SNWA_EXH_615

3M slideshow

environmentally sound as it relates to the basin from which the water is exported." As stated in Ruling 5726, "Water-level decline in and of itself is not environmentally unsound, rather it is the effects of water-level decline on the hydrologic-related natural resources that must be considered" (NDWR, 2007, at page 48).

The NSE presented his interpretation of the meaning of environmental soundness in various rulings regarding SNWA groundwater applications. In Ruling 5726, the NSE interpreted environmental soundness in the context of Nevada water law, legislative history, and NSE rulings and orders (NDWR, 2007, at pages 46-48).[1] The NSE found that, under Nevada water law, "whether the use of the water is environmentally sound for the basin of origin" means "whether the use of the water is sustainable over the long-term without unreasonable impacts to the water resources and the hydrologic-related natural resources that are dependent on those water resources" (NDWR, 2007, at page 47). In Rulings 6164-6167, the NSE equated "environmentally sound" with "the basins will remain environmentally viable," "a viable ecosystem will remain," and "viable plant and wildlife communities will remain" (NDWR, 2012a, at pages 187 and 191; NDWR, 2012b, at pages 147-148; NDWR, 2012c, at pages 142-143; NDWR, 2012d, at pages 140-141).

2.2 Unreasonable Effects

The definition of unreasonable effects, for the purposes of this report, 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; or
> e. cause excessive loss of shrub cover that results in extensive bare ground.

This definition of unreasonable effects is defined here in the context of the Remand Order and is specific to SNWA water rights in Spring and DDC valleys as part of the SNWA GDP. It responds to the concerns outlined in the Remand Order and is protective of senior water rights, protectable interests in existing domestic wells, and the public interest while allowing for reasonable lowering of the static water level as provided under Nevada water law (Section 2.1). The definition also incorporates the NSE's interpretation of environmental soundness under Nevada water law (Section 2.1), and identifies specific unreasonable environmental effects to avoid from SNWA GDP pumping. The 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

1. Ruling 5726 granted SNWA water rights in Spring Valley in 2007 and was vacated in 2010 because of a Nevada Supreme Court opinion that the NSE must re notice SNWA's original groundwater applications and reopen the protest period (Great Basin Water Network, et al., v. NSE, et al., June 17, 2010). A second water rights hearing was held, and the NSE issued Ruling 6164 granting SNWA water rights in Spring Valley in 2012.

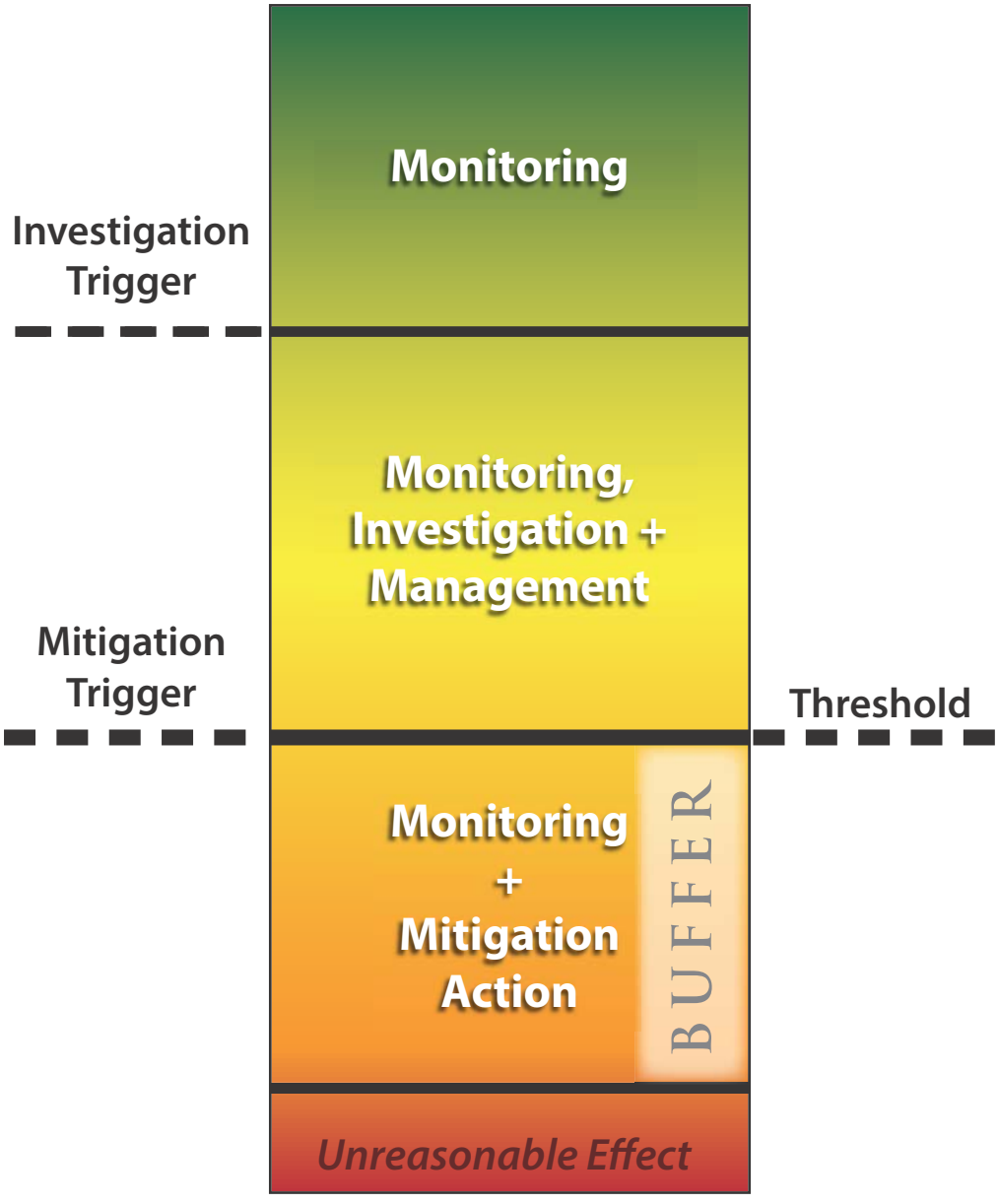


Figure 3-1
Threshold, Trigger, and Monitoring, Management, and Mitigation Approach

