183-1,285	Basin Fill	Quarterly
181M-1	181M-1	4,198,199.90	688,534.99	4,963.07	8/30/2005	1,501	1,471	6	765-1,451	58-1,501	Carbonate	Continuous
380531114534201	181 N03 E63 27CAA 1 USGS-MX	4,218,085.09	683,720.32	5,456.35	1/1/1981	2,395	2,395	10	---	775-2,395	Carbonate	Continuous[d]
209 S07 E62 20AA 1	209 S07 E62 20AA 1 (Dean Turley Well)	4,133,610.32	672,648.88	4,082.46	1/10/1981	695	695	8	600-695	55-695	Basin Fill/ Volcanic	Quarterly
373405115090001	209 S04 E61 28CD 1	4,159,504.38	663,314.66	4,230.58	9/19/1968	1,314	1,314	12	1,200-1,300	52-1,314	Basin Fill/ Volcanic	Quarterly
373803115050501	209 S04 E61 01AACB1	4,166,944.29	668,927.03	4,528.90	---	---	700	8	---	---	Basin Fill	Quarterly
209M-1	209M-1	4,168,065.79	677,323.46	5,097.30	8/4/2005	1,616	1,616	6	1,274-1,595	50-1,616	Carbonate	Continuous
383133115030201	207 N08 E62 30CD 1 USGS-MX	4,265,229.62	669,732.25	5,290.20	---	---	101	2	---	---	Basin Fill	Quarterly

[a]Professional survey complete on location and elevation. All coordinates are Universal Transverse Mercator (UTM), North American Datum of 1983 (NAD83), Zone 11.
[b]Elevations are North American Vertical Datum of 1988 (NAVD88).
[c]Carbonate bedrock was encountered at 265 ft bgs according to the well log.
[d]Well is monitored continuously by the USGS.
Well-construction data are based upon best available information from well logs, MX Project Report (Ertec Western Inc., 1981a through d), and direct field measurements.
Additional water-level data in the study area may be collected by SNWA or USGS and reported in future data reports.

Table A-3
New DDC Monitor Wells

Well Name	Location[a]		Estimated Surface Elevation[b] (ft amsl)	Estimated Depth to Water (ft)
	UTM Northing (m)	UTM Easting (m)		
WRV1012M	4,257,087	675,519	5,794	420
WRV1013M	--[c]	--[c]	--[c]	---[c]
PAH1010M	4,163,098	663,576	4,380	700
DEL4003X	4,125,223	682,153	4,738	1,450
PAH1011M (alternate site)	4,121,019	677,508	3,727	635

[a]All coordinates are UTM, NAD83, Zone 11.
[b]Elevations are NAVD88.
[c] To be determined.

Table A-4
DDC Springs Monitoring Locations and Monitoring Frequency

Basin Number	Station Number	Station Name	Elevation[a]	Location[b]		Monitoring Frequency
				UTM Northing (m)	UTM Easting (m)	
180	1800101	Cave Spring	6,490	4,279,249	691,760	Biannual
	1800301	Parker Station Spring	6,490	4,282,096	688,179	
	381624114540302	USBLM Silver King Well	6,230	4,238,220	683,551	
	381943114562201	Lewis Well	6,260	4,244,297	680,106	
181	1810301	Littlefield Spring	6,150	4,233,949	701,112	Biannual
	1810401	Coyote Spring	5,220	4,211,513	687,693	
	1810501	Big Mud Springs	6,430	4,241,387	689,547	
182	1820101	Grassy Spring	5,790	4,157,193	695,124	
207	2070501	Hot Creek Spring near Sunnyside, NV	5,230	4,249,926	661,290	Continuous
	2071101	Moorman Spring	5,300	4,273,440	662,053	Biannual
	2071501	Hardy Springs	5,350	4,278,196	667,553	
	2071401	Butterfield Spring	5,324	4,256,472	673,529	
209	2090101	Hiko Spring	3,880	4,162,744	657,549	Continuous
	2090201	Cottonwood Spring	3,240	4,123,643	667,261	Quarterly[c]
	2090801	Maynard Spring	3,110	4,117,909	674,444	Quarterly
Flag Springs Complex						
207	2071301	Flag Spring 3 (South)	5,290	4,254,416	672,579	Quarterly
	2071302	Flag Spring 2 (Middle)	5,280	4,254,570	672,576	Continuous
	2071303	Flag Spring 1 (North)	5,290	4,254,696	672,719	Quarterly
Crystal Springs						
209	09415589	Crystal Springs Diversion near Hiko, NV	3,820	4,155,336	656,011	Continuous
	2090401	Crystal Springs near Hiko, NV	3,800	4,155,348	656,165	
Ash Springs						
209	09415639	Ash Springs Diversion at Ash Springs, NV	3,600	4,147,415	659,716	Continuous
	2090501	Ash Springs	3,600	4,147,460	659,684	

[a]All elevations are rounded to the nearest 10 ft, NAVD88. High-resolution Global Positioning System will be used to determine elevations at a later date.
[b]All coordinates are UTM NAD83, Zone 11.
[c] Monitoring performed by USFWS. Data provided to SNWA will be presented in the annual data report.

Table A-5
Precipitation Stations

Station Number	Station Name	Surface Elevation[a] (ft amsl)	Location[b]		Monitoring /Reporting Agency	Remarks
			UTM Northing (m)	UTM Easting (m)		
RP2070101	Currant	6830	4,297,078	648,450	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.
RP1730201	Blue Eagle Ranch Hanks	4,680	4,264,609	626,888	WRCC	Standard rain and snow gage. Daily precipitation collected with a measuring stick as part of the NWS Coop network.
RP2050201	Caliente	4,380	4,165,731	718,331	WRCC	Standard rain and snow gage. Daily precipitation collected with a measuring stick as part of the NWS Coop network.
RP2090201	Hiko	3,900	4,158,266	656,900	WRCC	Standard rain and snow gage. Daily precipitation collected with a measuring stick as part of the NWS Coop network.
RP2070202	Lund	5,550	4,303,965	672,073	WRCC	Standard rain and snow gage. Daily precipitation collected with a measuring stick as part of the NWS Coop network.
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.
RP2020201	Pioche	5,990	4,201,608	724,101	WRCC	Standard rain and snow gage. Daily precipitation collected with a measuring stick as part of the NWS Coop network.
RP2070203	Sunnyside	5,300	4,254,608	672,625	WRCC	Standard rain and snow gage. Daily precipitation collected with a measuring stick as part of the NWS Coop network.
RP1730302	Corduroy Flat	8,640	4,317,969	637,107	NRCS	Shielded standpipe bulk storage precipitation gage with a pressure transducer. Daily precipitation collected as part of the NRCS Snotel network.
RP1790303	Defiance Mines	9,300	4,328,123	681,638	NRCS	Shielded standpipe bulk storage precipitation gage with a pressure transducer. Daily precipitation collected as part of the NRCS Snotel network.
RP2070301	Ward Mountain	9,200	4,333,184	676,331	NRCS	Shielded standpipe bulk storage precipitation gage with a pressure transducer. Daily precipitation collected as part of the NRCS Snotel network.
RP2070302	White River NV	7,440	4,312,471	640,092	NRCS	Shielded standpipe bulk storage precipitation gage with a pressure transducer. Daily precipitation collected as part of the NRCS Snotel network.

[a]Elevations are NAVD88.
[b]All coordinates in UTM, NAD83, Zone 11.

Appendix B

DDC 3M Plan Senior Water Rights and Domestic Wells

B.1.0

This appendix contains the senior water-rights tables as documented within Marshall et al. (2017 at Sections 8.0 and 9.0). 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.

Table B-1
Water Rights within Cave Valley and Downgradient of Shingle Pass in White River Valley 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]
4599	CER	STR	IRR	1917	0.12	36.0[h]	Adams, Myron	Alluvial Fan	14.1	6,710	E
4881	CE.	SPR	IRR	1918	0.751	225.6[h]	Cave Valley Ranch, LLC	Alluvial Fan / Mountain Block	14.6	6,490	E
6638	CER	UG	STK	1922	0.003	2.1*	Jensen, Bruce A.	Alluvial Fan	6.0	6,230	E
7397	CER	UG	STK	1925	0.015	1.9*,[h]	Jensen, Bruce A.	Alluvial Fan	3.5	6,260	E
9001	CER	SPR	DOM	1929	0.044	31.85[i]	Great Western Mining & Development Co	Alluvial Fan / Mountain Block	14.6	6,490	E
9720	CER	SPR	STK	1934	0.025	17.9*	Cave Valley Ranches	Alluvial Fan / Mountain Block	15.5	7,460	E
9721	CER	SPR	STK	1934	0.025	17.9*	Cave Valley Ranches	Alluvial Fan / Mountain Block	16.6	7,660	E
25322	CER	STR	IRR	1969	0.89	240.0	Leavitt, Paul and Chad 50% UDI; Leavitt, Dianne and Gary 50% UDI	Mountain Block / Alluvial Fan	15.0	6,930	E
25411	CER	SPR	IRR	1970	0.564	79.2	Leavitt, Paul and Chad 50% UDI; Leavitt, Dianne and Gary 50% UDI	Alluvial Fan	14.6	6,780	E
27814	CER	SPR	IRR	1973	0.67	126.0	Leavitt, Paul and Chad 50% UDI; Leavitt, Dianne and Gary 50% UDI	Alluvial Fan	14.6	6,780	E
V01675	VST	SPR	STK	1903	0.025	7.5*	Cave Valley Ranch, LLC	Alluvial Fan	18.1	7,570	E
V01678	VST	STR	STK	1903	0.016[i]	7.56[i]	Cave Valley Ranch, LLC	Alluvial Fan	17.7	7,840	E
V01680	VST	STR	STK	1903	0.016[i]	7.56[i]	Cave Valley Ranch, LLC	Alluvial Fan	16.8	6,950	E
V01696	VST	SPR	STK	1890	0.025	11.31[i]	Geyser Land & Cattle Co.	Alluvial Fan / Mountain Block	16.6	7,660	E
V01698	VST	SPR	STK	1890	0.025	11.31[i]	Geyser Land & Cattle Co.	Alluvial Fan / Mountain Block	15.5	7,460	E
V01699	VST	SPR	STK	1890	0.025	11.31[i]	Cave Valley Ranches Inc.	Alluvial Fan	15.1	7,190	E

Table B-1
Water Rights within Cave Valley and Downgradient of Shingle Pass in White River Valley 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]
V01807	VST	STR	IRR	1880	1.12[i]	336.82[i]	Cave Valley Ranch, LLC	Valley Floor	16.5	6,550	E
V02693	VST	SPR	IRR	1885	(-)[i]	0[i]	Leavitt, Paul and Chad 50% UDI; Leavitt, Dianne and Gary 50% UDI	Mountain Block / Alluvial Fan	15.0	6,930	E
V02694	VST	SPR	IRR	1890	(-)[i]	0[i]	Leavitt, Paul and Chad 50% UDI; Leavitt, Dianne and Gary 50% UDI	Alluvial Fan	14.6	6,780	E
White River Valley Water Rights Downgradient of Shingle Pass											
13341	CER	UG	STK	1950	0.008	4.0*,[h]	Jensen, Pamela G.	Alluvial Fan	19.5 / 8.0[g]	5,340	D
28209	CER	SPR (Butterfield Springs)	IRR	1974	2.15	1,556.5	Jensen, Bruce A.	Valley Floor / Alluvial Fan	14.0 / 6.2[g]	5,310	D
49476	CER	SPR (Flag Springs)	QM	1985	0.022	1.8	Nevada-Department of Wildlife	Valley Floor / Alluvial Fan	15.2 / 6.8[g]	5,300	D
V04605	VST	STR (Sunnyside Creek)	IRR	1880	7.69	2,206.4	Nevada-Department of Wildlife	Valley Floor	15.2 / 6.8[g]	5,300	D

[a]CER - Certified, VST - Vested
[b]SPR - Spring, STR - Stream, UG - Underground
[c]DOM - Domestic, IRR - Irrigation, QM - Quasi-municipal, STK - Stock watering
[d]Rounded to the nearest tenth of a mile.
[e]Rounded to the nearest ten feet.
[f]See Section 2.1.2.2 for an explanation of the Management Categories; D - Resource in adjacent hydrographic area, E - Resource not in hydraulic connection with producing aquifer in which SNWA GDP production wells will be installed.
[g]First distance measured from White River Valley senior permits to existing monitor well 180W501M. Second distance measured from White River Valley senior permits to nearest SNWA POD.
[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 or vested claim, but reported as such by the NDWR Hydrographic Abstract query.
Note: Additional senior water rights in southern White River Valley are presented in Table B-7.