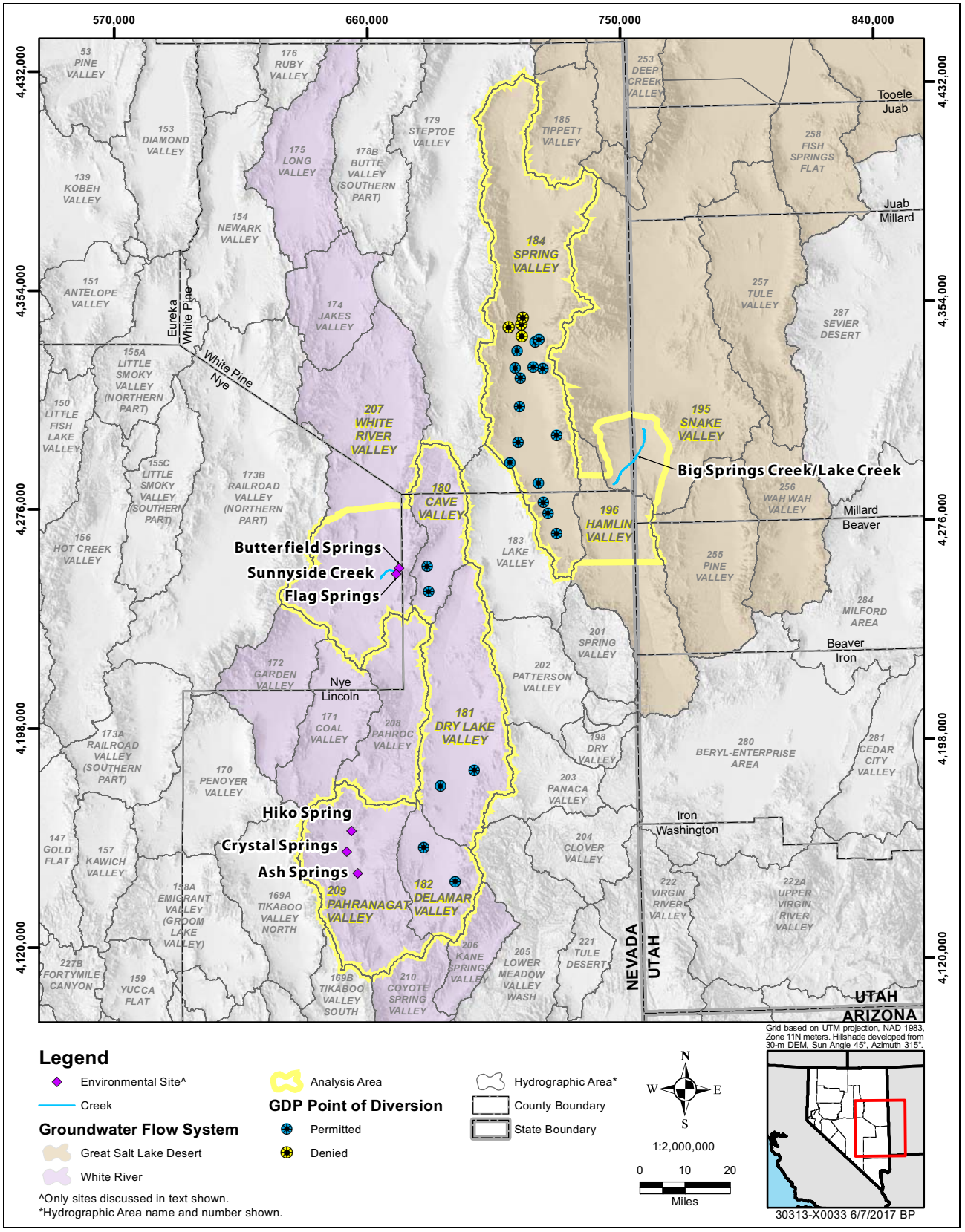


Figure 4-1
Analysis Area with Flow Systems

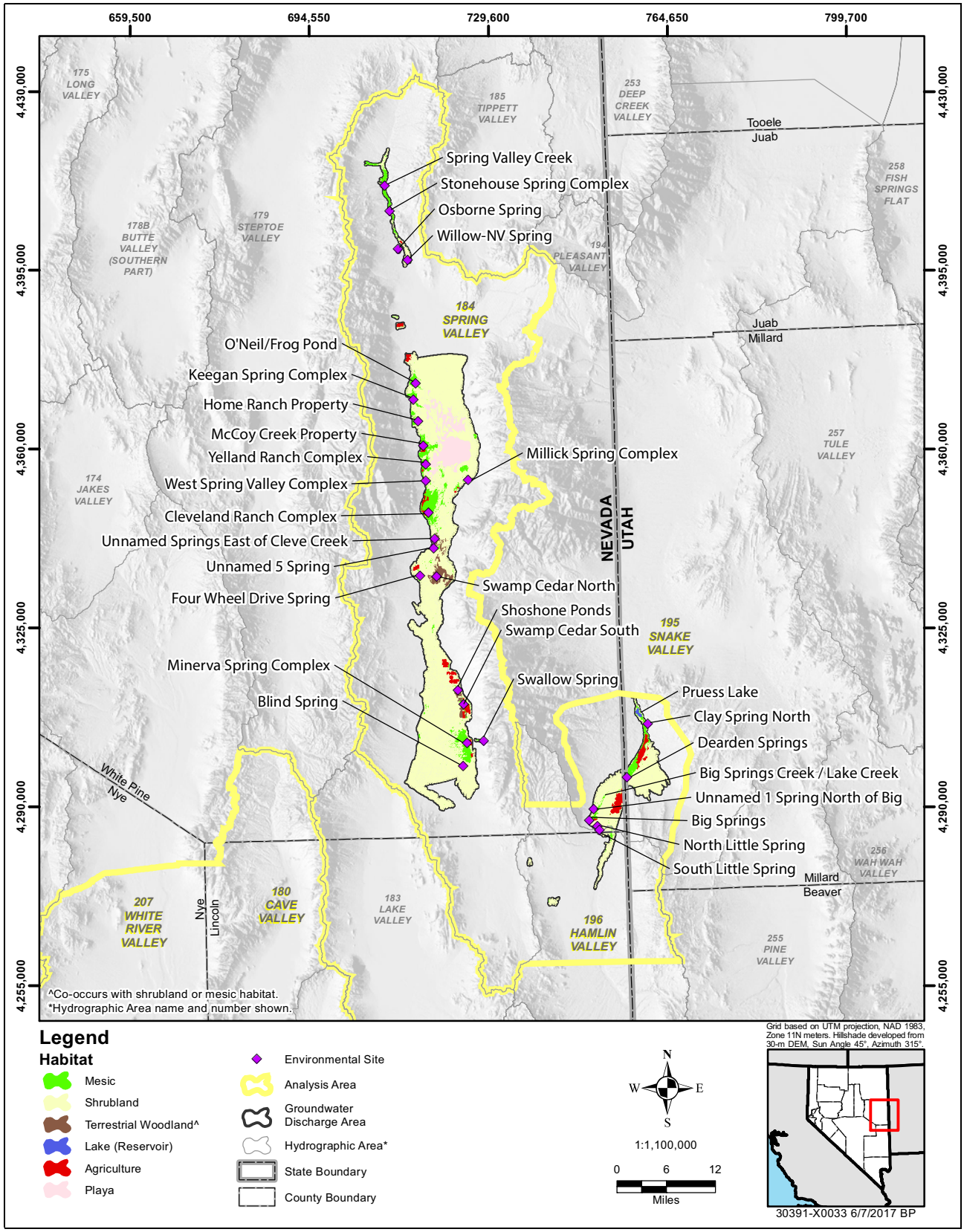


Figure 5-2
Habitats and Environmental Sites in Spring, Hamlin, and Snake Valleys

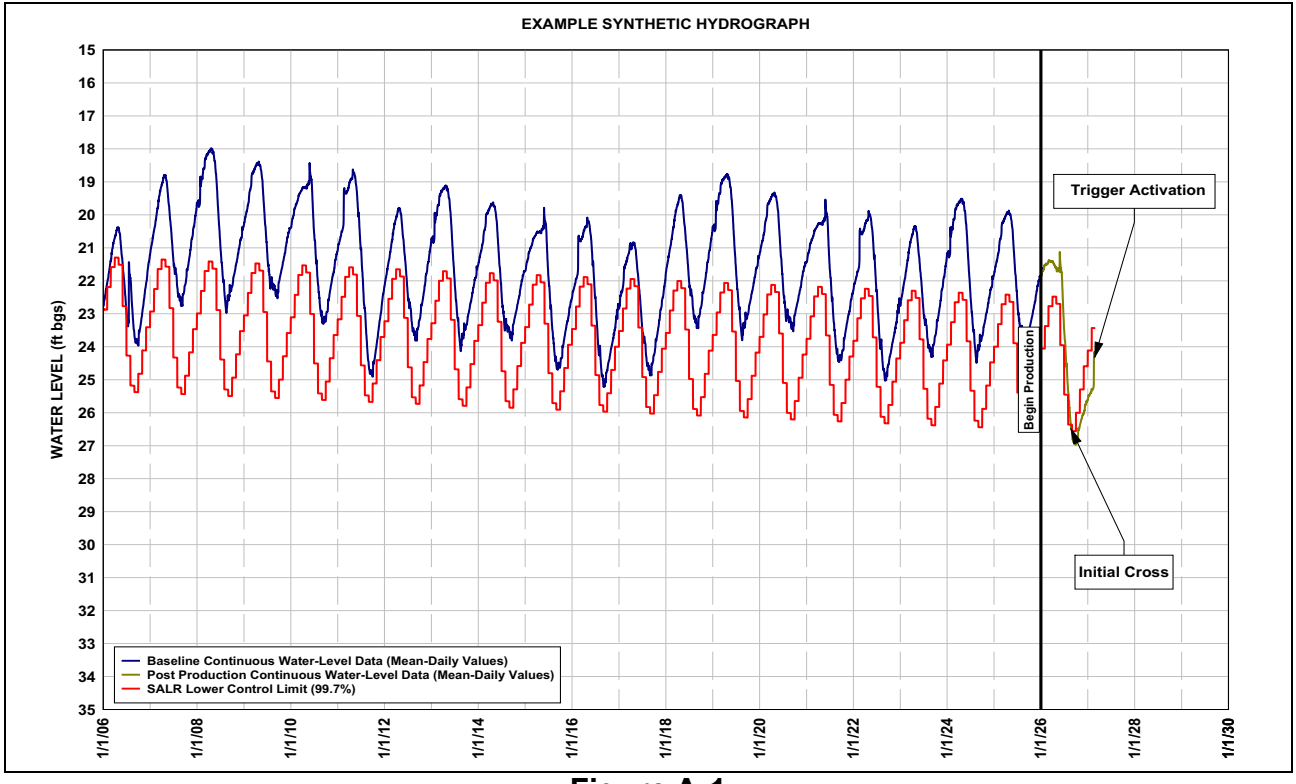


Figure A-1
Example of Trigger Activation - Strong Seasonality

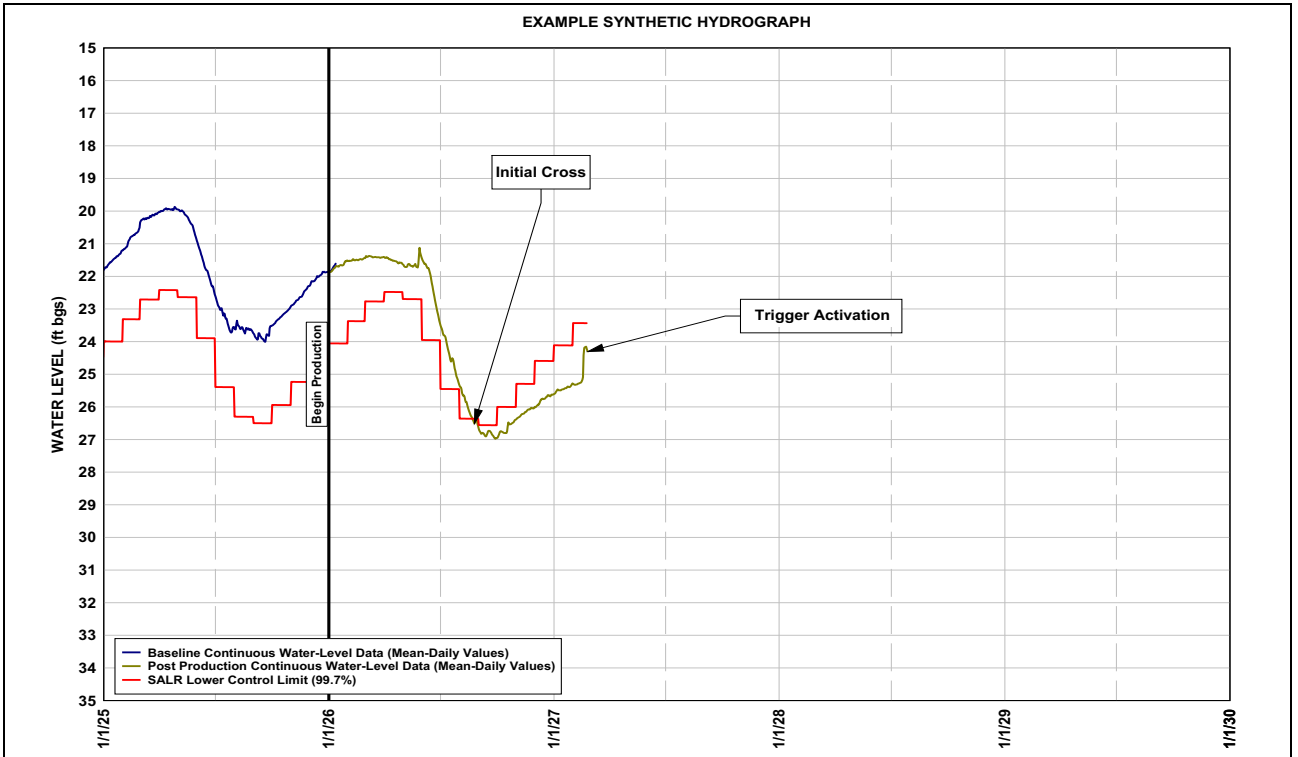


Figure A-2
Example of Trigger Activation Close up of Figure A-3

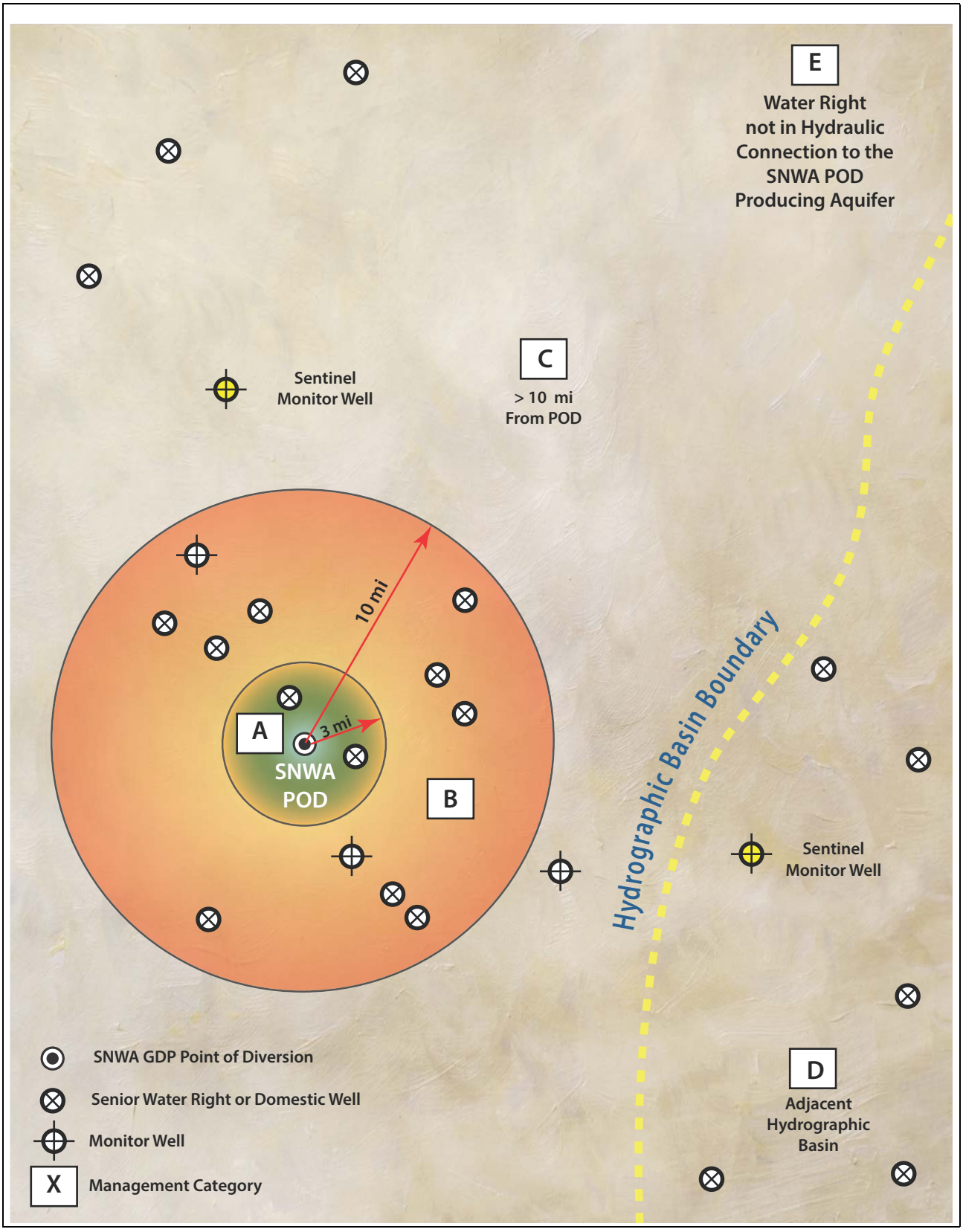


Figure 3-3
Plan View Illustration of Management Strategy Categories

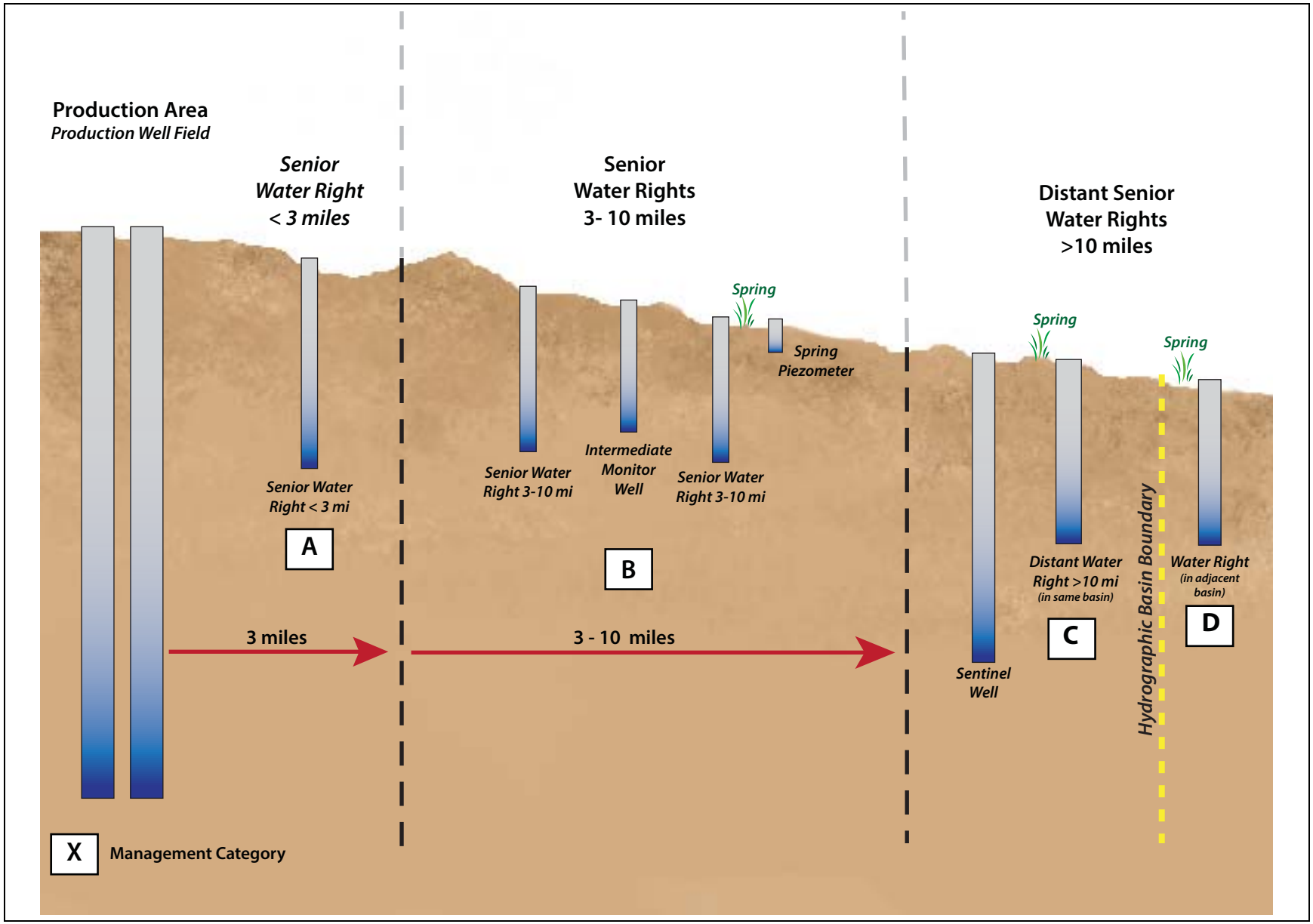


Figure 3-4
Profile Illustration of Management Strategy Categories

Table 3-1
Management 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 (Section 3.2.7) -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 months using the seasonally adjusted linear regression method (Section 3.2.1) -Mitigation trigger set at senior water right site (Section 3.2.6) -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 (Section 3.2.7) -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 months using the seasonally adjusted linear regression method (Section 3.2.1) -Mitigation trigger set at senior water right site (Section 3.2.6) -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 months using the seasonally adjusted linear regression method (Section 3.2.1) -Refine predictive tools with aquifer response data to estimate drawdown at other more distant monitor wells -Identify and implement management actions if needed (Section 3.2.3) -Mitigation trigger set at senior water right site (Section 3.2.6)

Table 3-1
Management 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 months using the seasonally adjusted linear regression method (Section 3.2.1) -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 (Section 3.2.3) -Mitigation trigger set at senior water right site (Section 3.2.6)
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 management category for each senior water right in the 3M Plan area is presented in the individual basin senior water right summary tables presented in Sections 6.0 - 9.0 and Appendix B.