Table B-2
Cave Valley Domestic Water Wells

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]
Cave Valley								
71199	04/24/1998	140	140	91	Alluvial Fan	23.5	7,000	E
104299	09/14/2007	400	400	240	Alluvial Fan	14.7	6,480	E
105365	12/19/2006	748	748	250	Alluvial Fan	15.7	6,600	E

[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 2.1.2.2 for an explanation of the Management Categories; E - Senior water right site not in hydraulic connection with SNWA GDP producing aquifer in which SNWA GDP production wells will be installed.

Table B-3
Water Rights within Dry Lake Valley 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]
5936	CER	UG	STK	1920	0.025	18.1*	Adams-McGill Company	Alluvial Fan / Valley Floor	35.0	5,630	C
8698	CER	SPR	STK	1928	0.017	12.1*,[g]	Vidler Water Company	Alluvial Fan / Valley Floor	6.9	4,780	E
18756	CER	UG	STK	1960	0.015	10.8*	Delmue, Albert	Valley Floor	10.5	4,710	C
35770	CER	UG	STK	1978	0.004	3.2*	Geyser Ranch, LLC	Valley Floor	19.6	4,970	C
35771	CER	SPR	STK	1978	0.005	3.3*	Geyser Ranch, LLC	Valley Floor	18.1	4,930	E
35773	CER	UG	STK	1978	0.004	3.2*	Geyser Ranch, LLC	Valley Floor	22.9	5,070	C
35774	CER	UG	STK	1978	0.004	3.2*	Geyser Ranch, LLC	Alluvial Fan	21.8	5,440	C
V03839	VST	SPR	STK	1890	0.004	2.0*,[g]	Imperial Farms Land and Cattle Co.	Alluvial Fan	18.9	5,040	E
V03840	VST	SPR	STK	1890	0.004	2.0*	Imperial Farms Land and Cattle Co.	Alluvial Fan	20.7	5,200	E

[a]CER - Certificated, VST - Vested
[b]SPR - Spring, UG - Underground
[c]STK - Stock watering
[d]Rounded to the nearest tenth of a mile.
[e]Rounded to the nearest 10 feet.
[f]See Section 2.1.2.2 for an explanation of the Management Categories; C - 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-4
Water Rights within Delamar Valley 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]
4620	CER	SPR	STK	1917	0.001	0.7*,[g]	Gardner Ranch Co.	Alluvial Fan	3.5	5,050	E
4622	CER	SPR	STK	1917	0.002	0.6*	Gardner Ranch Company	Alluvial Fan	7.6	5,620	E
5782	CER	SPR	STK	1919	0.012	9.1*	Duffins, Press W. Jr.	Alluvial Fan	3.7	4,930	E
5783	CER	SPR	STK	1919	0.015	10.9*	Duffin, Mamie R.	Alluvial Fan	3.5	4,930	E
11167	CER	SPR	STK	1944	0.003	2.2*	LDS	Alluvial Fan	5.9	5,300	E
V01520	VST	SPR	STK	1900	0.0016[h]	0.80[h]	Gardner Ranch Co	Alluvial Fan	5.9	5,300	E
V01654	VST	SPR	STK	1900	0.025	0.7*	Duffin, Mame R.	Alluvial Fan	3.2	4,970	E

[a]CER - Certificated, VST - Vested
[b]SPR - Spring
[c]STK - Stock watering
[d]Rounded to the nearest tenth of a mile.
[e]Rounded to the nearest 10 feet.
[f]See Section 2.1.2.2 for an explanation of the Management Categories; E - Resource not in hydraulic connection with 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 or vested claim, but reported as such by the NDWR Hydrographic Abstract query.

Table B-5
Selected Water Rights at Pahranagat Valley Regional Springs 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]
Hiko Spring											
12882	CER	SPR	IRR	1929	6.72	2,400.0[g]	Hiko Irrigation & Water Co.	Valley Floor	16.5	3,880	D
20544	CER	SPR	IRR	1962	3.0	2,171.4	Hiko Irrigation & Water Co.	Valley Floor	16.4	4,020	D
V01765	DEC	SPR	DEC	1884	1.368	392.8	Castles, Mary A.	Valley Floor	16.5	3,880	D
V01788	DEC	SPR	DEC	1872	0.171	68.4	Wright, Mary E.	Valley Floor	16.5	3,880	D
V01796	DEC	SPR	DEC	1888	1.347	390.4	Nesbitt, Edgar	Valley Floor	16.5	3,880	D
V01797	DEC	SPR	DEC	1872	0.1	40.0	Castles, James	Valley Floor	16.5	3,880	D
V01798	DEC	SPR	DEC	1873	2.715	972.0	Schofield, W. U and W.J.	Valley Floor	16.5	3,880	D
Crystal Springs											
V01794	DEC	SPR	DEC	1867	6.75	2,295.4	LDS	Valley Floor	17.1	3,810	D
V01825	DEC	SPR	DEC	1866	5.795	1,541.6	Farmland Reserve, Inc.	Valley Floor	17.1	3,810	D
Ash Springs											
23730A01	CER	SPR	QM	1885	0.015	8.2[g]	Dimick, Orlando Ephriam Trustee	Valley Floor	15.8	3,620	D
23730A02	CER	SPR	QM	1885	0.005	3.0[g]	Reed, Inc.	Valley Floor	15.8	3,620	D
45452	CER	SPR	QM	1982	0.00	3.0[g]	Barker, Joseph & Andrea	Valley Floor	15.8	3,620	D
V01793	DEC	SPR	DEC	1880	5.208	1,194.2	Barker, Joseph & Andrea	Valley Floor	15.8	3,620	D

[a]CER - Certificated, DEC - Decreed
[b]SPR - Spring
[c]DEC - As Decreed, IRR - Irrigation, QM - Quasi-municipal
[d]Rounded to the nearest tenth of a mile.
[e]Rounded to the nearest 10 feet.
[f]See Section 2.1.2.2 for an explanation of the Management Categories; D - Resource in adjacent hydrographic area.
[g]Acre-ft per season.
Note: Additional senior water rights in Pahranagat Valley including those dependent upon discharge from Hiko, Crystal, and Ash springs are presented in Table B-6.

Table B-6
Water Rights within Pahranagat Valley Senior to SNWA GDP Permits
(Page 1 of 4)

App No.	Status[a]	Source[b]	Use[c]	Priority Date	Div Rate (cfs)	Annual Duty (afa)	Owner of Record	Geographic Location	Management Category[d]
878	CER	LAK	IRR	1908	0.105	0.0*,e	RICHARD, JOHN W.	Valley Floor	D
3387	CER	STR	IRR	1915	0.11	44	HIGBEE, JOE V.	Valley Floor	D
3755	CER	SPR	IRR	1915	0.091	43.7e	KOYEN, CHRISTIAN AUGUST	Valley Floor	D
3806	CER	SPR	STK	1916	0.025	18.0*	RYAN, JAMES	Alluvial Fan	D
11478	CER	LAK	IRR	1946	0	211.6	RICHARD, J.W.	Valley Floor	D
12882	CER	SPR	IRR	1929	6.72	2,400.0e	HIKO IRRIGATION & WATER COMPANY	Valley Floor	D
12898	CER	UG	DOM	1949	0.133	96.3*	ALAMO SEWER AND WATER G.I.D.	Alluvial Fan	D
19475	CER	UG	IRR	1961	0.8	73.5	SCHOFIELD, FREEDA M. JR.	Alluvial Fan	D
20234	PER	SPR	IRR	1962	18.14	0.0*	USFWS	Valley Floor	D
20544	CER	SPR	IRR	1962	3	2,171.4	HIKO IRRIGATION & WATER CO.	Valley Floor	D
23730A01	CER	SPR	QM	1885	0.015	8.2e	Dimick, Orlando Ephriam Trustee	Valley Floor	D
23730A02	CER	SPR	QM	1885	0.005	3.0e	REED, INC.	Valley Floor	D
25906	CER	UG	IRR	1971	1.11	405.0e	NEVADA-DEPARTMENT OF WILDLIFE	Valley Floor	D
25907	CER	UG	WLD	1971	1.11	407.3*,e	NEVADA-DEPARTMENT OF WILDLIFE	Valley Floor	D
25913	CER	UG	IRR	1966	0.74	270.0e	NEVADA-DEPARTMENT OF WILDLIFE	Valley Floor	D
26007	CER	SPR	IRR	1971	0.382	152.8e	GERTRUDE NELSON TRUST	Valley Floor	D
26638	CER	UG	IRR	1972	2.236	465.0	CRAIG L. TURLEY & ANNETTE H. TURLEY, HUSBAND AND WIFE AS JTWROS	Valley Floor	D
28296	CER	UG	IRR	1974	0.53	149.3	GIFFORD, OMER	Valley Floor	D
28599	CER	STR	IRR	1974	1.898	759.2	KENT WHIPPLE RANCH LLC	Valley Floor	D
30162	PER	UG	QM	1989	2	560.1	ALAMO SEWER AND WATER G.I.D.	Alluvial Fan	D
32354	CER	UG	IRR	1960	0.693	289.3	HIKO PROPERTIES, LLC	Alluvial Fan	D
35054	CER	UG	IRR	1978	0.867	283.4	Whipple, Keith Murray	Alluvial Fan	D
35055	CER	UG	IRR	1978	0.446	106.7	WHIPPLE, KEITH MURRAY	Alluvial Fan	D
35453	CER	UG	IRR	1978	0.5	140.0	HIGBEE, EVELYN Y	Valley Floor	D
35739	CER	UG	IRR	1978	0.1	66.8	WADSWORTH, CHARLES E. JR.	Alluvial Fan	D
45452	CER	SPR	QM	1982	0.06	3.0e	BARKER, JOSEPH & ANDREA	Valley Floor	D
45759	CER	UG	IRR	1982	0.2	144.8	BARLOW 1978 TRUST & BUNKER, W & S	Valley Floor	D