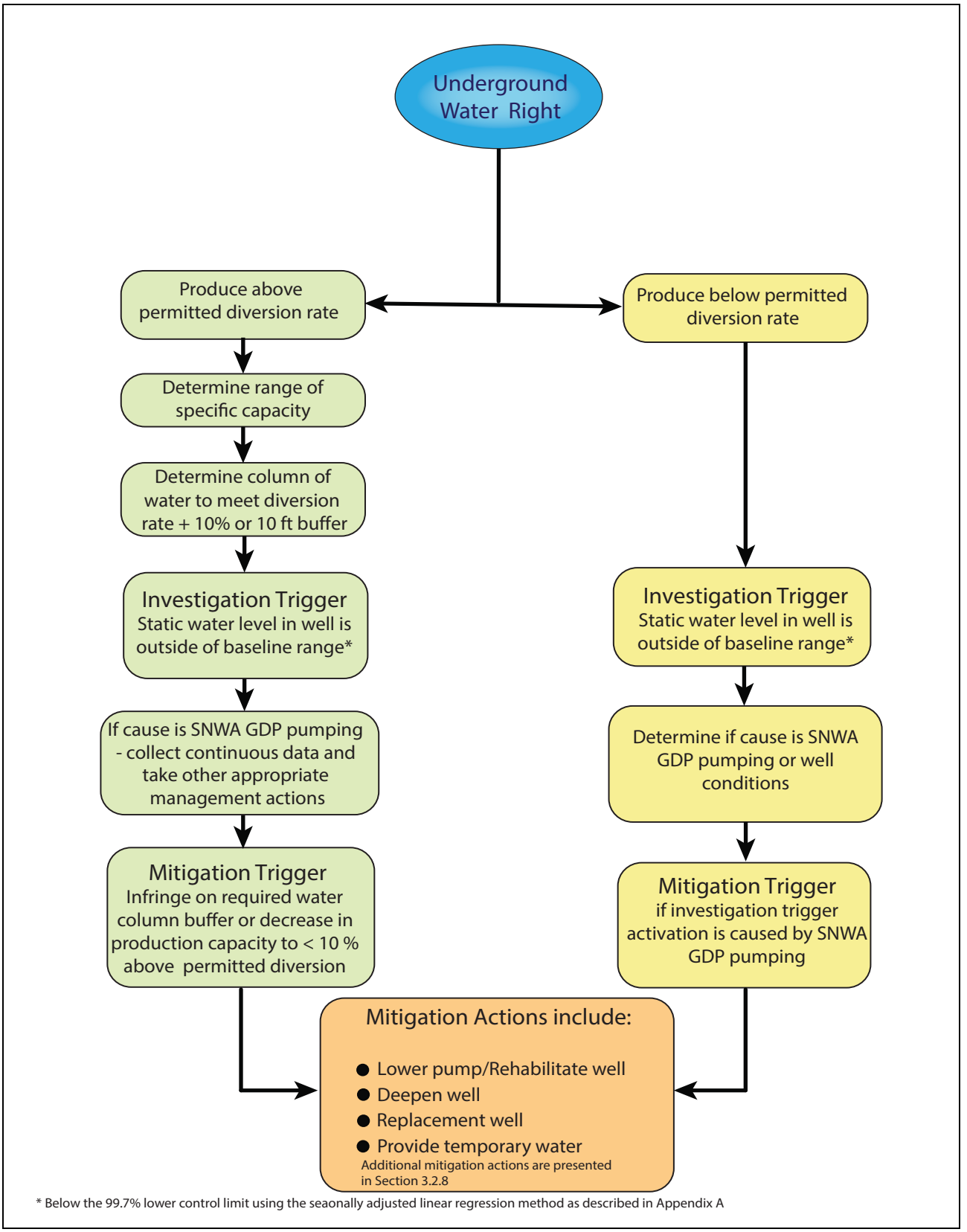


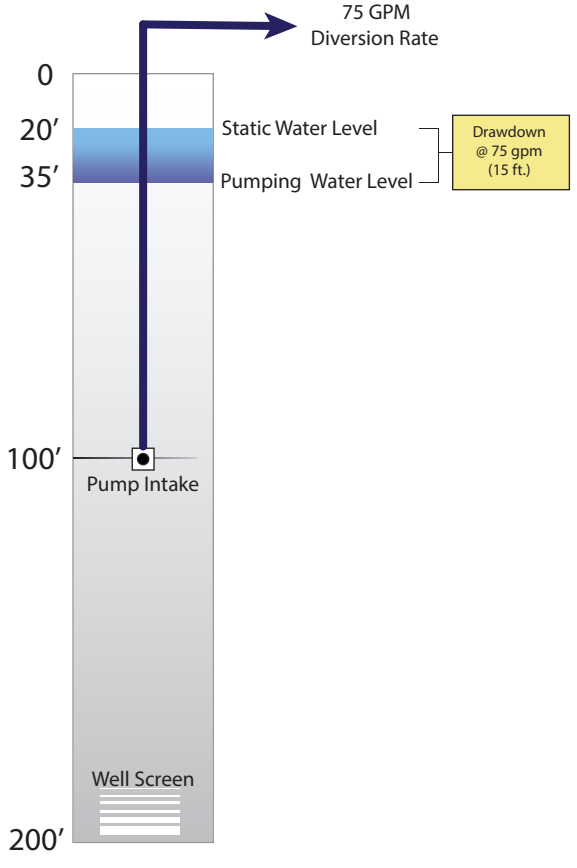
Figure 3-5
Management and Mitigation Flow Chart for Senior Underground Water Right

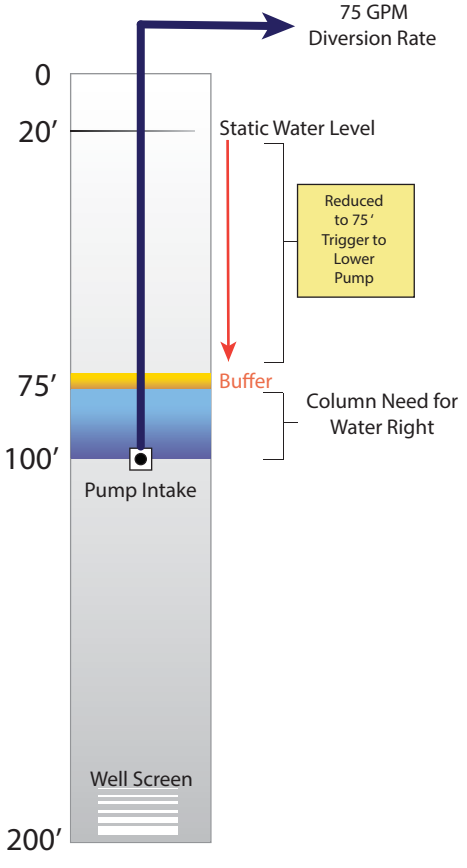
$$\frac{\text{Pumping Rate}}{\text{Drawdown}} = \text{Specific Capacity}$$

Example:

$$\frac{75\ \text{GPM}}{15\ \text{ft. Drawdown}} = 5\ \frac{\text{GPM}}{\text{ft.}}$$

$$\text{Column of Water Needed} = \frac{\text{Diversion Rate}}{\text{Range of Specific Capacity}}$$





Mitigation Trigger = Column of water needed to produce water right. + 10 % or 10 ft offset buffer (whichever is greater)

Example: 25 ft. above pump intake = 15 ft. + 10 ft. buffer

Mitigation Trigger

- Static water level decline infringing on column of water needed to produce water right.

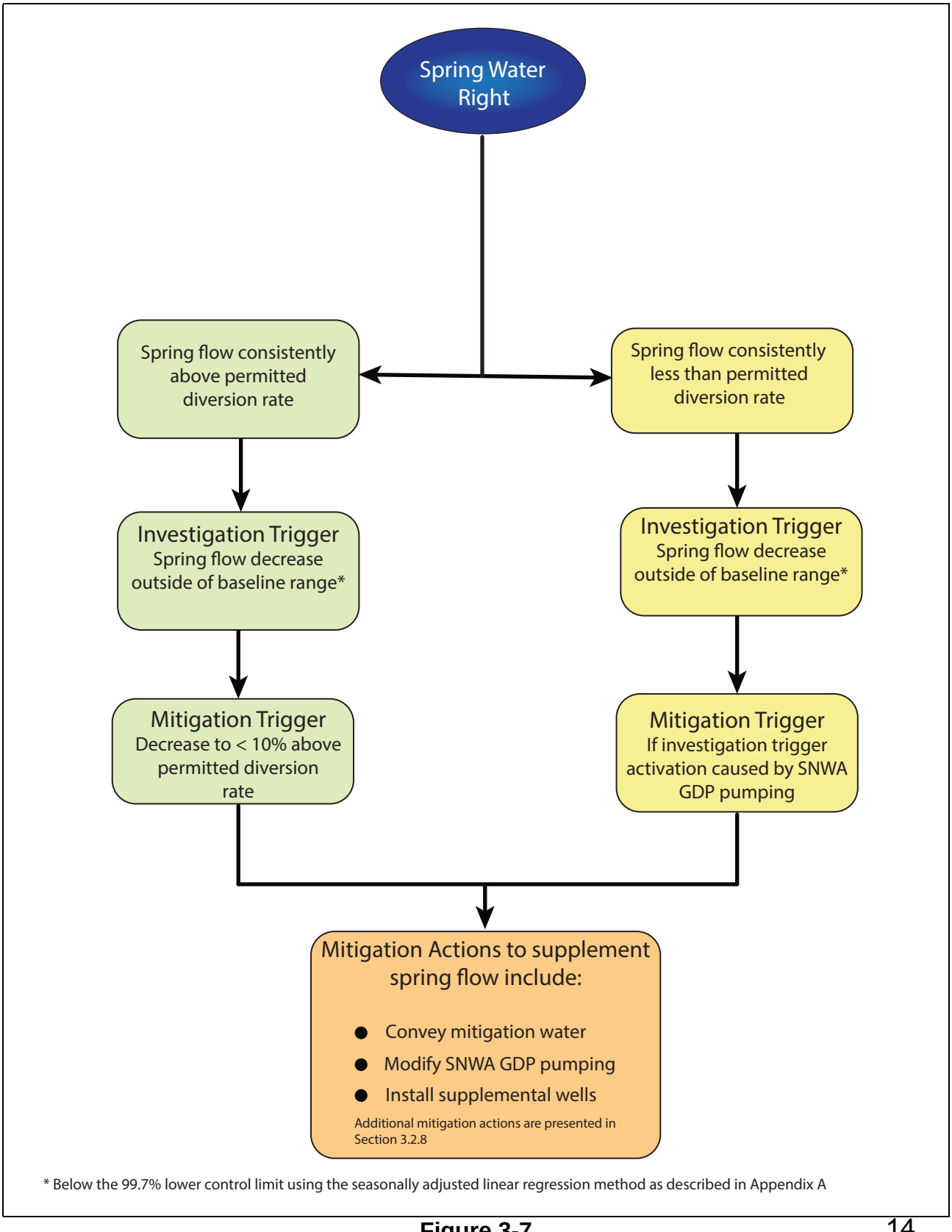
or

- Decline in pumping rate to < 10 % or 10 ft. above diversion rate.

Figure 3-6

Specific Capacity Template for a Mitigation Trigger at an Underground Water Right

Page 13 Intentionally Omitted



* Below the 99.7% lower control limit using the seasonally adjusted linear regression method as described in Appendix A

Figure 3-7
Management and Mitigation Flow Chart for Senior Spring or Stream Water Right

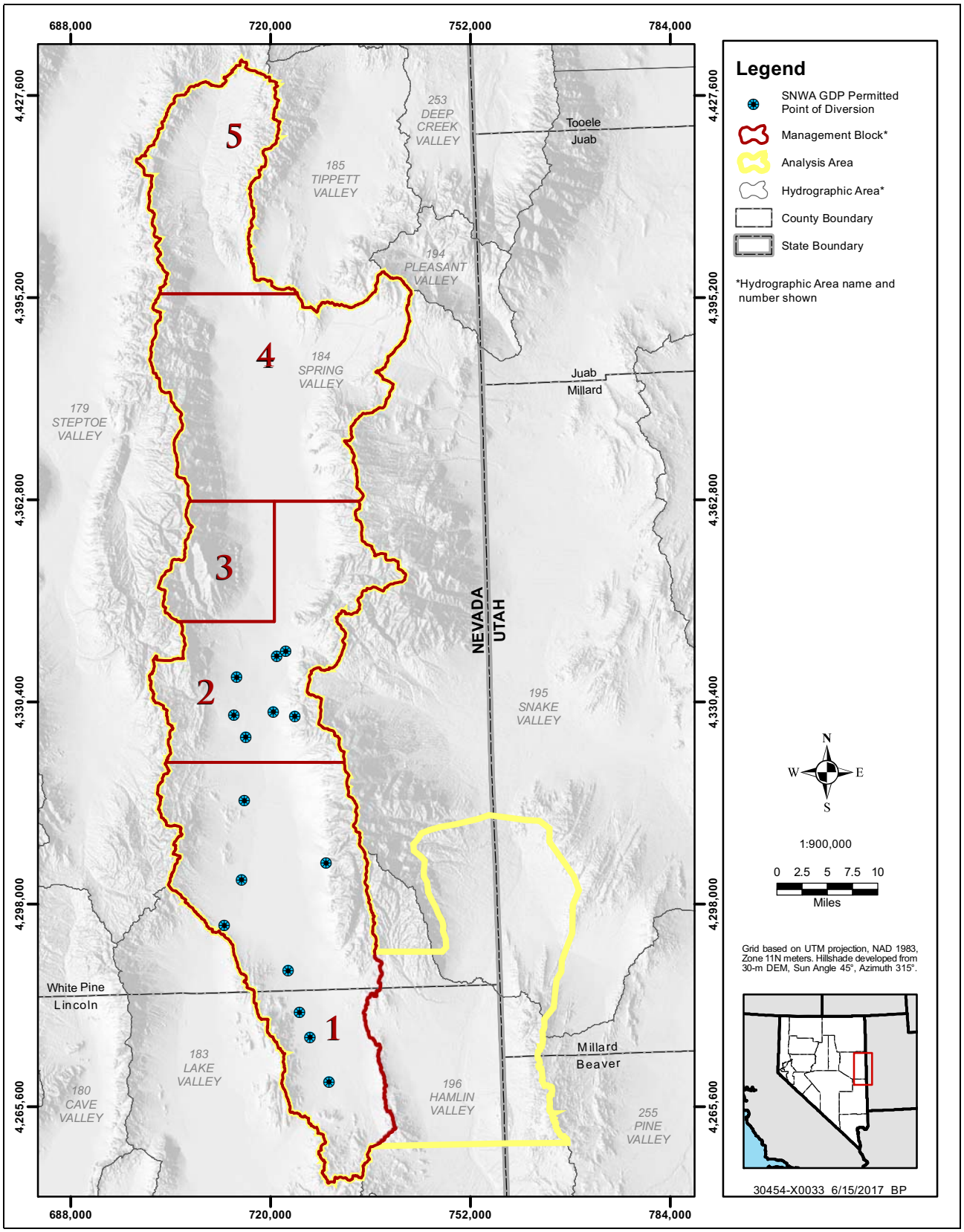


Figure 1-1
3M Plan Area for SNWA GDP Pumping in Spring Valley

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

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

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

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

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

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

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

[a]Well removed from program previously.

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

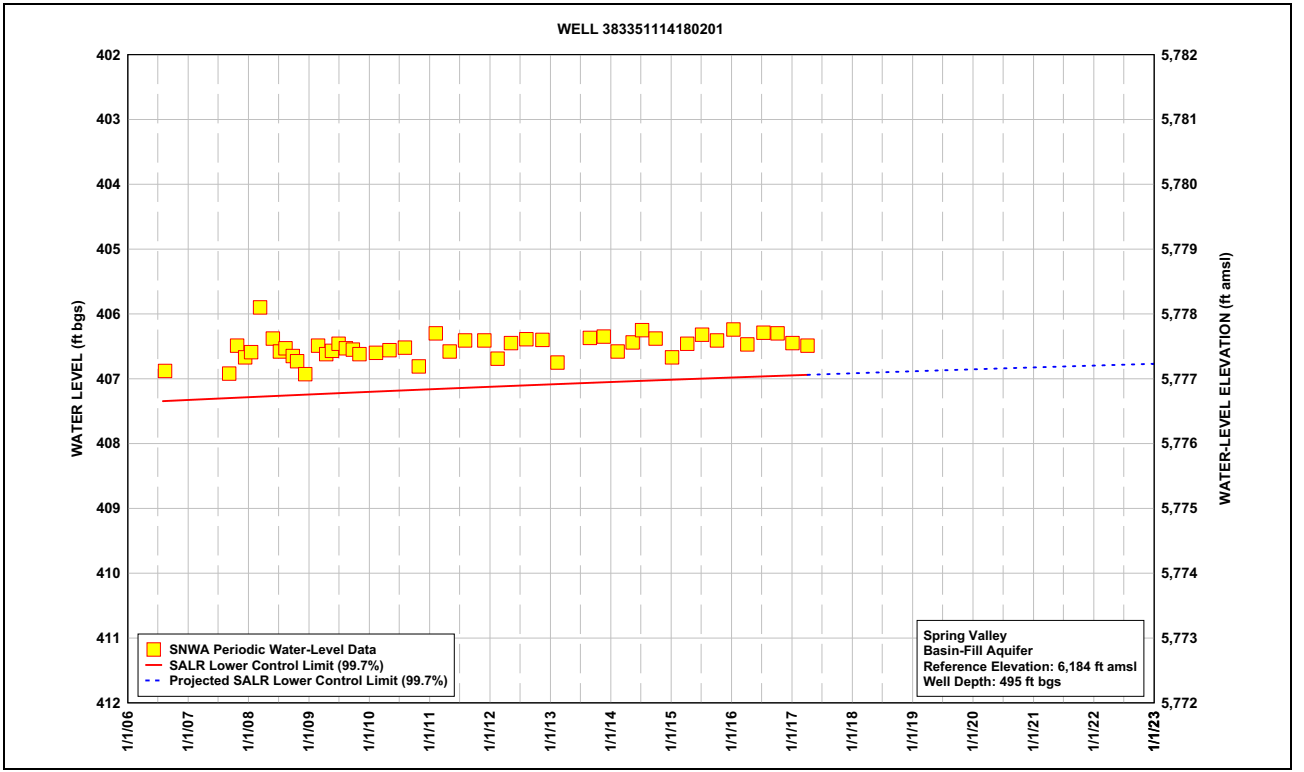
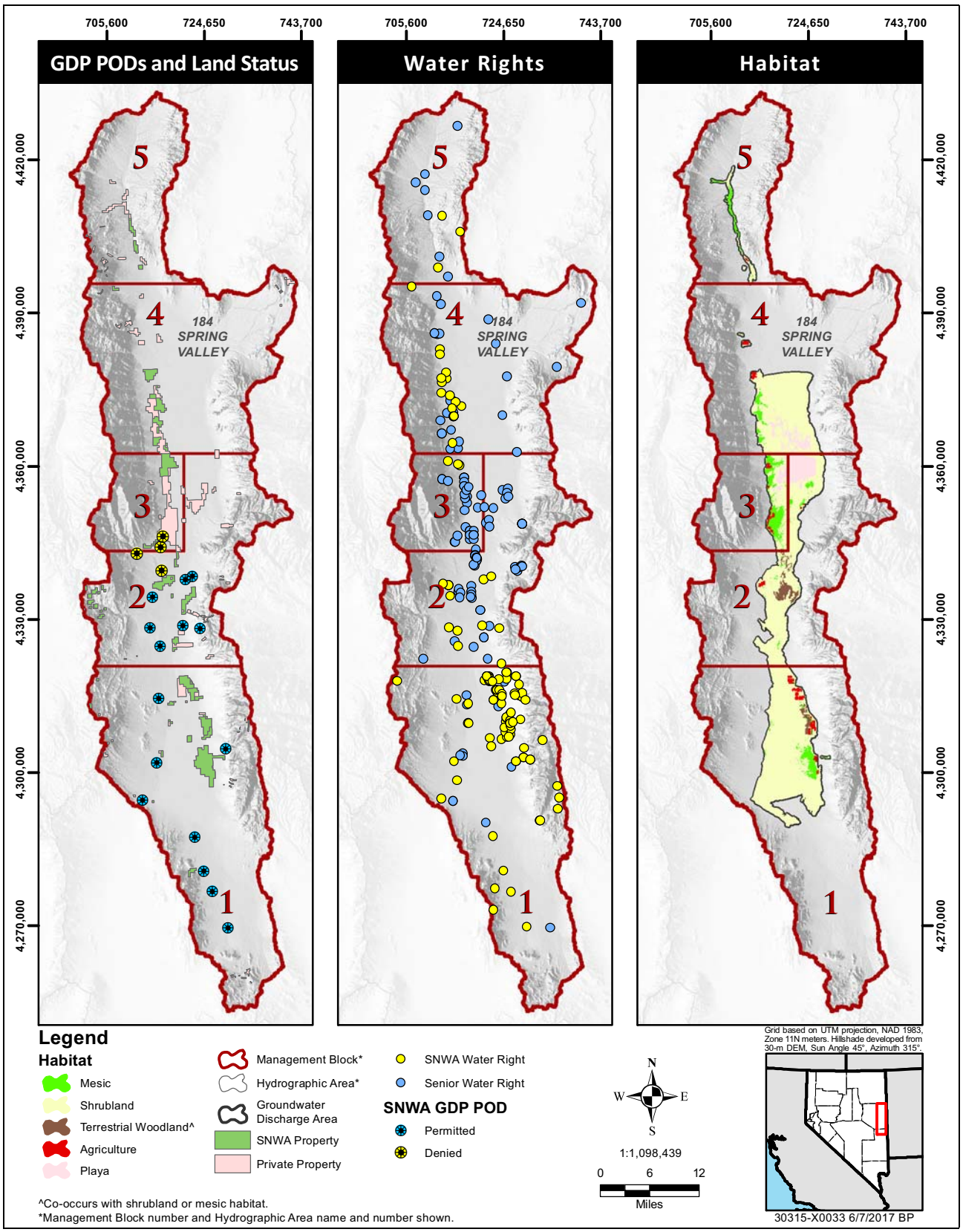
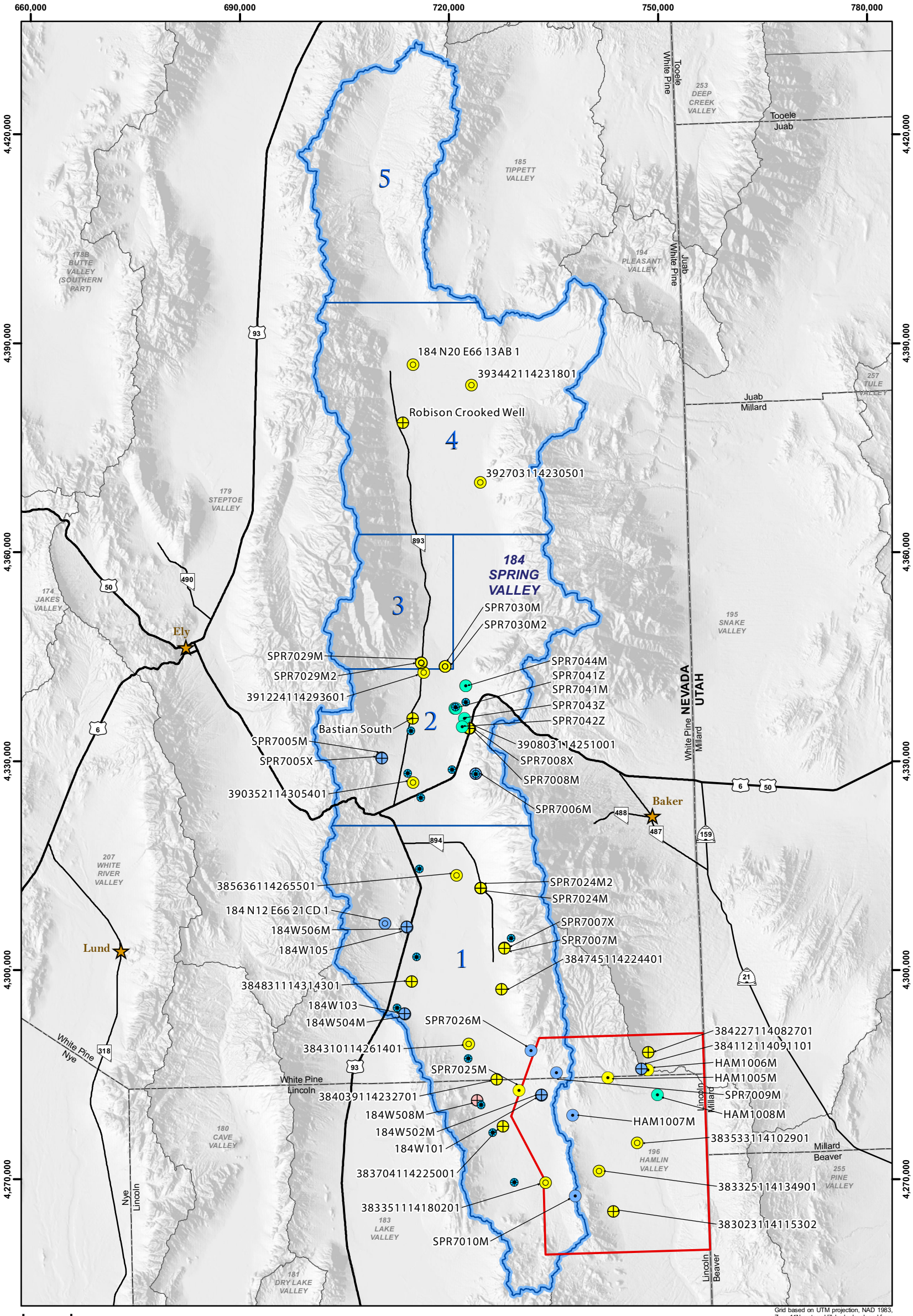


Figure C-5
Trigger, Well 383351114180201, Spring Valley Block 1



^Co-occurs with shrubland or mesic habitat.
*Management Block number and Hydrographic Area name and number shown.

Figure 6-1
Management Blocks within the Spring Valley Hydrographic Area



Legend

SNWA Monitor and Test Well

- Basin Fill Well (Continuously)
- Carbonate Well (Continuously)
- Volcanic Well (Continuously)
- Basin Fill Well (Quarterly)
- Carbonate Well (Quarterly)

Planned SNWA Monitor Well

- Carbonate Well (Continuously)
- Basin Fill Well (Continuously)
- Proposed Basin Fill Well (Continuously)
- SNWA GDP Permitted Point of Diversion

- Spring Valley*
- Hydrographic Area*
- Management Block**
- Interbasin Monitoring Zone
- County
- State
- Town
- U.S. Highway
- State Route

N W E S

1:600,000

0 4 8

Miles

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

30330-X0033 6/22/2017 RH/BP

*Hydrographic Area name and number shown **Management block number shown

Figure 10-1
Spring Valley 3M Plan Monitor Well Network Locations

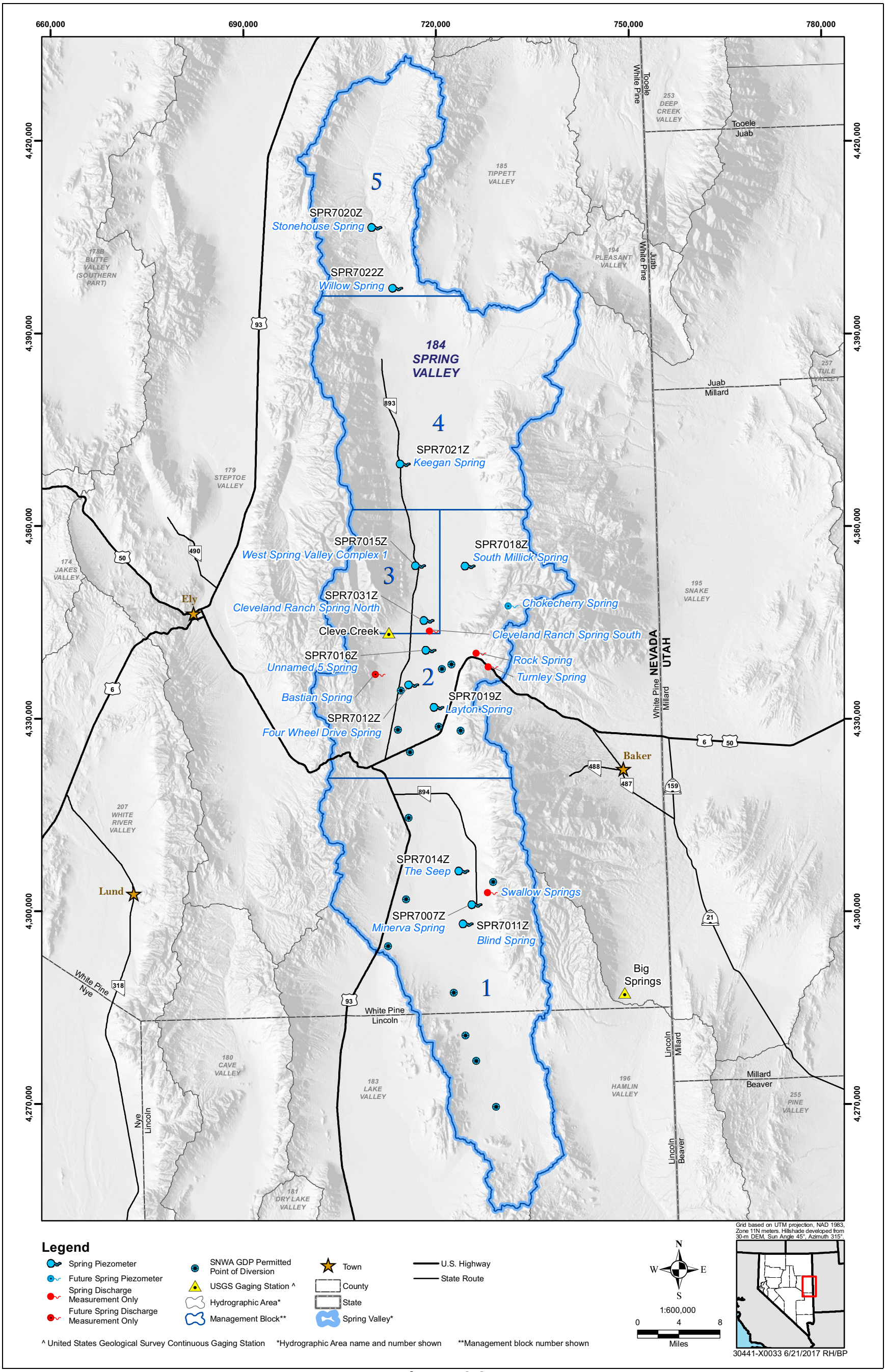


Figure 10-2
Spring Valley 3M Plan Spring and Stream Hydrologic Monitoring Locations

Table 10-3
Spring Valley Senior Water Right PODs - Monitoring Sites
(Page 1 of 2)

Senior Water Right	Monitoring Site	Notes
Management Block 1		
8074, 18045	Directly at one POD - Well	Stock water - two grouped at same location
8076, 18043,18044	Directly at one POD - Well	Stock water - three grouped at same location
8077	Directly at POD - Well	Stock water
8713	Directly at POD - Well	Stock water
12467	SPR7007Z	Milling and mining - may not be active
27768	Directly at POD - Well	Flowing artesian well at Shoshone NDOW Well. If not accessible substitute BLM well Shoshone well #2.
45496	383351114180201	Stock water
R05273	Directly at POD -Spring	Reserved right
Management Block 2		
3203, 3973, 5691, R05291, V10087	Sentinel Well SPR 7030M and SPR7044M (planned well)	---
8721,10921,10993, 80902, V10088	SPR7018Z proxy monitoring site and sentinel wells SPR7030M and SPR7044M (planned well)	Near south Millick Spring
V10078 - V10085, R05279, R05280, R05292, R05294	SPR7016Z proxy monitoring site	Near Unnamed 5 Spring
R05269, R05272, R05278, V10074, V10075	SPR7019Z proxy monitoring site	Near 4WD Spring
4171, V10073	SPR7018Z proxy monitoring site	Layton Spring - frequently dry
7446	Directly at POD - Well	Stock water
29371, 29567	Directly at one well POD	Milling and mining-tow grouped at same location
18841-18843 V10076, V10077	Directly at one or more POD - Wells and springs	Stock water - three wells and two spring vested claims in close proximity with each other
V02077	Directly at spring vested claim	Stock water

Table 10-3
Spring Valley Senior Water Right PODs - Monitoring Sites
(Page 2 of 2)