Table B-6
Water Rights within Pahranagat Valley Senior to SNWA GDP Permits
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App No.	Status[a]	Source[b]	Use[c]	Priority Date	Div Rate (cfs)	Annual Duty (afa)	Owner of Record	Geographic Location	Management Category[d]
45761	CER	UG	STK	1982	0.003	2.2*	LDS	Alluvial Fan	D
45908	PER	UG	MUN	1982	2	184.8	ALAMO SEWER AND WATER G.I.D.	Valley Floor	D
45909	PER	UG	MUN	1979	3	291.2	ALAMO SEWER AND WATER G.I.D.	Valley Floor	D
48333	CER	UG	IRR	1978	0.191	54.5	PHYLLIS M. FRIAS MANAGEMENT TRUST, PHYLLIS M. FRIAS TRUSTEE	Valley Floor	D
48913	CER	UG	IRR	1985	0.125	17.3	SPENCER, ISAAC T.	Valley Floor	D
52013	CER	UG	IRR	1982	0.2	144.8	BARLOW 1978 TRUST & BUNKER, W & S	Valley Floor	D
53698	CER	UG	IRR	1989	0.05	25.0	LANGE, RUSSELL	Alluvial Fan	D
54514	PER	UG	QM	1989	2	560.1	ALAMO SEWER AND WATER G.I.D.	Valley Floor	D
59308	CER	UG	STK	1988	0.011	7.9*	LDS	Alluvial Fan	D
62434	PER	SPR	WLD	1970	6.634	1,514.4	USFWS	Valley Floor	D
62435	PER	LAK	WLD	1908	1.517	460.4	USFWS	Valley Floor	D
62436	PER	SPR	WLD	1928	1.1	795.0	USFWS	Valley Floor	D
62437	PER	LAK	WLD	1946	1.01	729.6	USFWS	Valley Floor	D
62438	PER	LAK	WLD	1946	1.64	1,186.0	USFWS	Valley Floor	D
62439	PER	UG	WLD	1972	1.327	960.9	USFWS	Valley Floor	D
62440	PER	UG	WLD	1970	1	723.8	USFWS	Valley Floor	D
70990	PER	UG	IRR	1960	0.446	0.0*	HIKO PROPERTIES, LLC	Alluvial Fan	D
72770	PER	UG	IRR	1978	0.394	13.4	HIKO PROPERTIES, LLC	Alluvial Fan	D
72771	PER	UG	IRR	1960	0.021	5.2	HIKO PROPERTIES, LLC	Alluvial Fan	D
72772	PER	UG	IRR	1978	0.293	95.6	HIKO PROPERTIES, LLC	Alluvial Fan	D
74652	PER	UG	IRR	1972	0.021	4.3	JENSEN, KARLA R.	Valley Floor	D
74653	PER	UG	IRR	1972	0.058	12.0	JENSEN, KARLA R.	Alluvial Fan	D
78099	PER	UG	COM	1978	0.046	13.0	PHYLLIS FRIAS MANAGEMENT TRUST	Valley Floor	D
79197	PER	UG	IRR	1972	0.18	37.5	CASTANEDA, VERONA	Valley Floor	D
79484	CER	UG	IRR	1949	1.973	364.9	STEWART-NEVADA ENTERPRISES LLC	Alluvial Fan	D
79485	CER	UG	IRR	1950	0.257	62.9	STEWART-NEVADA ENTERPRISES LLC	Alluvial Fan	D
79486	CER	UG	IRR	1950	0.89	72.5	STEWART-NEVADA ENTERPRISES LLC	Alluvial Fan	D

Table B-6
Water Rights within Pahranagat Valley Senior to SNWA GDP Permits
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App No.	Status[a]	Source[b]	Use[c]	Priority Date	Div Rate (cfs)	Annual Duty (afa)	Owner of Record	Geographic Location	Management Category[d]
79487	CER	UG	IRR	1973	0.89	387.8	STEWART-NEVADA ENTERPRISES LLC	Alluvial Fan	D
79488	CER	UG	IRR	1973	2.01	218.4	STEWART-NEVADA ENTERPRISES LLC	Alluvial Fan	D
79490	CER	UG	IRR	1950	1.674	231.7	STEWART-NEVADA ENTERPRISES LLC	Alluvial Fan	D
80337	PER	UG	QM	1989	2	560.1	ALAMO SEWER AND WATER GID	Alluvial Fan	D
81871	CER	UG	IRR	1973	2.85	584.3	STEWART-NEVADA ENTERPRISES LLC	Alluvial Fan	D
84387	PER	UG	IRR	1974	1.34	600.0	CORPORATION OF THE PRESIDING BISHOP OF THE CHURCH OF JESUS CHRIST OF LATTER-DAY SAINTS	Alluvial Fan	D
84388	PER	UG	IRR	1974	1.11	792.0	CORPORATION OF THE PRESIDING BISHOP OF THE CHURCH OF JESUS CHRIST OF LATTER-DAY SAINTS	Alluvial Fan	D
84389	PER	UG	IRR	1988	0.2	120.2	CORPORATION OF THE PRESIDING BISHOP OF THE CHURCH OF JESUS CHRIST OF LATTER-DAY SAINTS	Alluvial Fan	D
R05992	RES	SPR	OTH	1926	0.002	1.4*	BLM	Valley Floor	D
R05993	RES	SPR	OTH	1926	0.003	2.2*	BLM	Valley Floor	D
V01354	DEC	SPR	IRR	1894	1.659	663.6	SHARP. J.L.	Valley Floor	D
V01362	DEC	SPR	DEC	1882	0.82	304.0	RICHARD J. W.	Valley Floor	D
V01363	DEC	SPR	DEC	1866	0.82	328.0	WEDGE, JOHN W.	Valley Floor	D
V01393	DEC	SPR	DEC	1868	1.09	436.0	RICHARD J. W.	Valley Floor	D
V01394	DEC	SPR	DEC	1875	4.594	1,837.6	KENT WHIPPLE RANCH LLC	Valley Floor	D
V01490	DEC	SPR	DEC	1882	0.595	238.0	RICHARD, LAWRENCE	Valley Floor	D
V01548	DEC	SPR	DEC	1872	3.387	1,259.8	FARMLAND RESERVE, INC.	Valley Floor	D
V01630	DEC	STR	DEC	1872	0.513	184.4	STEWART, RACHEL	Valley Floor	D
V01705	VST	SPR	IRR	1979	4	0.0*	SHARP, J.L.	Valley Floor	D
V01765	DEC	SPR	DEC	1884	1.368	392.8	CASTLES, MARY A.	Valley Floor	D
V01788	DEC	SPR	DEC	1872	0.171	68.4	WRIGHT, MARY E.	Valley Floor	D
V01789	DEC	SPR	DEC	1867	1	400.0	SHARP, J.L.	Valley Floor	D
V01793	DEC	SPR	DEC	1880	5.208	1,194.2	BARKER, JOSEPH AND ANDREA	Valley Floor	D
V01794	DEC	SPR	DEC	1867	6.75	2,295.4	LDS	Valley Floor	D
V01796	DEC	SPR	DEC	1888	1.347	390.4	NESBITT, EDGAR	Valley Floor	D

Table B-6
Water Rights within Pahranagat Valley Senior to SNWA GDP Permits
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App No.	Status[a]	Source[b]	Use[c]	Priority Date	Div Rate (cfs)	Annual Duty (afa)	Owner of Record	Geographic Location	Management Category[d]
V01797	DEC	SPR	DEC	1872	0.1	40.0	CASTLES, JAMES	Valley Floor	D
V01798	DEC	SPR	DEC	1873	2.715	972.0	SCHOFIELD, W. U AND W. J.	Valley Floor	D
V01799	DEC	SPR	DEC	1877	0.114	45.6	THORNE, W.F.	Valley Floor	D
V01802	DEC	SPR	DEC	1868	5.015	1,873.2	ALAMO IRRIGATION CO. INC.	Valley Floor	D
V01825	DEC	SPR	DEC	1866	5.795	1,541.6	FARMLAND RESERVE, INC.	Valley Floor	D
V03154	VST	UG	STK	1904	0.1	11.9*	BUCKHORN LAND & CATTLE CO. (DBA)	Valley Floor	D
V03155	VST	UG	STK	1904	0.1	11.9*	BUCKHORN LAND & CATTLE CO (DBA)	Valley Floor	D
V03156	VST	LAK	STK	1904	0.1	0.0*	BUCKHORN LAND AND CATTLE CO.(DBA)	Alluvial Fan	D
V03157	VST	LAK	STK	1905	0.1	0.0*	BUCKHORN LAND & CATTLE CO.(DBA)	Valley Floor	D
V03158	VST	LAK	STK	1904	0.1	0.0*	BUCKHORN LAND & CATTLE CO. (DBA)	Valley Floor	D
V03159	VST	LAK	STK	1904	0.1	0.0*	BUCKHORN LAND AND CATTLE CO.(DBA)	Valley Floor	D
V03160	VST	UG	STK	1905	0.1	11.9*	BUCKHORN LAND & CATTLE CO.(DBA)	Valley Floor	D
V03161	VST	UG	STK	1904	0.1	11.9*	LAMB, FLOYD R.	Valley Floor	D
V03162	VST	LAK	STK	1904	0.1	0.0*	BUCKHORN LAND & CATTLE COMPANY (DBA)	Valley Floor	D
V08964	VST	UG	STK	NA	0.001	0.7*	ROBINSON, ELWYN L.	Valley Floor	D
V08965	VST	SPR	IRR	NA	0.022	16.1*	R0BINSON, ELWYN L.	Valley Floor	D

[a]DEC - Decreed, CER - Certificated, PER - Permitted, VST - Vested
[b]LAK - Lake, SPR - Spring, STR - Stream, UG - Underground
[c]COM - Commercial, DOM - Domestic, DEC - As Decreed, IRR - Irrigation, MUN - Municipal, OTH - Other, QM - Quasi-municipal, STK - Stock watering, WLD - Wildlife
[d]See Section 2.1.2.2 for an explanation of the Management Categories; D - Resource in adjacent hydrographic area.
[e]Acre-ft per season.
*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
Note: Analysis and listing of domestic wells located in Pahranagat Valley derived from review of the NDWR on-line well log database are presented in Stanka, (2017a).

Table B-7
Water Rights within Southern White River Valley Senior to SNWA GDP Permits
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App No.	Status[a]	Source[b]	Manner of Use[c]	Priority Date	Diversion Rate (cfs)	Annual Duty (afa)	Owner of Record	Geographic Location	Management Category[d]
2661	CER	STR	IRR	1913	0	3,330.0[e]	NEVADA-DEPARTMENT OF WILDLIFE	Valley Floor	D
3232	CER	STR	IRR	1915	1.929	817.4[e]	NEVADA-DEPARTMENT OF WILDLIFE	Valley Floor	D
3235	CER	STR	IRR	1915	1.222	443.0[e]	NEVADA-DEPARTMENT OF WILDLIFE	Valley Floor	D
4818	CER	STR	IRR	1918	0.816	297.3[e]	HOLMGREN DAIRY, LLC	Alluvial Fan	D
5486	CER	OSW	IRR	1919	1.537	370.0[e]	JENSEN, BRUCE A.	Valley Floor	D
7979	CER	SPR	STK	1927	0.156	65.1*,[e]	JENSEN, BRUCE A.	Valley Floor	D
12517	CER	STR	IRR	1948	10	1,853.0	JENSEN, BRUCE A.	Valley Floor	D
13341	CER	UG	STK	1950	0.008	4.0*,[e]	JENSEN, Pamela G.	Alluvial Fan	D
13760	CER	SPR	IRR	1945	5	1,513.0[e]	GURLEY, JOHN E. & RUTH A.	Valley Floor	D
19294	CER	SPR	IRR	1960	0.096	53.0	HOLMGREN DAIRY, LLC	Valley Floor	D
20329	CER	SPR	STK	1962	0.015	11.4*	HOLMGREN DAIRY, LLC	Valley Floor	D
20465	CER	STR	IRR	1962	0	680.0[e]	NEVADA-DEPARTMENT OF WILDLIFE	Valley Floor	D
20466	CER	STR	WLD	1962	0	3,040.0	NEVADA-DEPARTMENT OF WILDLIFE	Valley Floor	D
20797	CER	UG	IRD	1962	4.45	360.0	HOWARD, MRS. LOUISE E.	Valley Floor	D
20819	CER	STR	IRR	1962	0	507.0	NEVADA-DEPARTMENT OF WILDLIFE	Valley Floor	D
22882	CER	SPR	STK	1965	0.015	10.8*	JENSEN, BRUCE A.	Valley Floor	D
23590	CER	UG	IRR	1967	2.67	432.0	HOWARD, LOUISE	Valley Floor	D
23624	CER	STR	WLD	1967	2.403*	1,120.0[e]	NEVADA-DEPARTMENT OF WILDLIFE	Valley Floor	D
28206	CER	SPR	IRR	1974	0.671	268.0	JENSEN, BRUCE A.	Alluvial Fan	D
28207	CER	SPR	IRR	1974	0.41	132.6	JENSEN, BRUCE A.	Valley Floor	D
28208	CER	SPR	IRR	1974	1.279	824.0	JENSEN, BRUCE A.	Alluvial Fan	D
28209	CER	SPR	IRR	1974	2.150	1,556.5	JENSEN, BRUCE A.	Valley Floor	D
38205	CER	STR	WLD	1979	80	1,230.0	NEVADA-DEPARTMENT OF WILDLIFE	Valley Floor	D

Table B-7
Water Rights within Southern White River Valley 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	Management Category[d]
49476	CER	SPR	QM	1985	0.022	1.8	NEVADA-DEPARTMENT OF WILDLIFE	Valley Floor	D
V00801	VST	STR	IRR	1891	0	0.0*	NEVADA-DEPARTMENT OF WILDLIFE	Valley Floor	D
V01351	VST	STR	IRR	1885	0	11,600.0*	NEVADA-DEPARTMENT OF WILDLIFE	Valley Floor	D
V02091	VST	SPR	STK	1893	0.25	7.4*,[e]	JENSEN, BRUCE A.	Valley Floor	D
V02092	VST	SPR	IRR	1902	1	24.4*,[e]	JENSEN, Pamela G.	Valley Floor	D
V02232	VST	OSW	STK	1904	0.25	75.4*,[e]	JENSEN, BRUCE A.	Valley Floor	D
V02429	VST	OSW	STK	1904	5	11.2*,[e]	JENSEN, BRUCE A.	Valley Floor	D
V04605	VST	STR	IRR	1880	7.69	2,206.4	NEVADA-DEPARTMENT OF WILDLIFE	Valley Floor	D
V09237	VST	SPR	STK	1887	0.01	4.74[f]	WHEELER FAMILY TRUST	Alluvial Fan	D
V10515	VST	STR	IRR	1874	4.16[f]	1,107.60[f]	JENSEN, BRUCE A. AND PAMELA G.	Valley Floor	D

[a]CER - Certified, VST - Vested
[b]OSW - Other Surface Water, SPR - Spring, STR - Stream, UG - Underground
[c]IRD - Irrigation Desert Land Entry, IRR - Irrigation, QM - Quasi-municipal, STK - Stock watering, WLD - Wildlife
[d]See Section 2.1.2.2 for an detailed explanation of the Management Categories; D - Resource in adjacent hydrographic area,
[e]Acre-ft per season.
[f]Reported number was derived from an analysis documented in Stanka (2017b).
*The reported annual duty is not explicitly documented on the certificate or vested claim, but reported as such by the NDWR Hydrographic Abstract query.
Note: Analysis and listing of domestic wells located in White River Valley derived from review of the NDWR on-line well log database are presented in Stanka, (2017a).

Appendix C

Hydrographs and Triggers for Selected Monitor Wells and Springs

Table C-1
Triggers for DDC Sentinel and Select Monitor Wells

Well	Type	Basin
383307114471001	Sentinel Monitor Well	Cave Valley
180W501M	Sentinel Monitor Well	Cave Valley
209 S07 E62 20AA 1	Sentinel Monitor Well	Pahranagat Valley
209M-1	Sentinel Monitor Well	Pahranagat Valley
382807114521001	Select Monitor Well	Cave Valley
180W902M	Select Monitor Well	Cave Valley
383133115030201	Select Monitor Well	White River Valley
372639114520901	Select Monitor Well	Dry Lake Valley
181M-1	Select Monitor Well	Dry Lake Valley
181W909M	Select Monitor Well	Dry Lake Valley
380531114534201	Select Monitor Well	Delamar Valley
182M-1	Select Monitor Well	Delamar Valley
182W906M	Select Monitor Well	Delamar Valley
373405115090001	Select Monitor Well	Pahranagat Valley
373803115050501	Select Monitor Well	Pahranagat Valley
Flag Spring 2 - 2071302	Select Spring	White River Valley

Note: Planned Sentinel Monitor Wells that have not been constructed yet will be included after construction and data are available. These wells are: DEL4003X, WRV1012M, WRV1013M, and PAH1010M.