Senior Water Right	Monitoring Site	Notes
Management Block 2		
16890	Directly at POD - Well	Quasi-municipal
31239	Directly at POD - Well	Milling and mining
Management Block 3		
All Senior Water Rights	Sentinel wells and wells to monitor aquifer conditions	Sentinel Monitor Wells SPR7029M, SPR7029M2, SPR7030M, SPR7030M2, SPR7044M (planned well) and wells SPR7031Z, Cleveland Ranch Spring South, and SPR7015Z
Management Block 4		
All Senior Water Rights	Sentinel wells and wells to monitor aquifer conditions	Sentinel Monitor Wells SPR7029M, SPR7029M2, SPR7030M, SPR7030M2, SPR7044M (planned well) and wells SPR7021Z, 392703114230501, 393442114231801, 184 N20 E66 13AB 1, Robison Crooked well
Management Block 5		
All Senior Water Rights	Sentinel wells and wells to monitor aquifer conditions	Sentinel Monitor Wells SPR7029M, SPR7029M2, SPR7030M, SPR7030M2, SPR7044M (planned well) and wells SPR7020Z, SPR7022Z
Hamlin Valley		
45495 (Spring), V02198 (OGW)	Sentinel wells and HAM1007M	Sentinel Monitor Wells SPR7009M,SPR7010M and HAM1007M
45497 (UG), V02199 (UG)	Sentinel wells and 383325114134901	Sentinel Monitor Wells SPR7009M,SPR7010M and HAM1007M
45498 (UG), 45500 (UG)	Sentinel wells and 383023114115302	Sentinel Monitor Wells SPR7009M,SPR7010M and HAM1007M
45499 (UG)	Sentinel wells and 383533114102901	Sentinel Monitor Wells SPR7009M,SPR7010M and HAM1007M
Snake Valley and other senior water rights Hamlin Valley		
All Senior Water Rights	Sentinel wells and HAM1008M mitigation trigger	Sentinel Monitor Wells SPR7009M,SPR7010M and HAM1007M

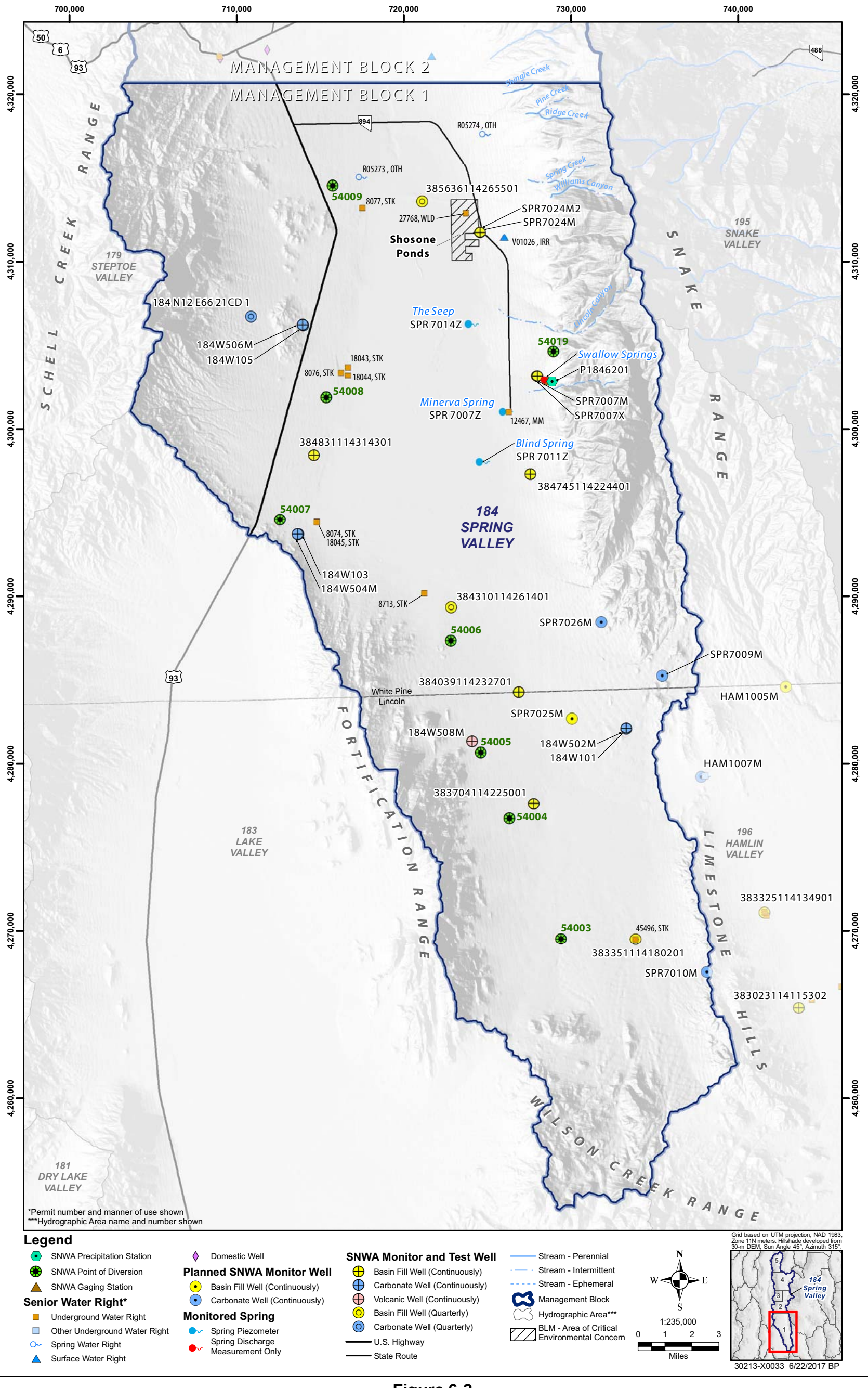


Figure 6-2
Management Block 1 GDP PODs, Senior Water Rights, and Hydrologic Monitoring Network

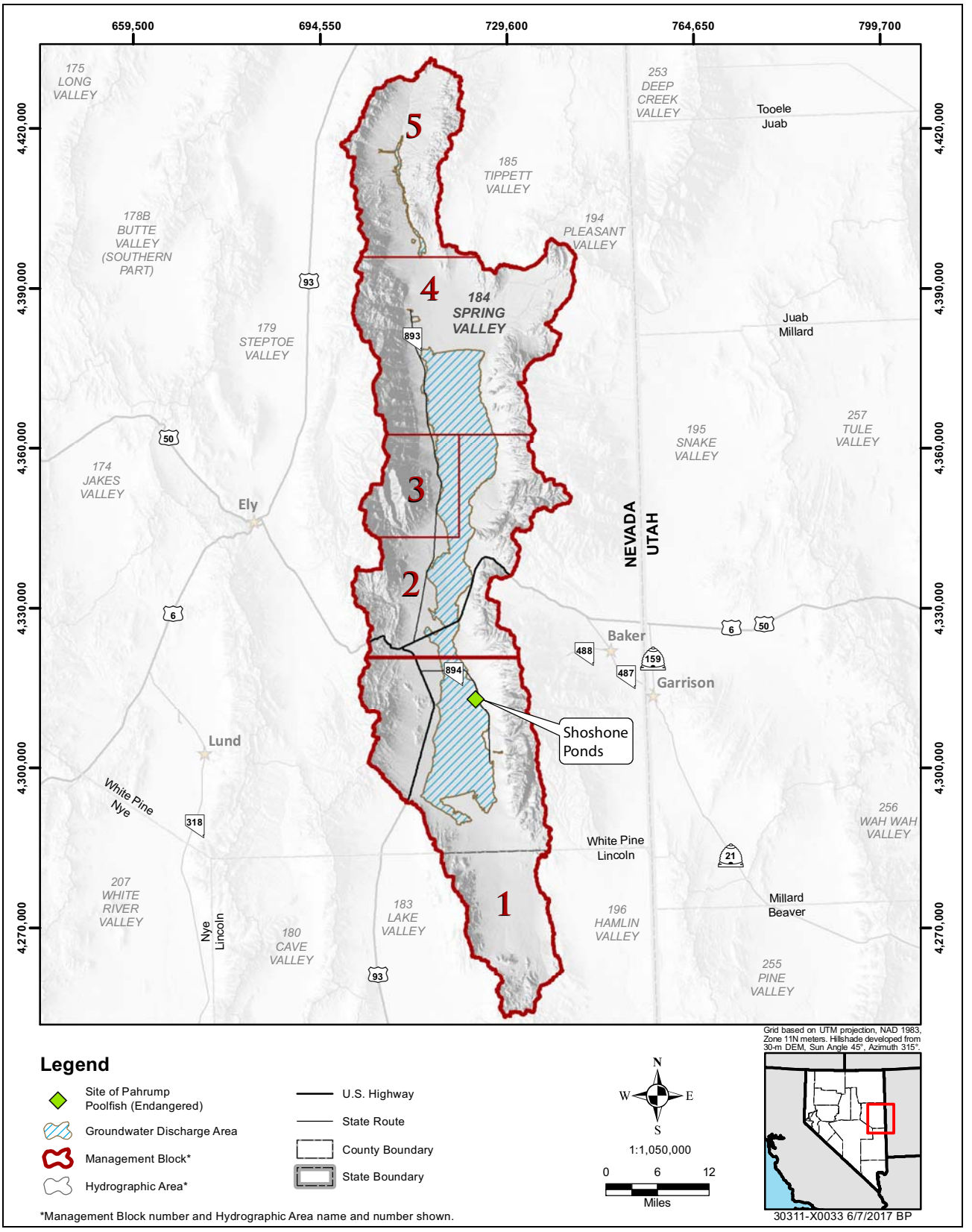
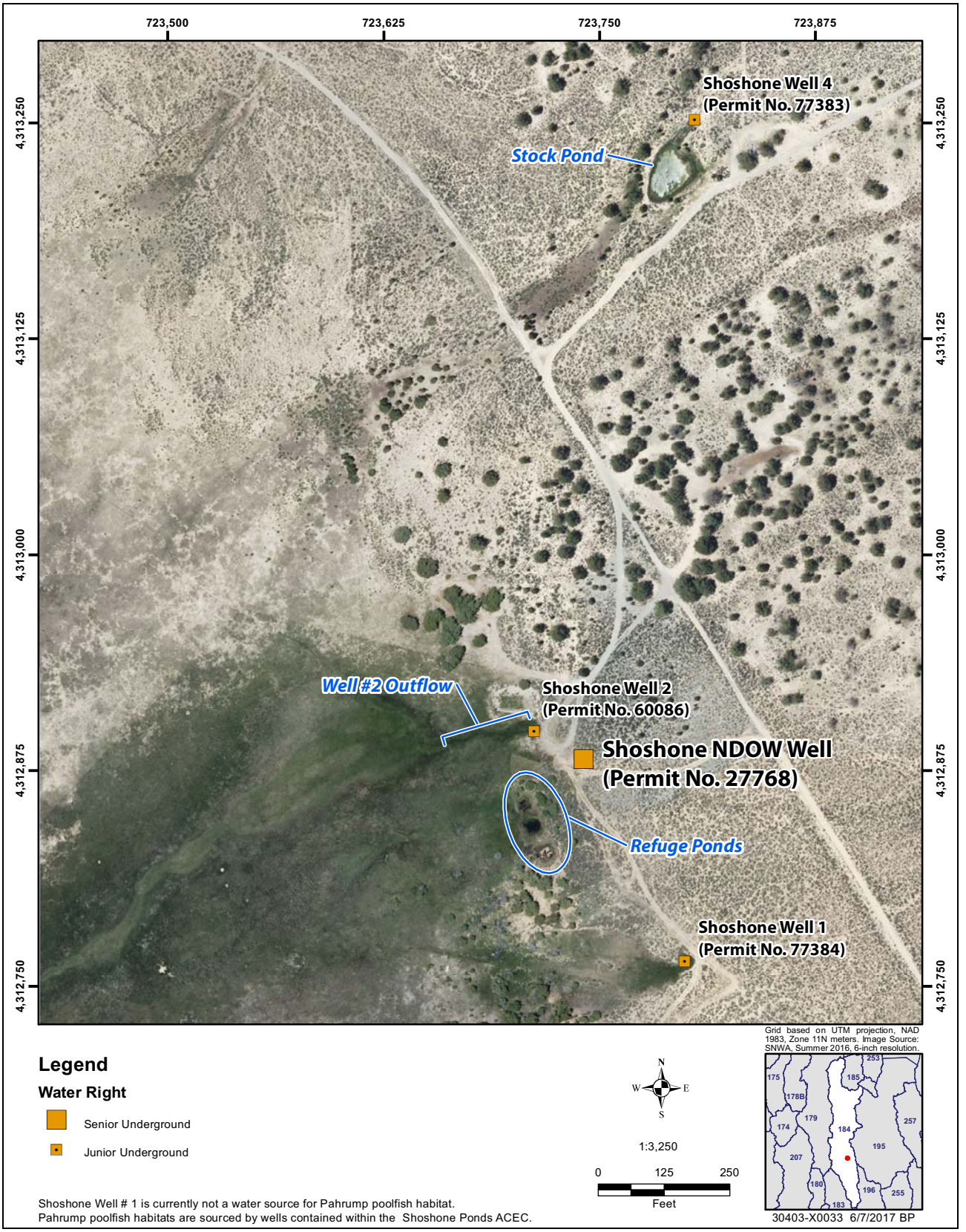


Figure 6-24
Shoshone Ponds, Spring Valley



Shoshone Well # 1 is currently not a water source for Pahrump poolfish habitat.
Pahrump poolfish habitats are sourced by wells contained within the Shoshone Ponds ACEC.

Figure 6-25
Shoshone Ponds Habitats and Wells

Figure 6-38
Shoshone Well #4

Looking west. Stock Pond to the left. (SNWA photograph)

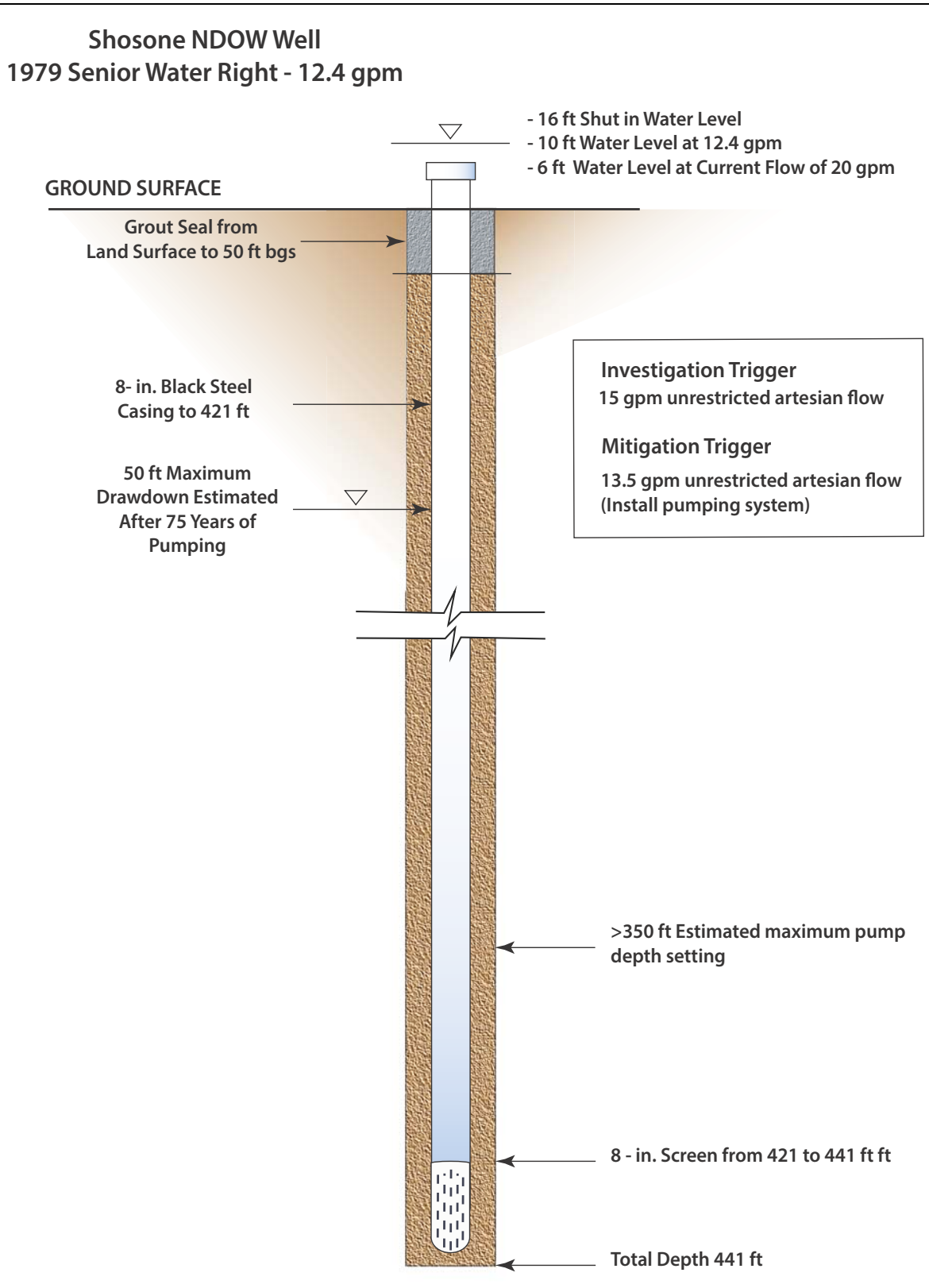


Figure 6-39
Shoshone NDOW Well Construction Schematic and Management Plan

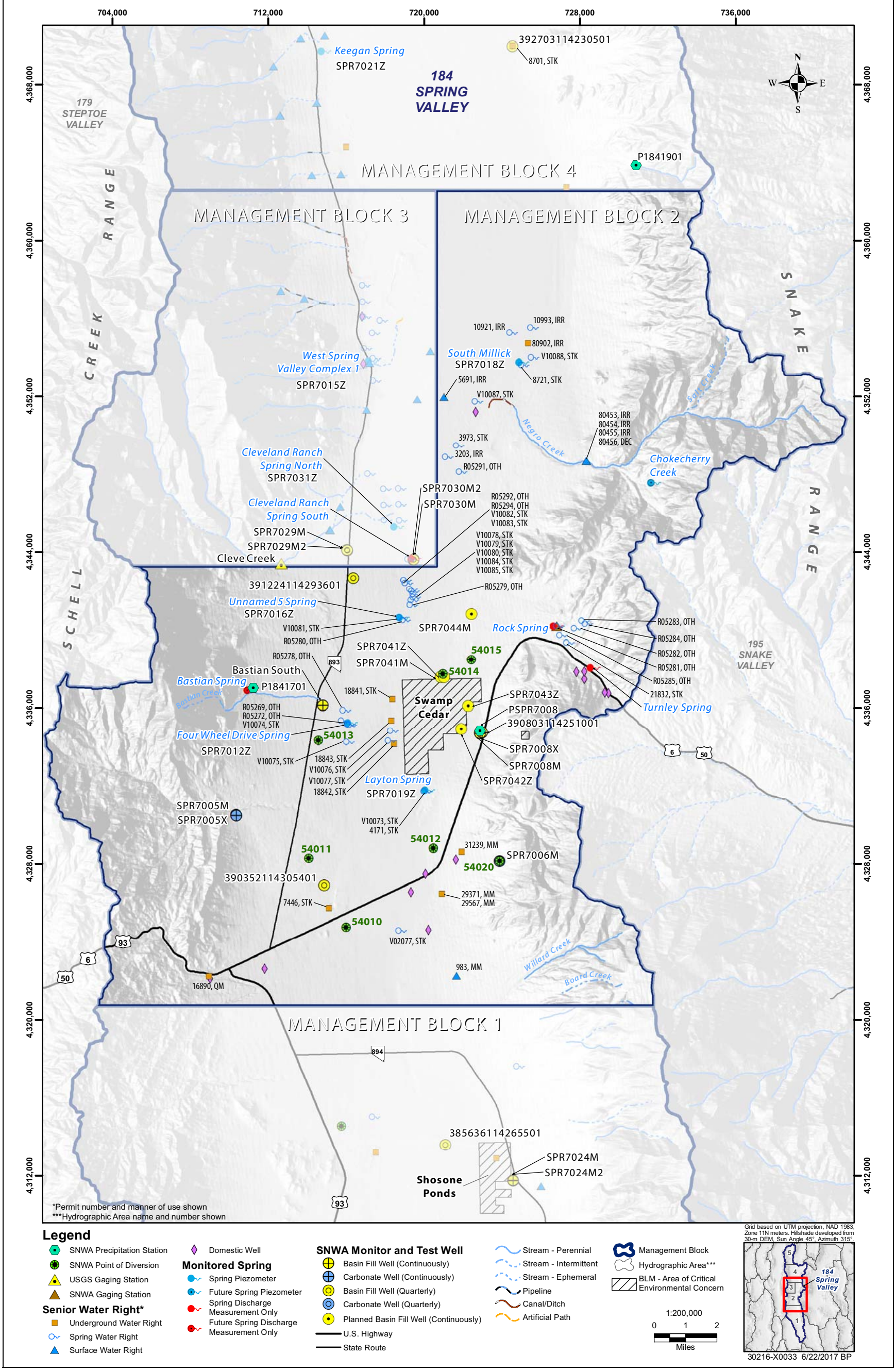
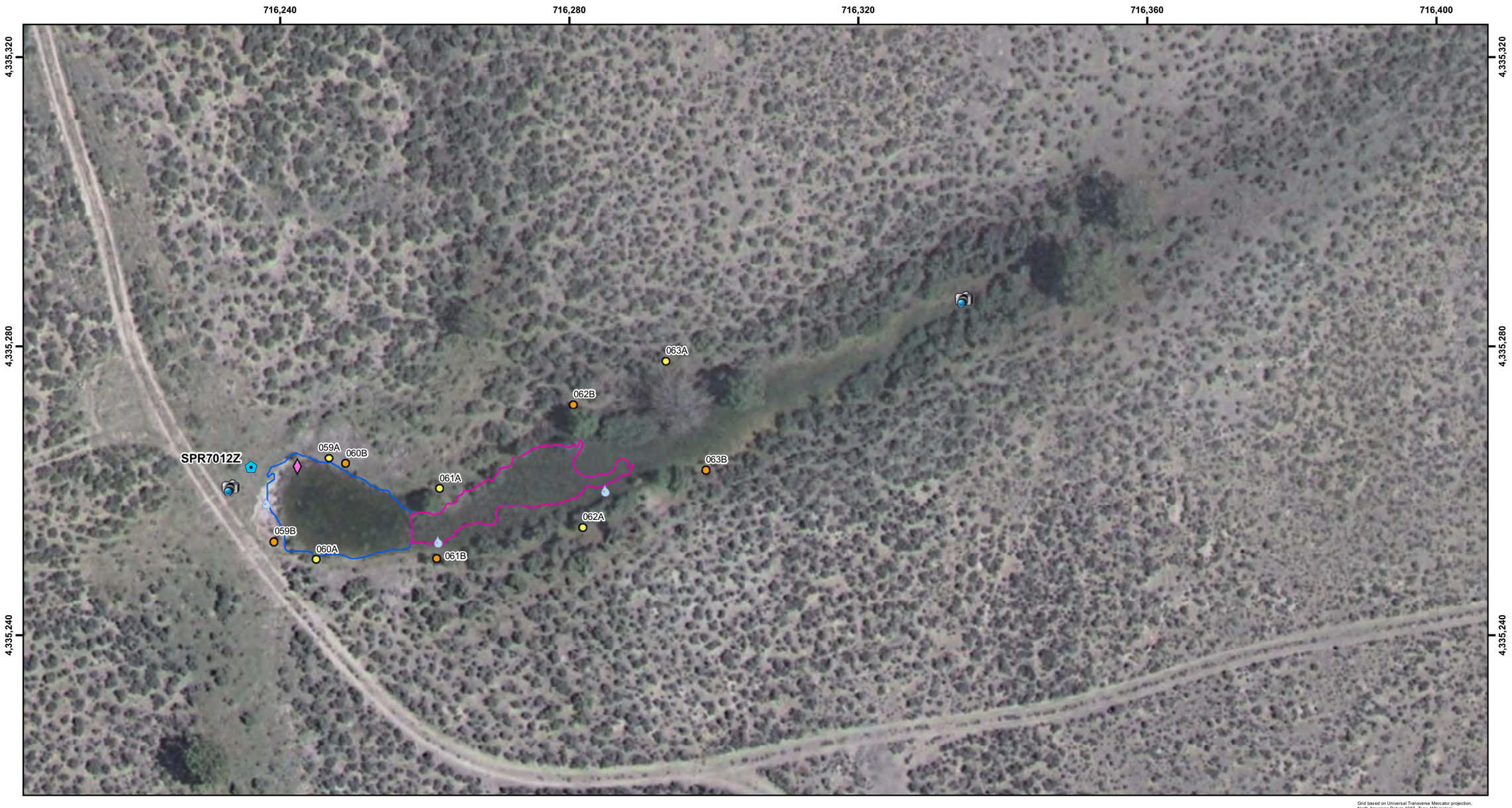


Figure 6-4
Management Block 2 GDP PODs, Senior Water Rights, and Hydrologic Monitoring Network



Legend

Bio Physical Habitat (Fall 2010)

- Channel
- Pool

Vegetation Transect Point

- A (Start Point)
- B (End Point)

- Staff Plate
- Piezometer
- Fixed Station Photography Point
- Biological Field Water Quality Sample (Fall 2010)

N
W E
S

1:600

0 25 50

Feet

MAP ID 18905-3213 4/24/2012 BP

Grid based on Universal Transverse Mercator projection, North American Datum 1983, Zone 11N meters.
Image Source: SNWA, Summer 2007, 6-inch resolution.