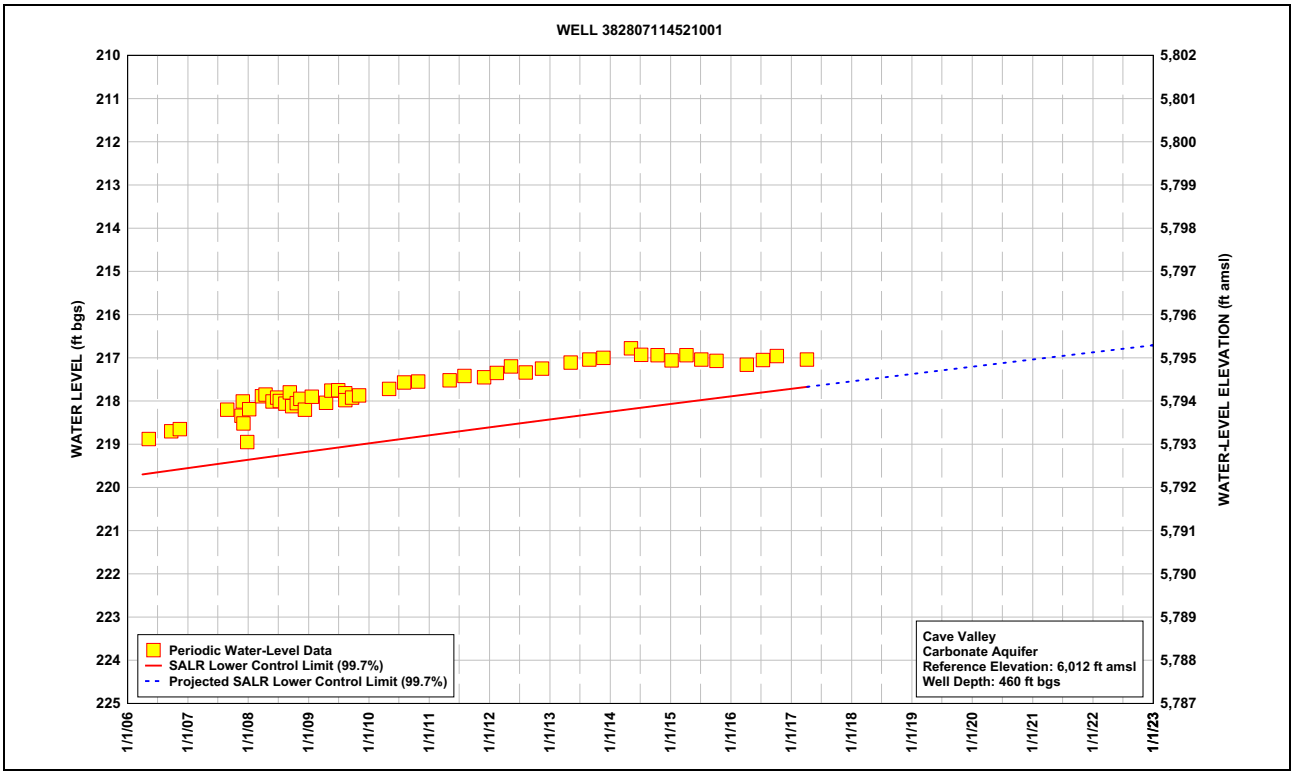

Figure C-1
Trigger, Well 382807114521001, Cave Valley

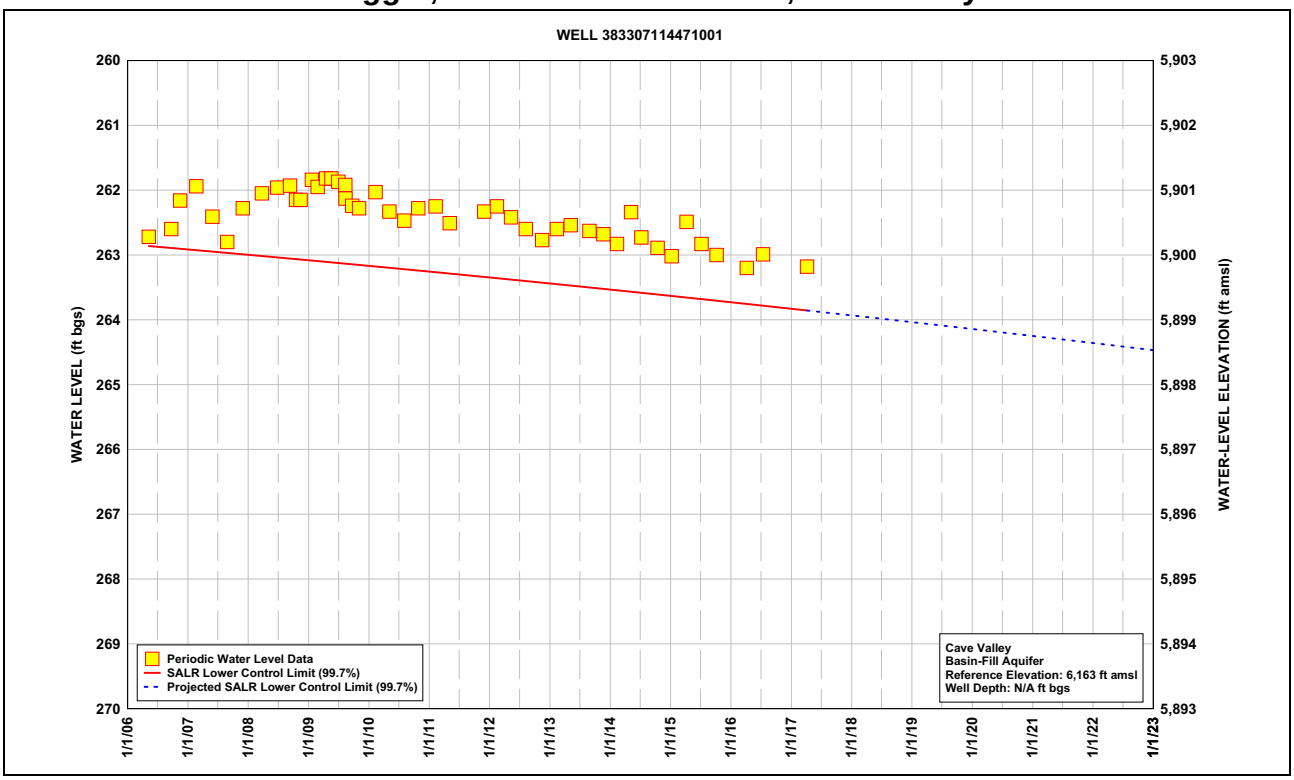

Figure C-2
Trigger, Well 383307114471001, Cave Valley

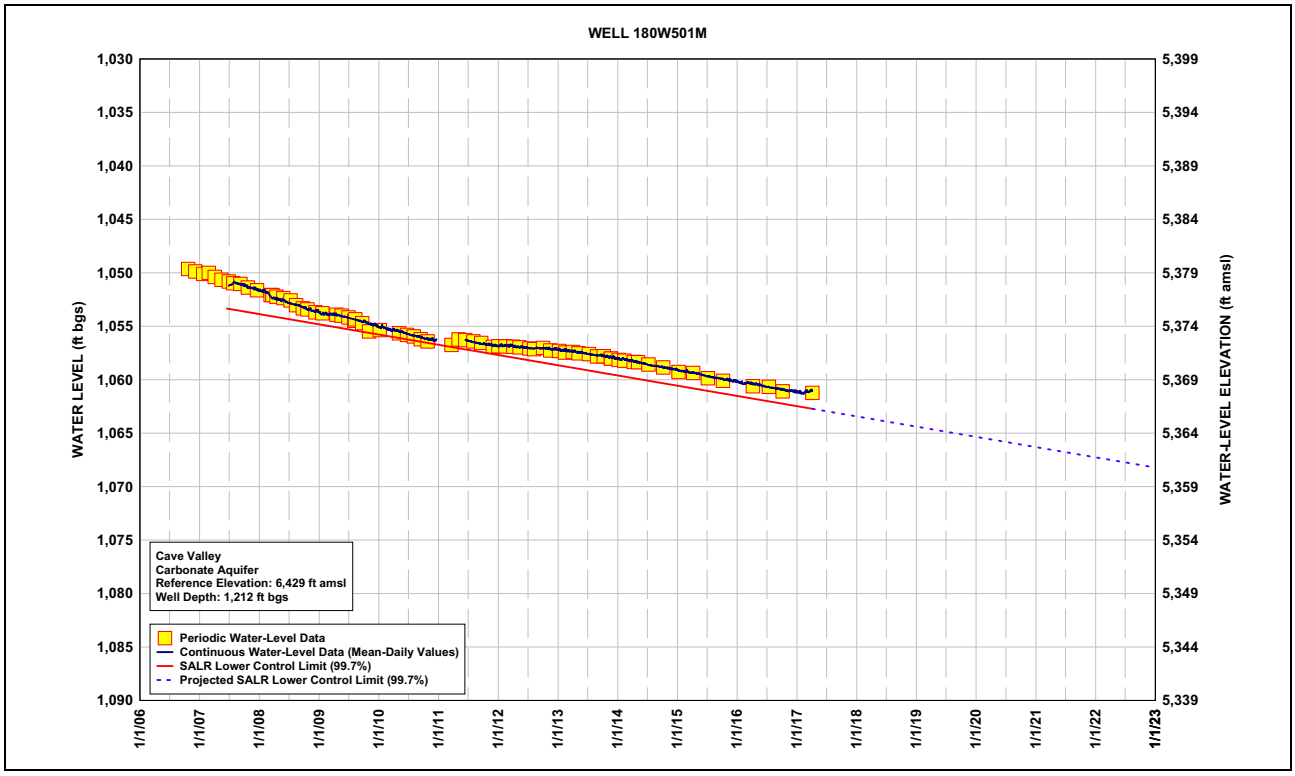

Figure C-3
Trigger, Well 180W501M, Cave Valley

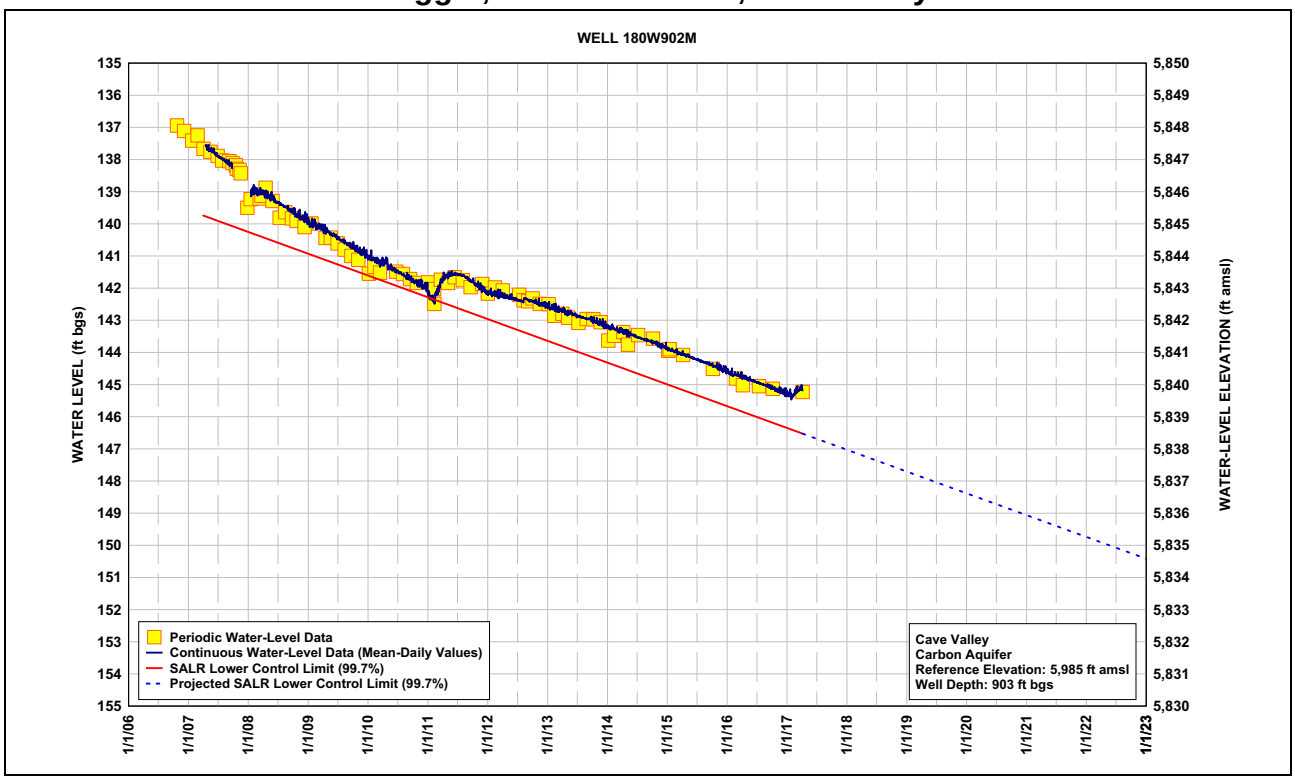

Figure C-4
Trigger, Well 180W902M, Cave Valley

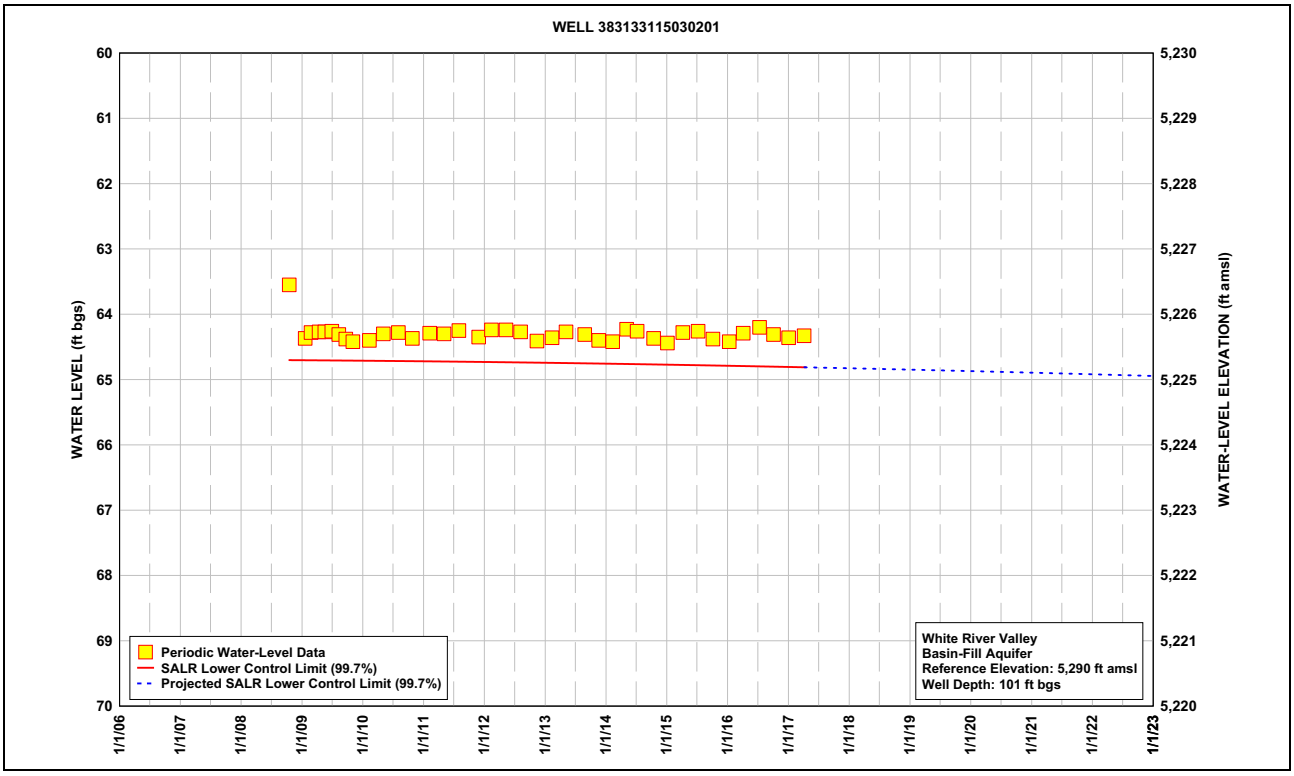