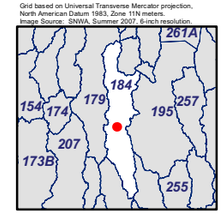


Figure 7-3
High-Resolution Aerial Photo of Four Wheel Drive Spring

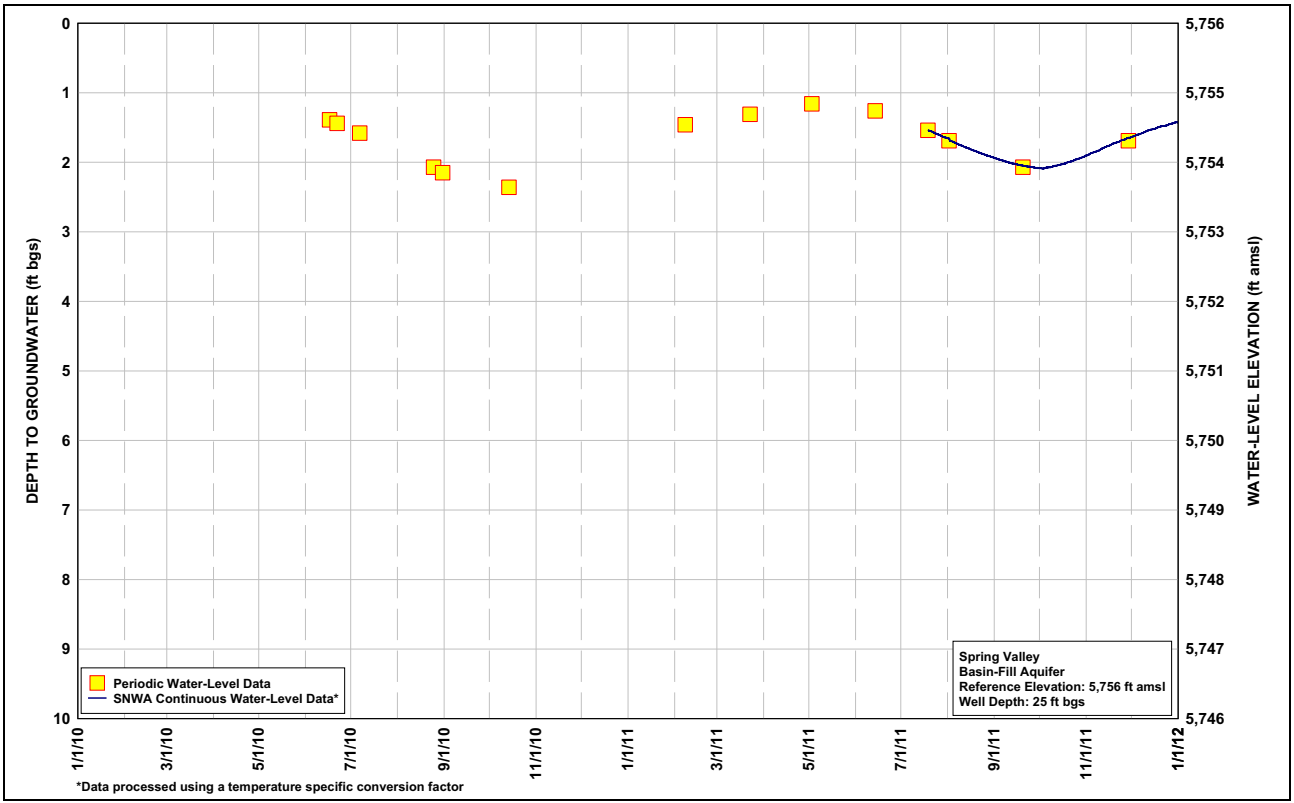


Figure 7-7
Hydrograph of Four Wheel Drive Spring Piezometer

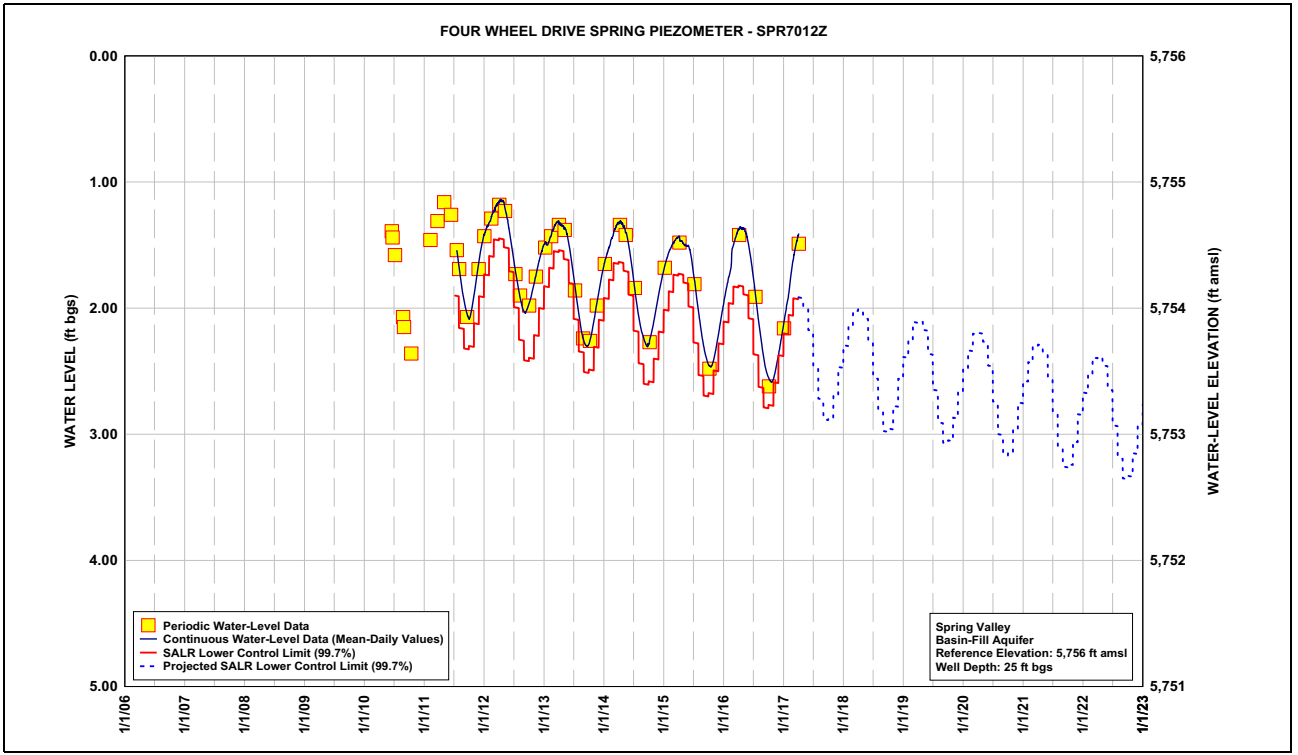


Figure 6-5
SPR7012Z 4WD Spring - Trigger

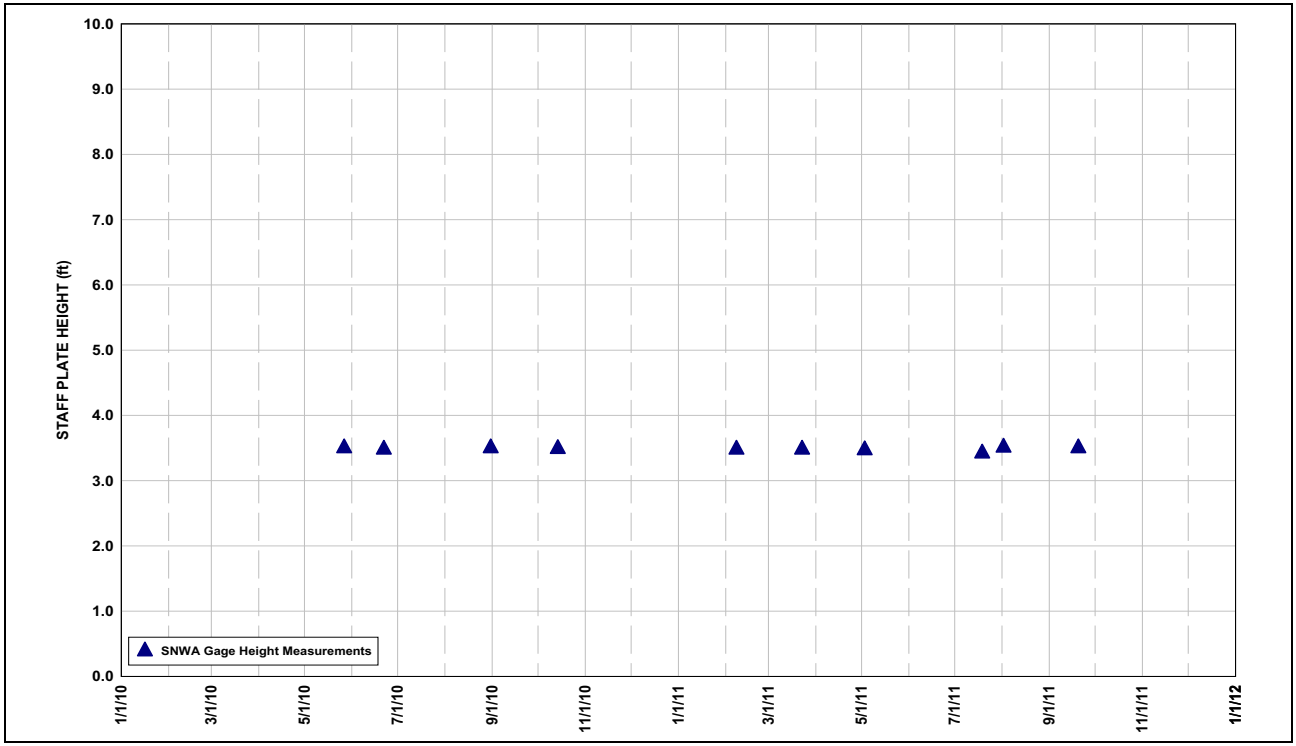
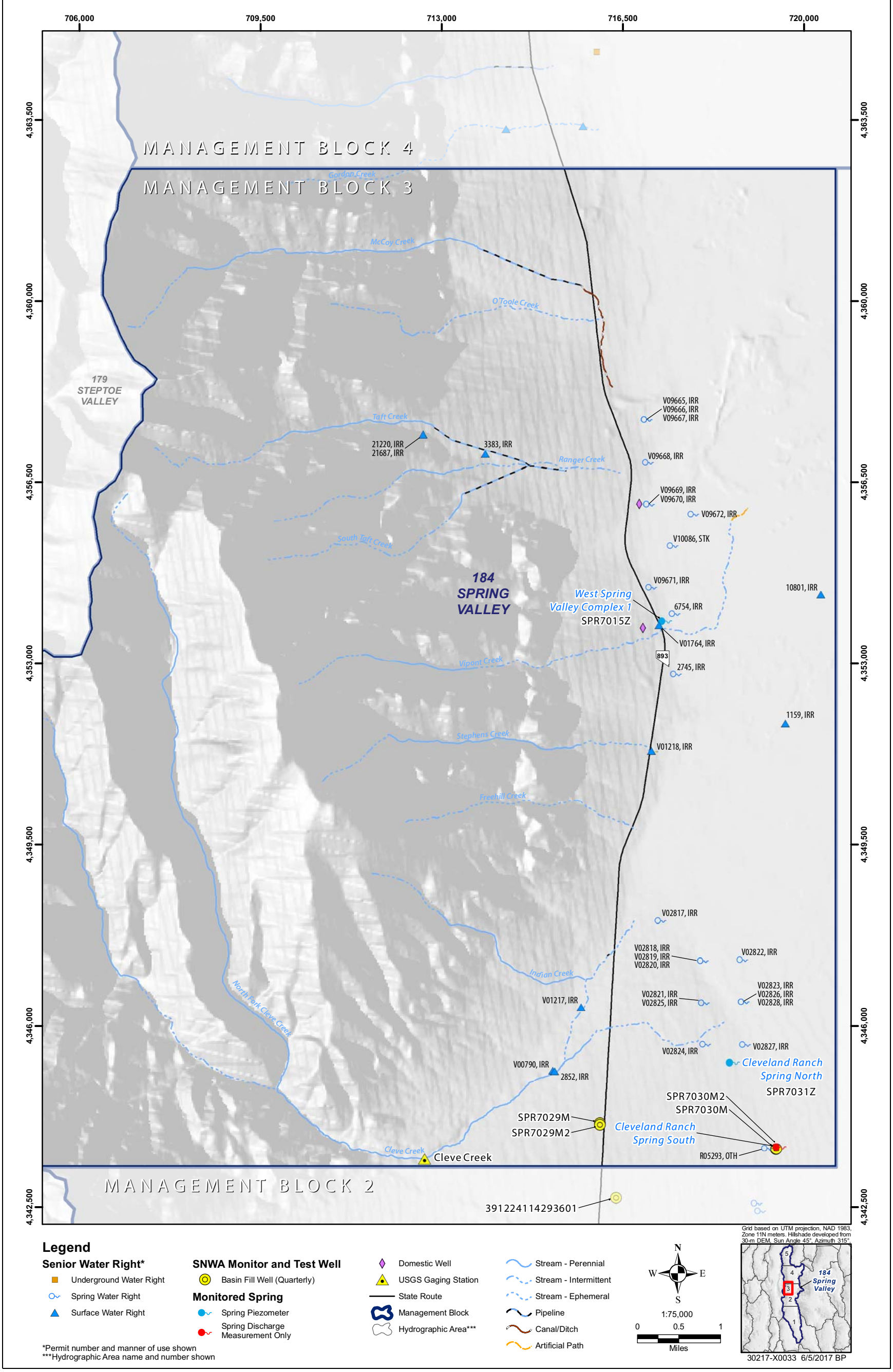


Figure 7-8
Spring-Pool Elevation Hydrograph for Four Wheel Drive Spring



Legend

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

SNWA Monitor and Test Well
- Basin Fill Well (Quarterly)

Monitored Spring
- Spring Piezometer
- Spring Discharge Measurement Only

- Domestic Well
- USGS Gaging Station
- State Route
- Management Block
- Hydrographic Area***

- Stream - Perennial
- Stream - Intermittent
- Stream - Ephemeral
- Pipeline
- Canal/Ditch
- Artificial Path

*Permit number and manner of use shown
***Hydrographic Area name and number shown

N W E S

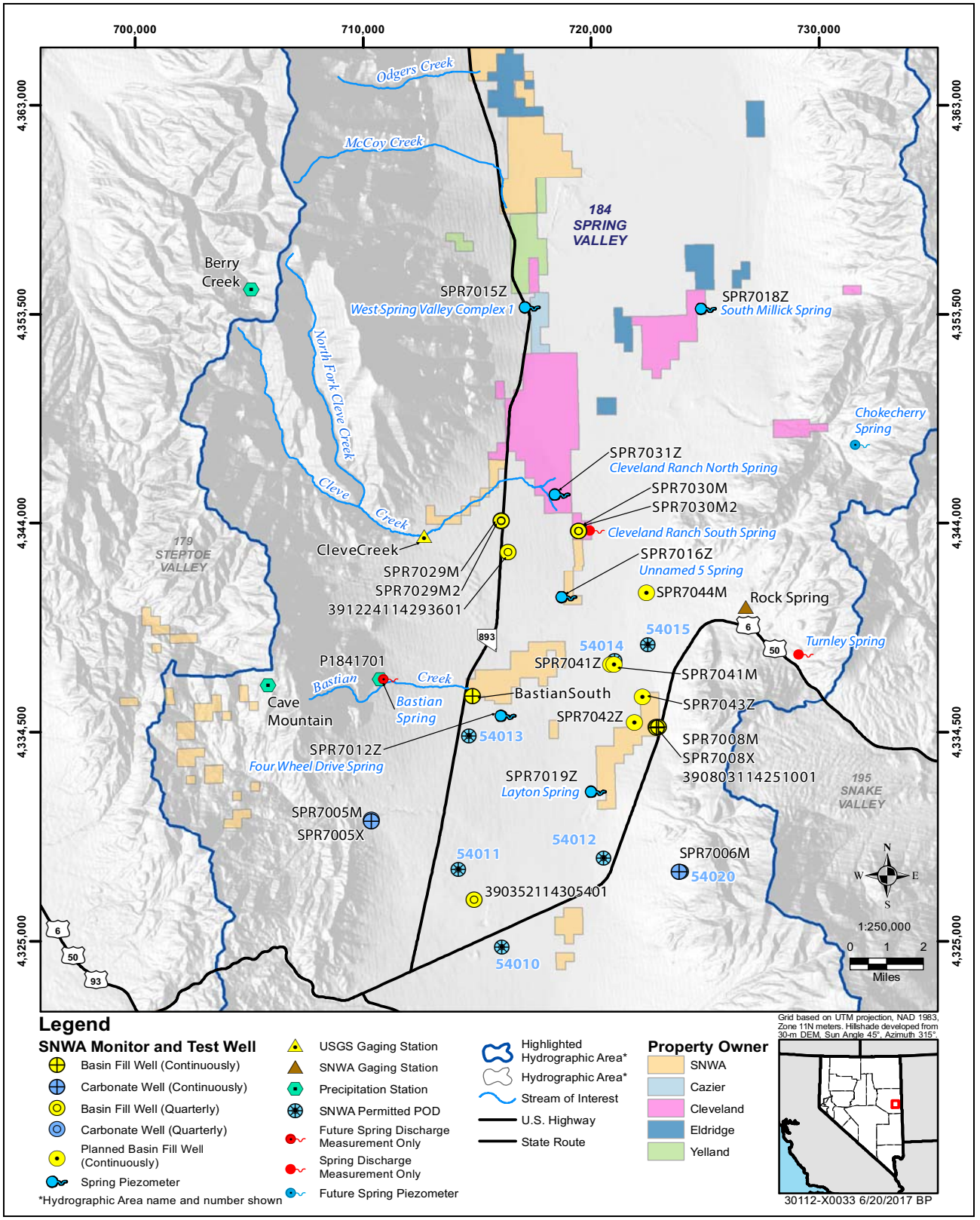
1:75,000

0 0.5 1
Miles

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

30217-X0033 6/5/2017 BP

Figure 6-7
Management Block 3 Senior Water Rights and Hydrologic Monitoring Network



Legend

SNWA Monitor and Test Well

- Basin Fill Well (Continuously)
- Carbonate Well (Continuously)
- Basin Fill Well (Quarterly)
- Carbonate Well (Quarterly)
- Planned Basin Fill Well (Continuously)
- Spring Piezometer

*Hydrographic Area name and number shown

- USGS Gaging Station
- SNWA Gaging Station
- Precipitation Station
- SNWA Permitted POD
- Future Spring Discharge Measurement Only
- Spring Discharge Measurement Only
- Future Spring Piezometer

- Highlighted Hydrographic Area*
- Hydrographic Area*
- Stream of Interest
- U.S. Highway
- State Route

Property Owner

- SNWA
- Cazier
- Cleveland
- Eldridge
- Yelland

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

30112-X0033 6/20/2017 BP

Figure 6-8
Cleveland Ranch/McCoy Creek area with SNWA GDP PODs and Hydrologic Monitoring Locations