Figure C-5
Trigger, Well 383133115030201, White River Valley

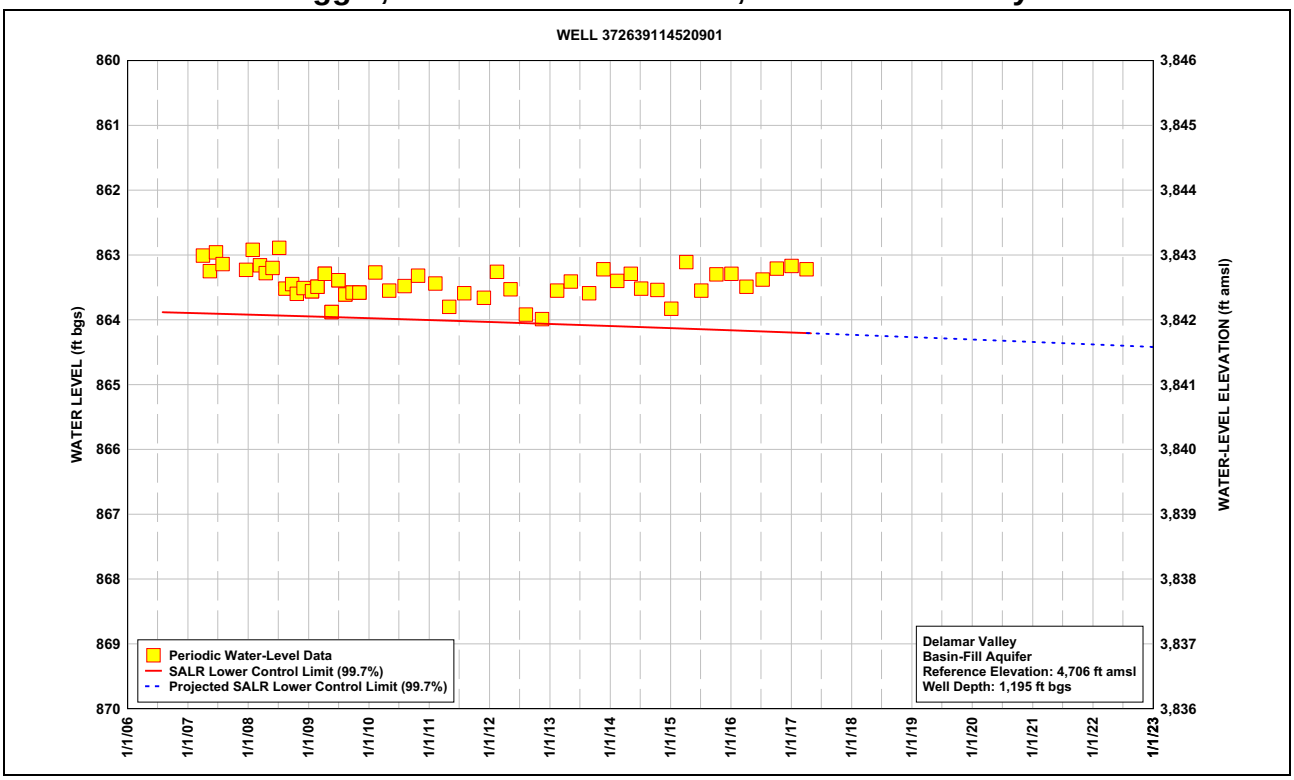

Figure C-6
Trigger, Well 372639114520901, Dry Lake Valley

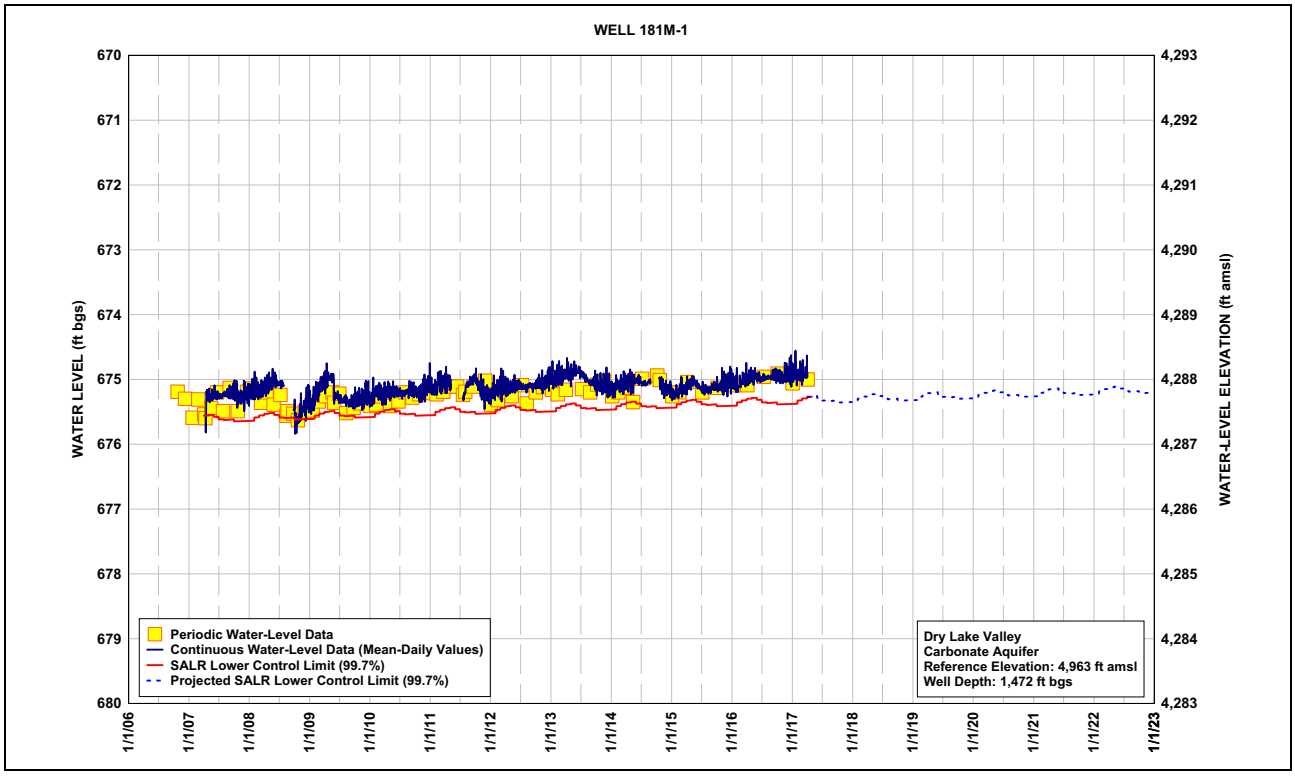

Figure C-7
Trigger, Well 181M-1, Dry Lake Valley

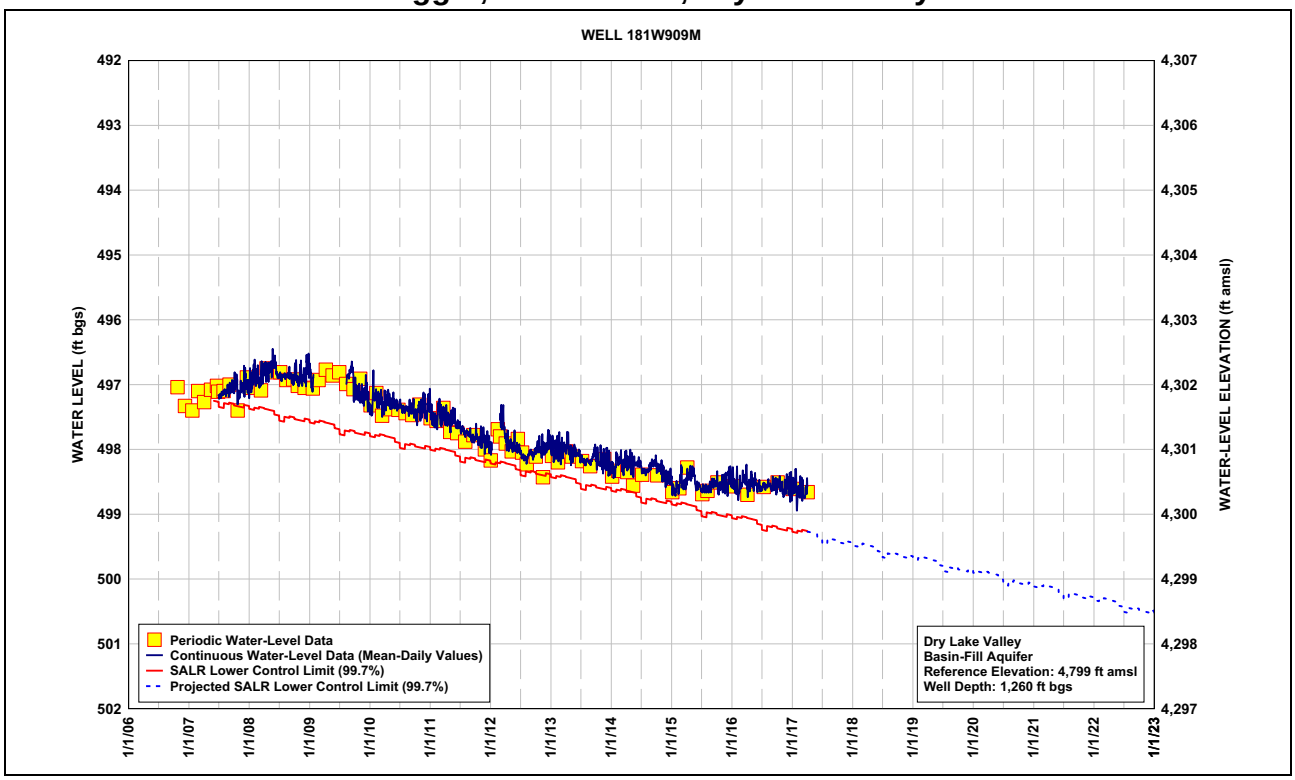

Figure C-8
Trigger, Well 181W909M, Dry Lake Valley

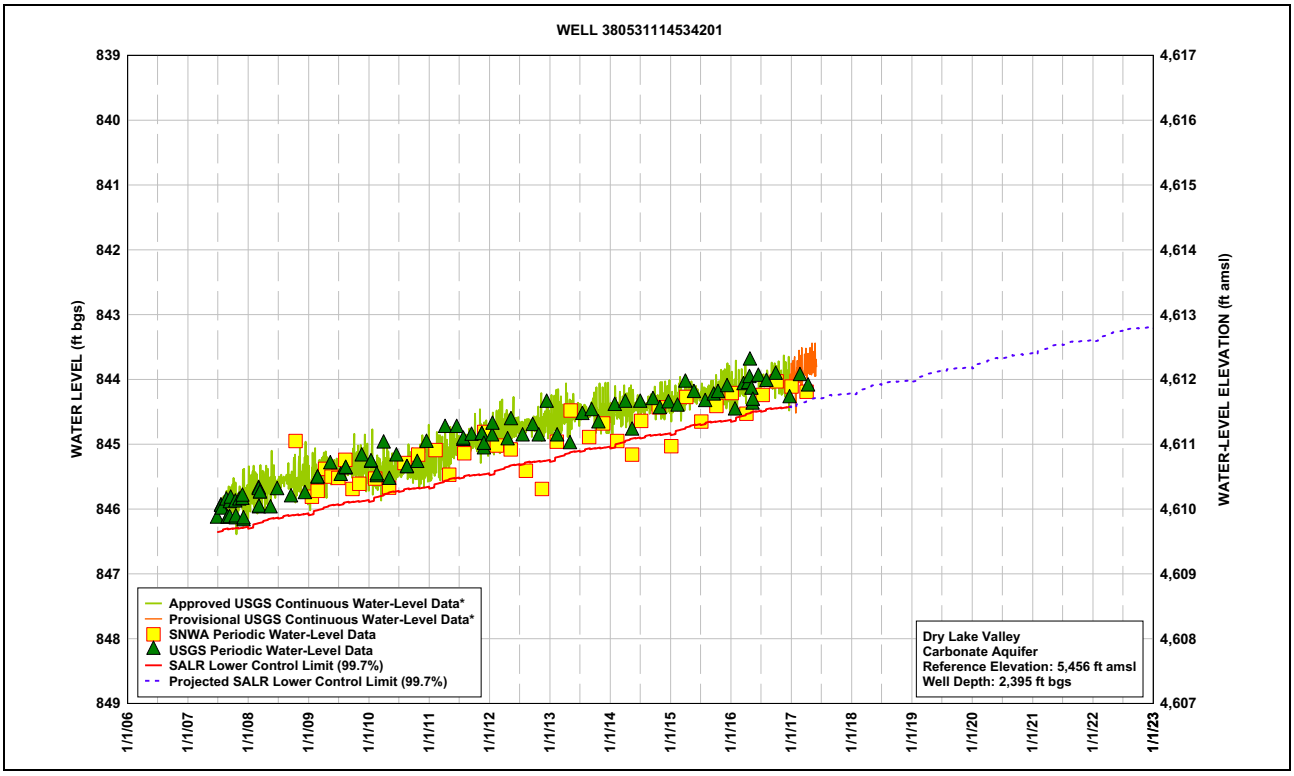

Figure C-9
Trigger, Well 380531114534201, Delamar Valley

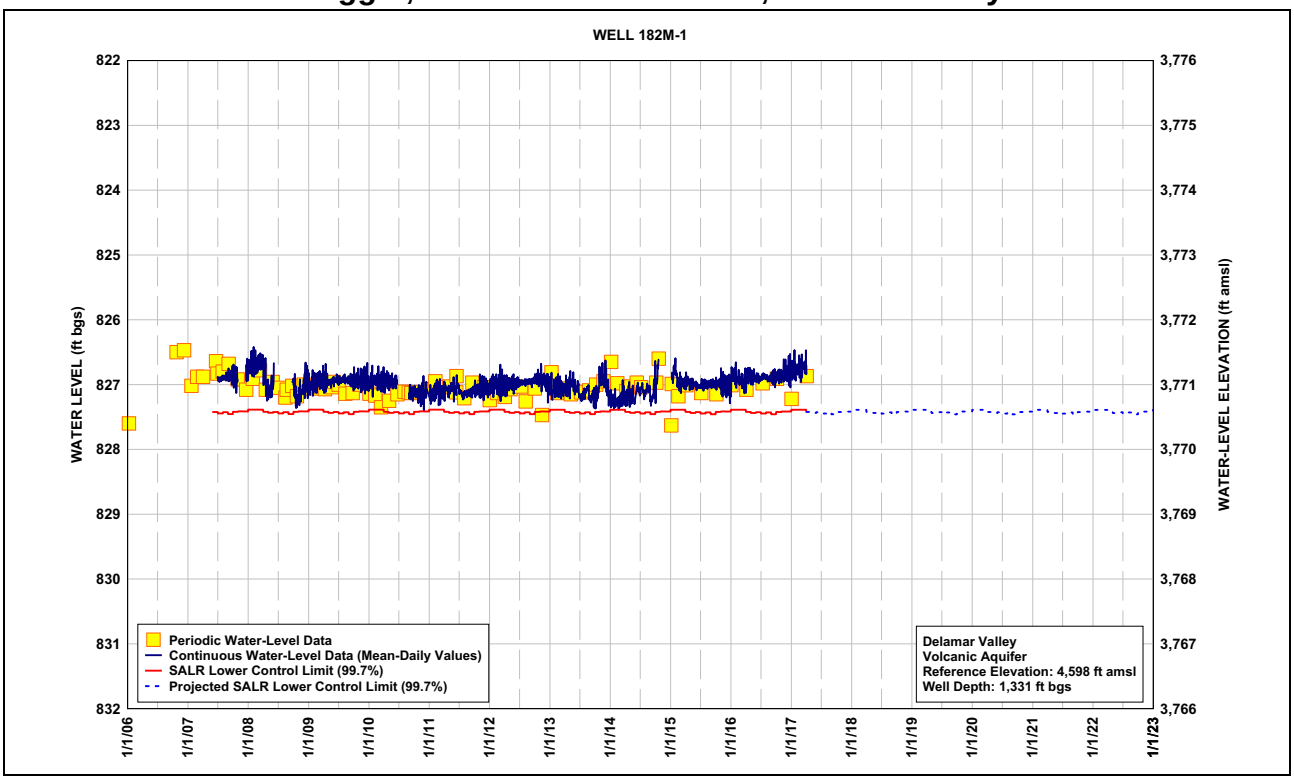

Figure C-10
Trigger, Well 182M-1, Delamar Valley

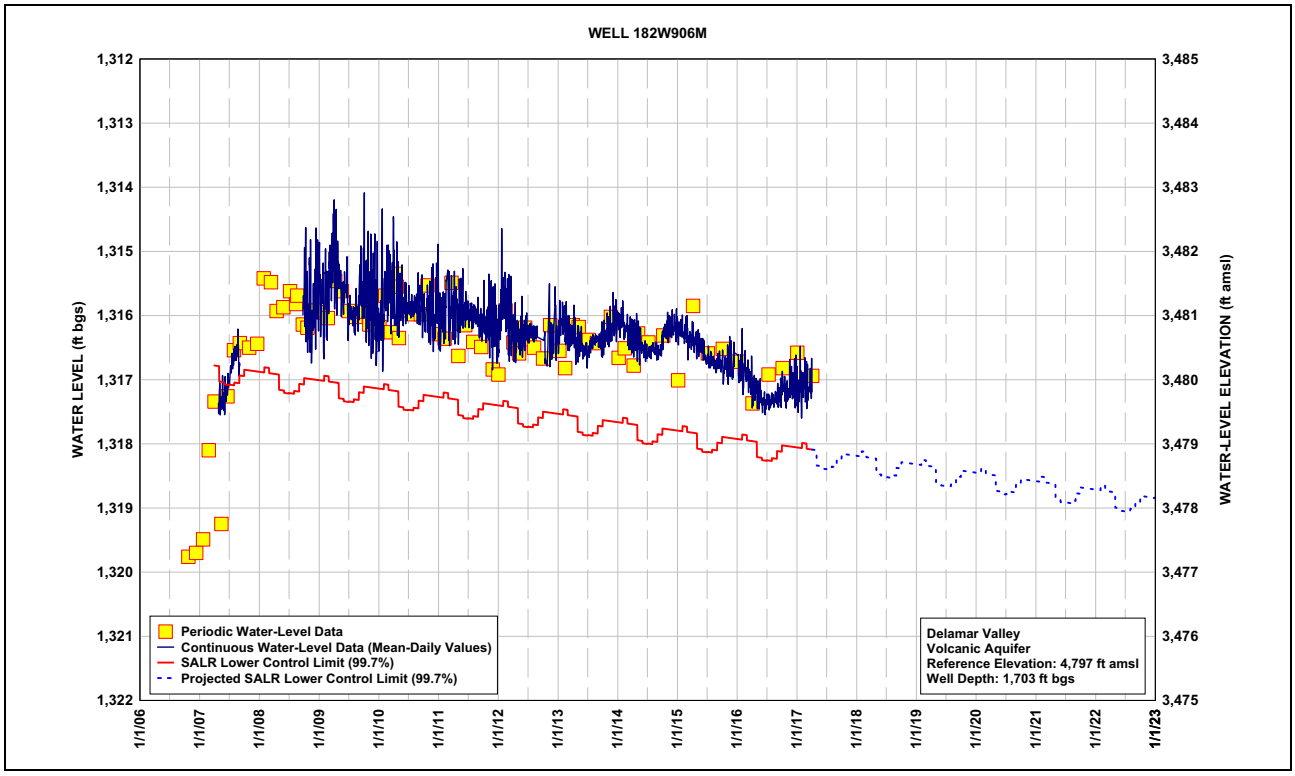

Figure C-11
Trigger, Well 182W906M, Delamar Valley

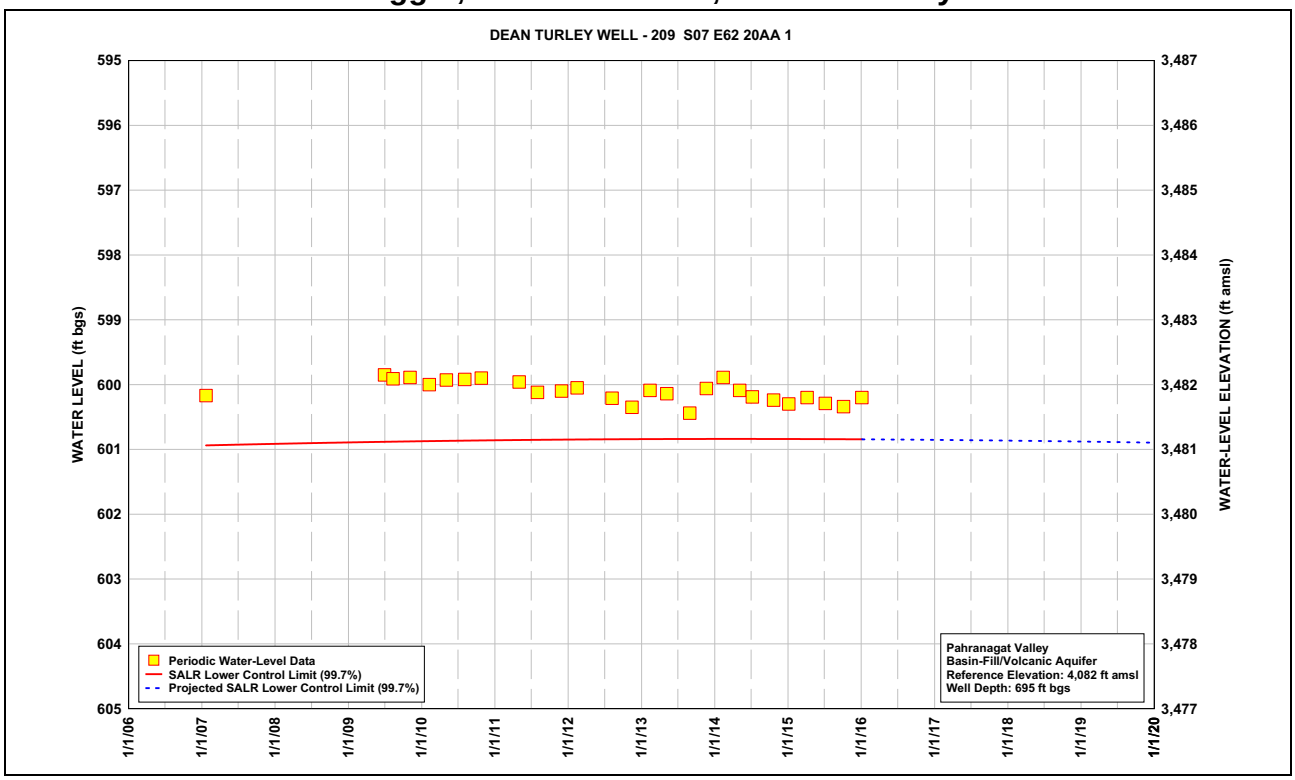

Figure C-12
Trigger, Well 209 S07 E62 20AA 1 (Dean Turley), Pahranagat Valley

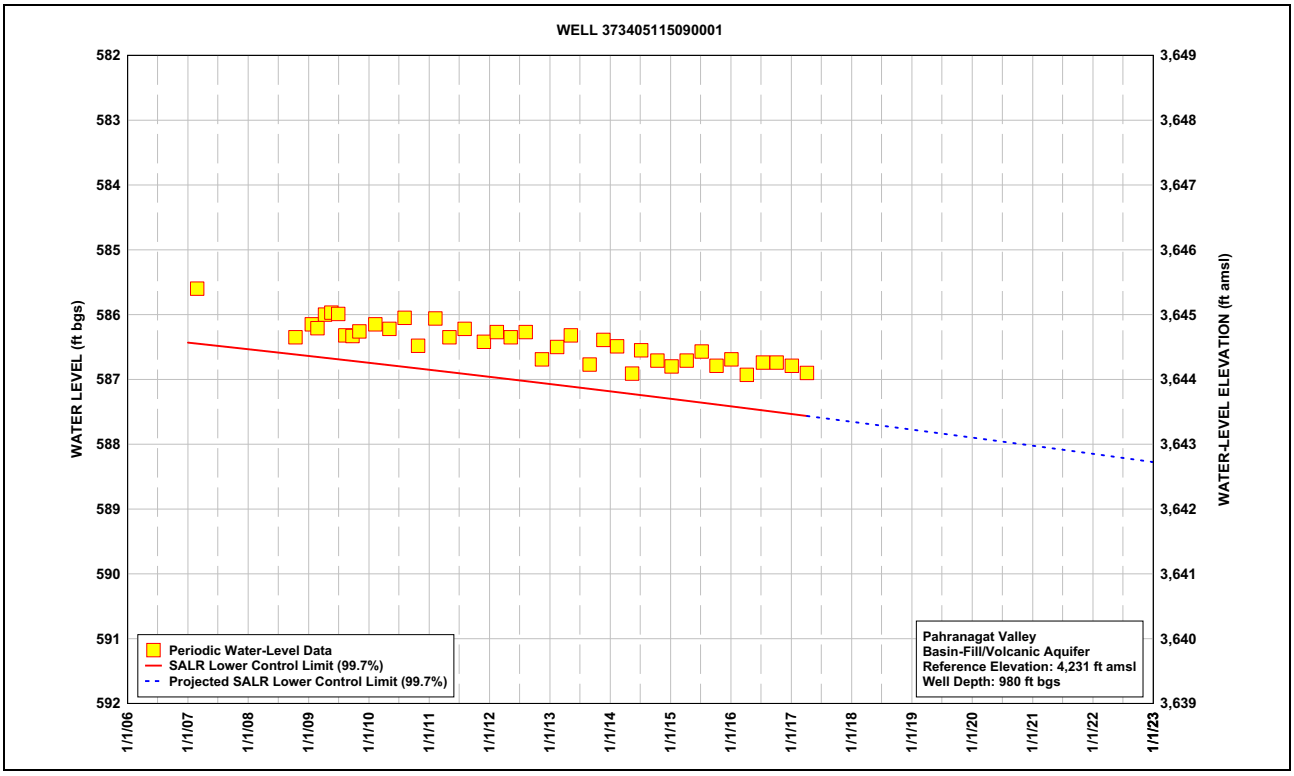

Figure C-13
Trigger, Well 373405115090001, Pahranagat Valley

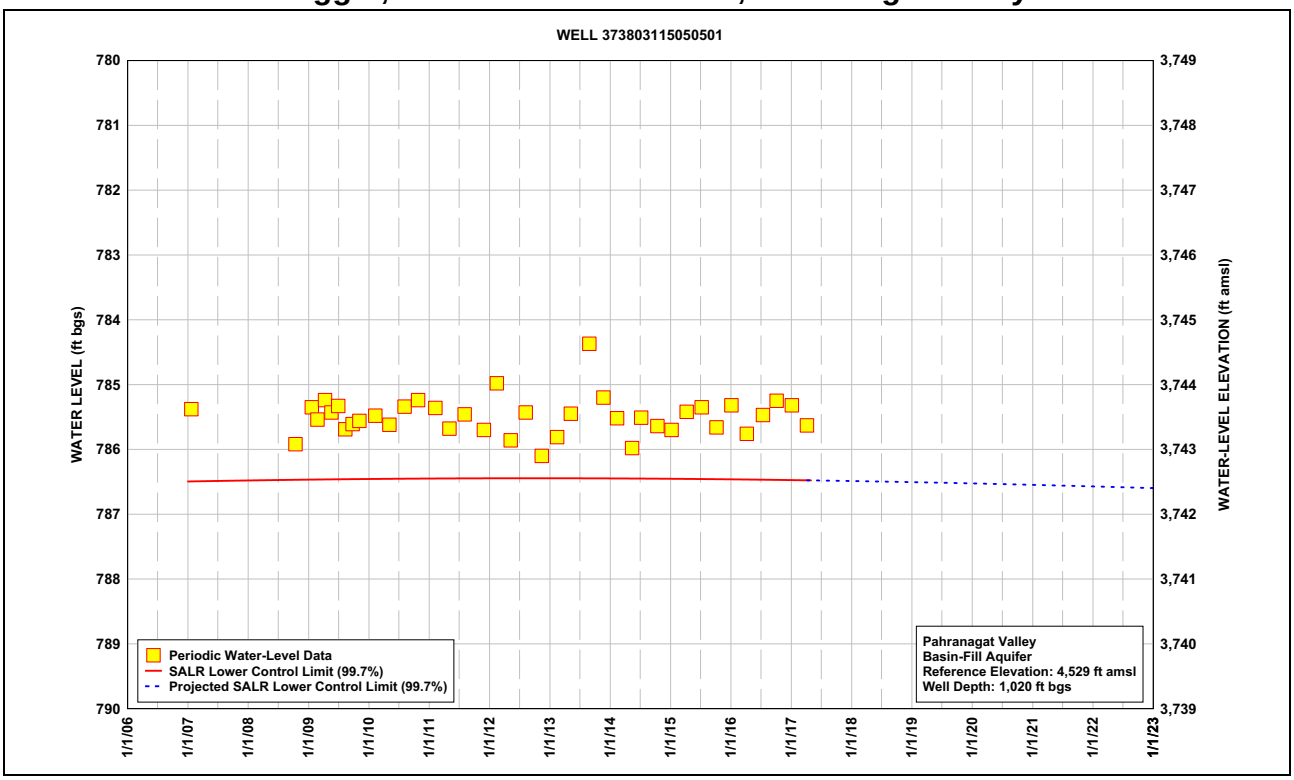

Figure C-14
Trigger, Well 373803115050501, Pahranagat Valley

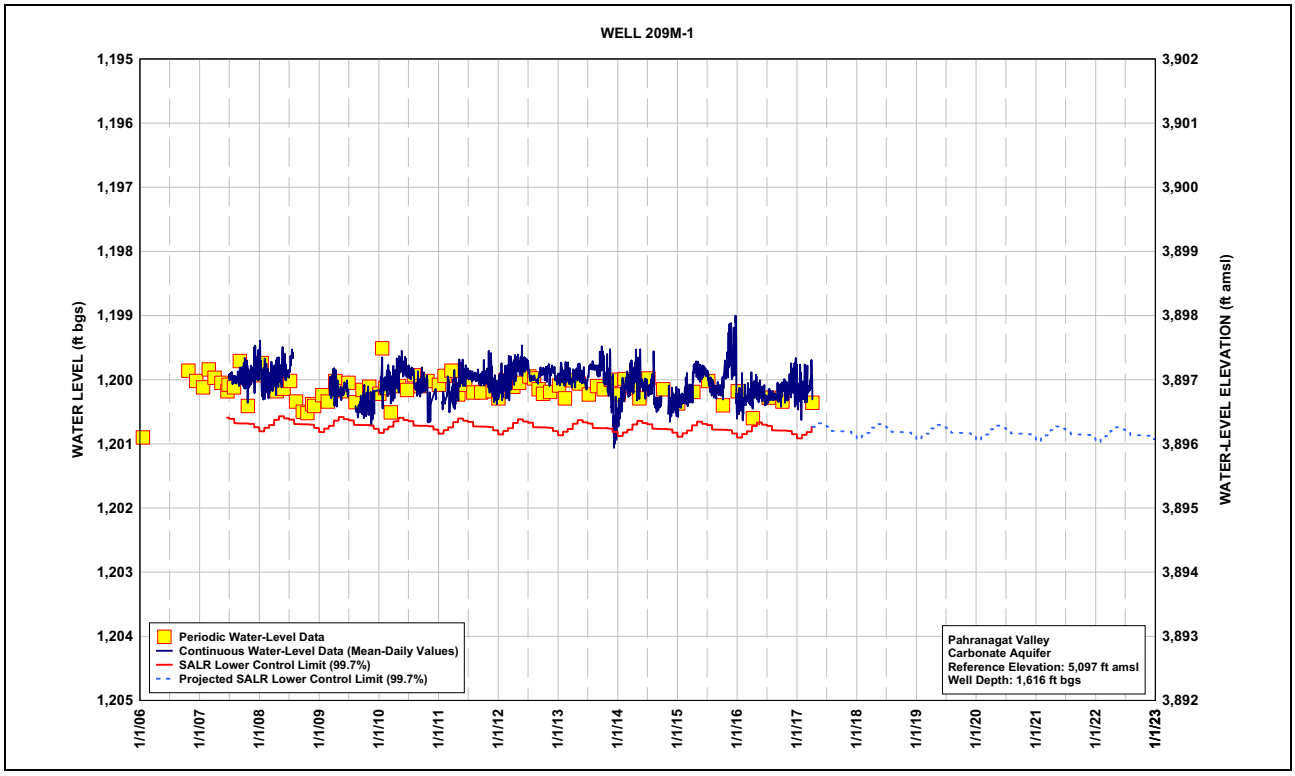

Figure C-15
Trigger, Well 209m-1, Pahranagat Valley

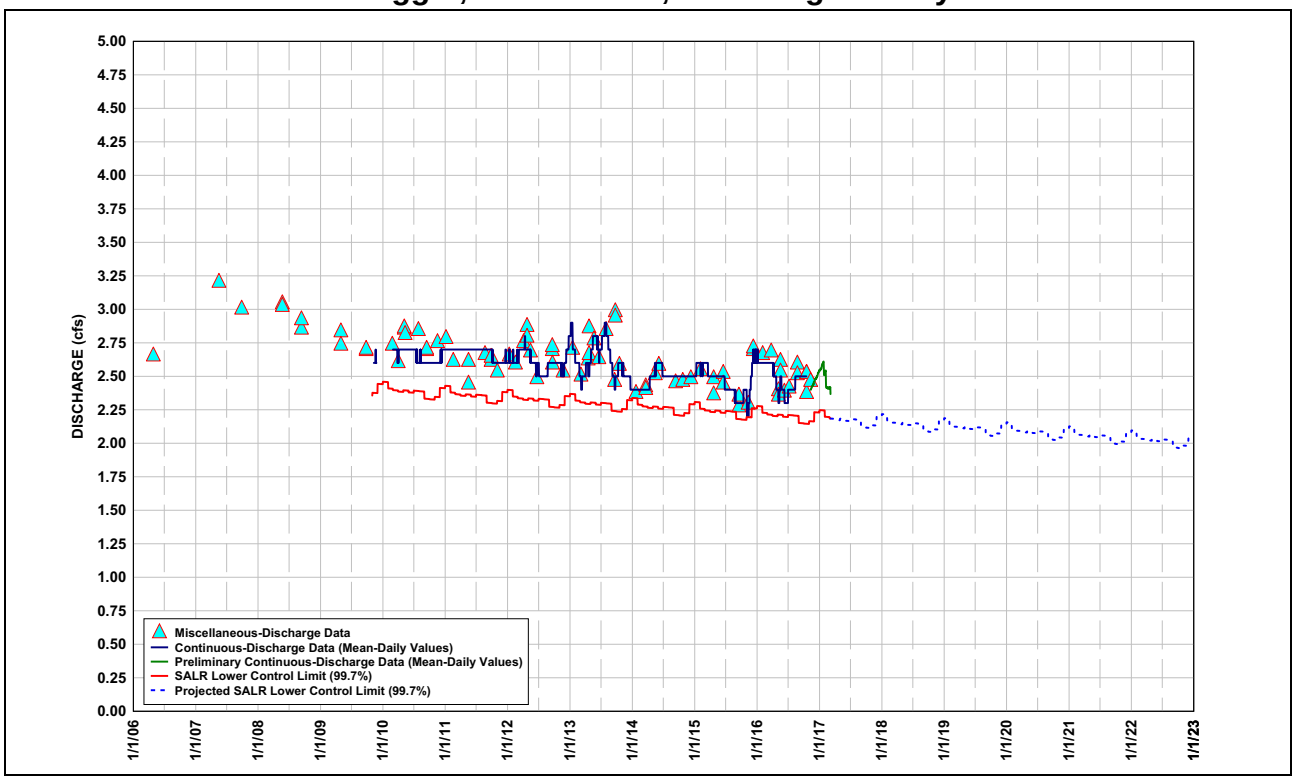

Figure C-16
Trigger, Flag Spring 2 - 2071302, White River Valley