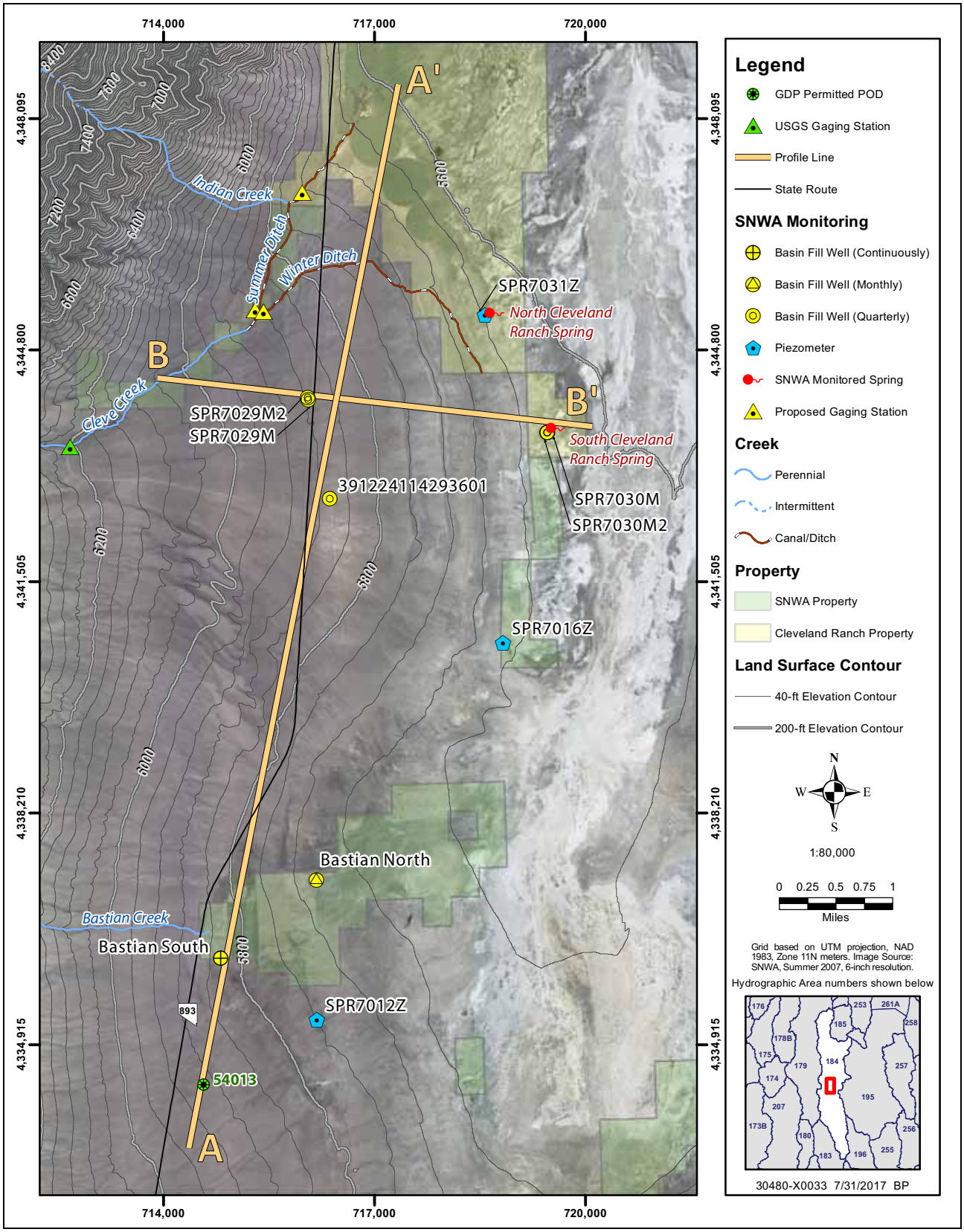
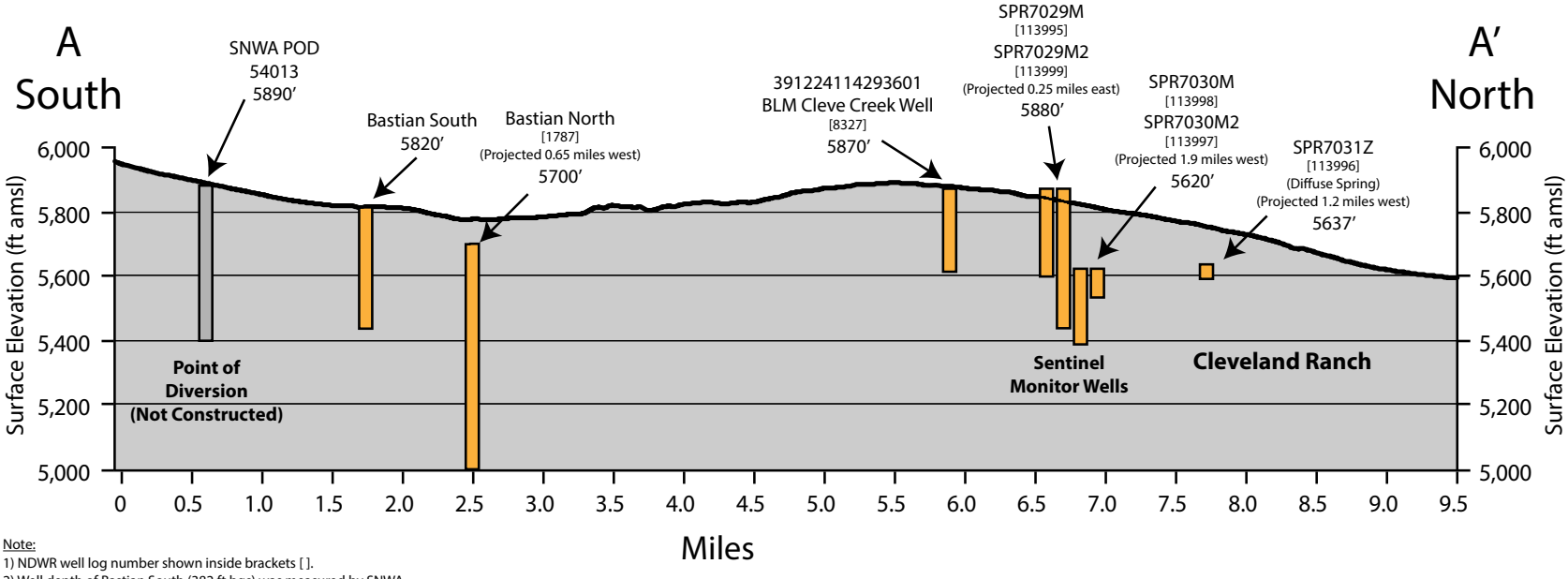


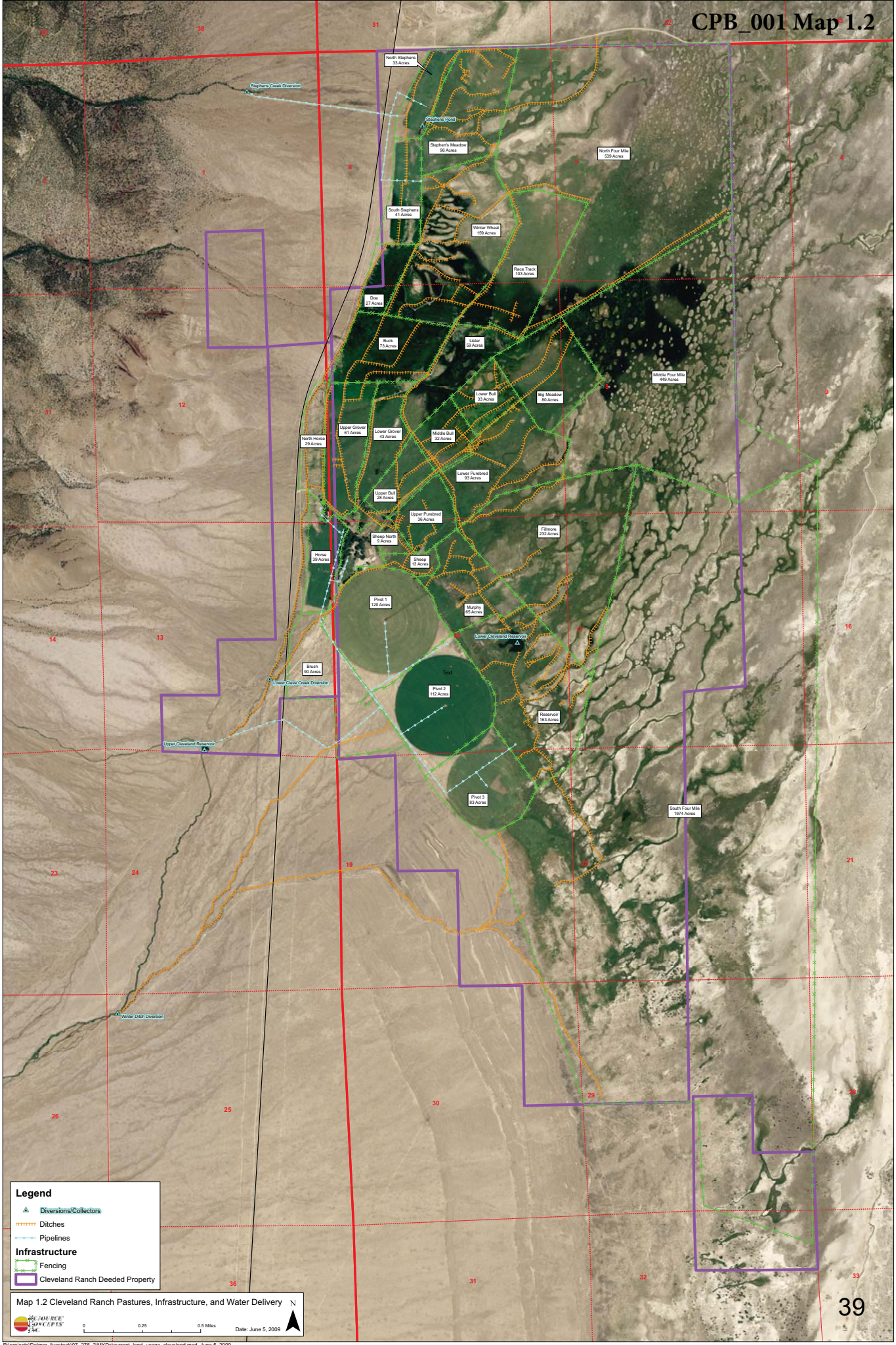
Figure 4
Hydrologic Monitoring and Profile Locations in the Vicinity of Cleveland Ranch

Monitor Well Profile
SNWA POD 54013 to Cleveland Ranch



Note:
1) NDWR well log number shown inside brackets [ ].
2) Well depth of Bastian South (382 ft bgs) was measured by SNWA.

Figure 5
North - South Monitor Well Profile - SNWA POD 54013 to Cleveland Ranch



R:\projects\Delmar_livestock\07_276_2\MXDs\current_land_usage_cleveland.mxd June 5, 2009

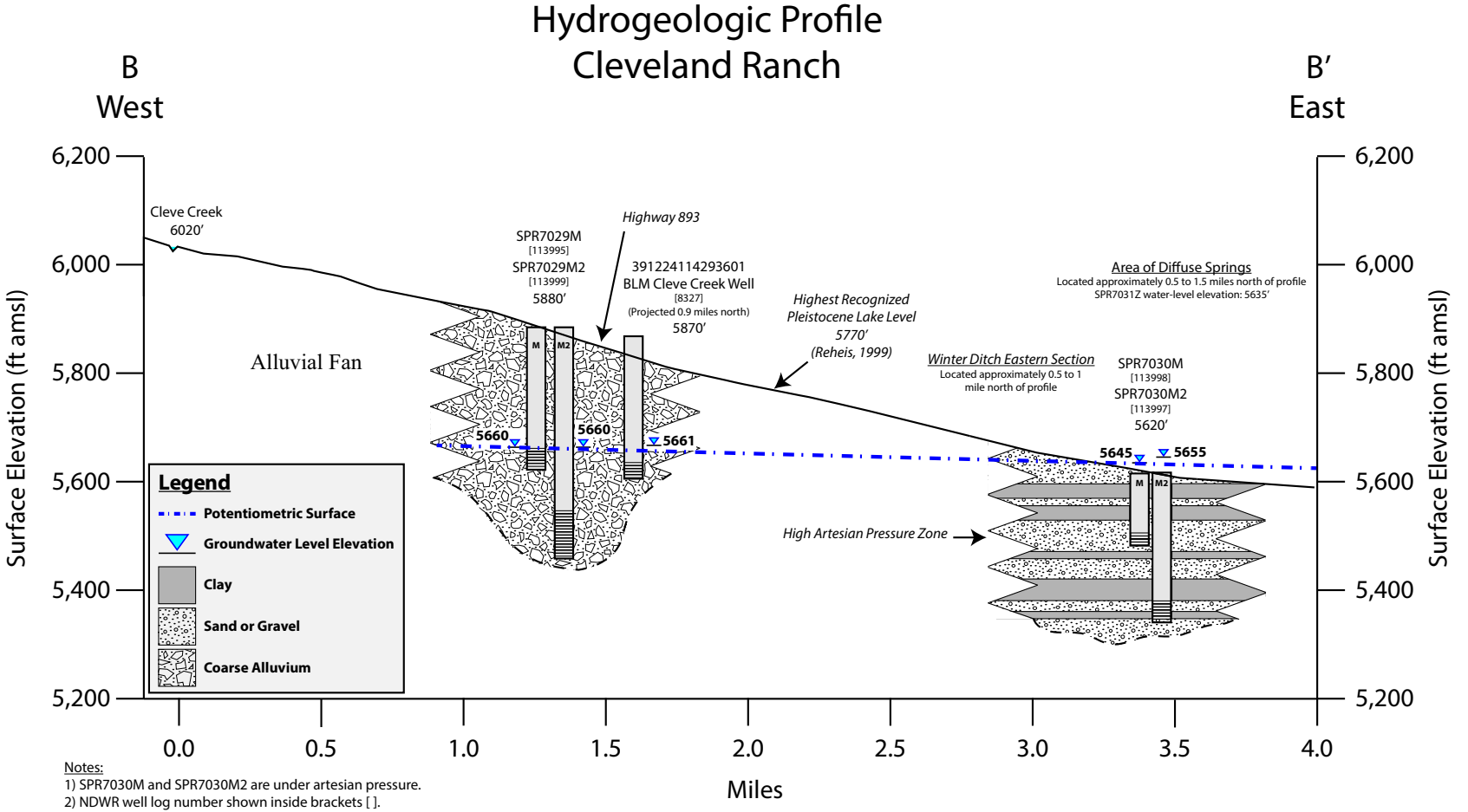
Table 4-2 Summary of northern Spring Valley groundwater age data from the vicinity of Cleveland and Rogers Ranches.

Sample ID	BYU lab #	Sampling Date	pH	^{14}C [pmc]	+/-	$\delta^{13}C$	+/-	^{3}H [TU]	+/-	$HCO3^-$ [mg/L]	Fontes calculated 14C age [years]
Bastian Creek Spring	9232	7/19/11	8.01	44.39	0.15	-7.87	0.04			184	1200
Irrigation Well	9234	7/19/11	8.11	37.56	0.13	-8.22	0.04	3.9	0.2	186	2500
Stephens Creek	9236	7/19/11						11.1	0.4		
Big Resevoir Spring (#1/2)	9237	7/20/11	7.93	77.12	0.22	-13.90	0.04			131	modern
Millick Spring	9238	7/20/11	7.92	44.94	0.14	-8.63	0.04	2.0	0.1	270	1200
Negro Creek Spring	9239	7/19/11						9.1	0.1		

The Cleveland Ranch flowing-artesian well contains ~37.6 pmc and 3.9 tritium units (TU), which means the water has mixed recharge sources, both modern and older groundwater recharge. The old component of recharge is appreciably older than the calculated Fontes ^{14}C age of 2,500 years and the tritium content is a mixture of pre-atmospheric nuclear testing groundwater and more recent recharge water. Because the well is screened from about 100 feet to about 600 feet below ground surface, it is likely that the well acquires modern groundwater near the surface and older groundwater deeper in the alluvial fan. The fact that the well is a flowing artesian well indicates that the well penetrates a confining layer, and that there are at least two groundwater systems in the alluvial fan within 700 feet of the ground surface. The significance of the two groundwater systems with different groundwater travel times is that deeper alluvial fan groundwater is not rapidly replenished by annual groundwater recharge; whereas, the overlying shallow alluvial system has an active hydrodynamic communication with surface water and annual recharge events. Because the carbonate aquifer underlies the alluvium, the carbonate groundwater would be older than the deeper alluvial groundwater. The importance of this to groundwater extraction by deep alluvial fan and carbonate aquifer wells is that shallow alluvial fan groundwater will be readily replenished by annual recharge events, whereas the replenishment of the deeper groundwater will require hundreds to thousands of years.

The carbon-14 ages and tritium contents of the Bastian Creek spring and the Millick spring (Table 4-2) suggest that these spring discharges are also supported by younger shallow and older deep groundwater. The fact that shallow and deep groundwater is found supporting springs on opposite sides of Spring Valley indicates that deep groundwater discharges into shallow groundwater is common in Spring Valley.

Because the SNWA GDP calls for the production wells to be screened in both the alluvial and deeper portion of the groundwater system, the cones of depression from the production wells will impact both the shallow and deep groundwater systems. What this means is that the production wells may quickly impact the spring discharge fluxes that are supported by the shallowest groundwater and will continue to impact the springs as the deeper groundwater system(s) are dewatered.



Notes:
1) SPR7030M and SPR7030M2 are under artesian pressure.
2) NDWR well log number shown inside brackets [ ].

Figure 6
Cross Sectional Profile Cleve Creek to Cleveland Ranch

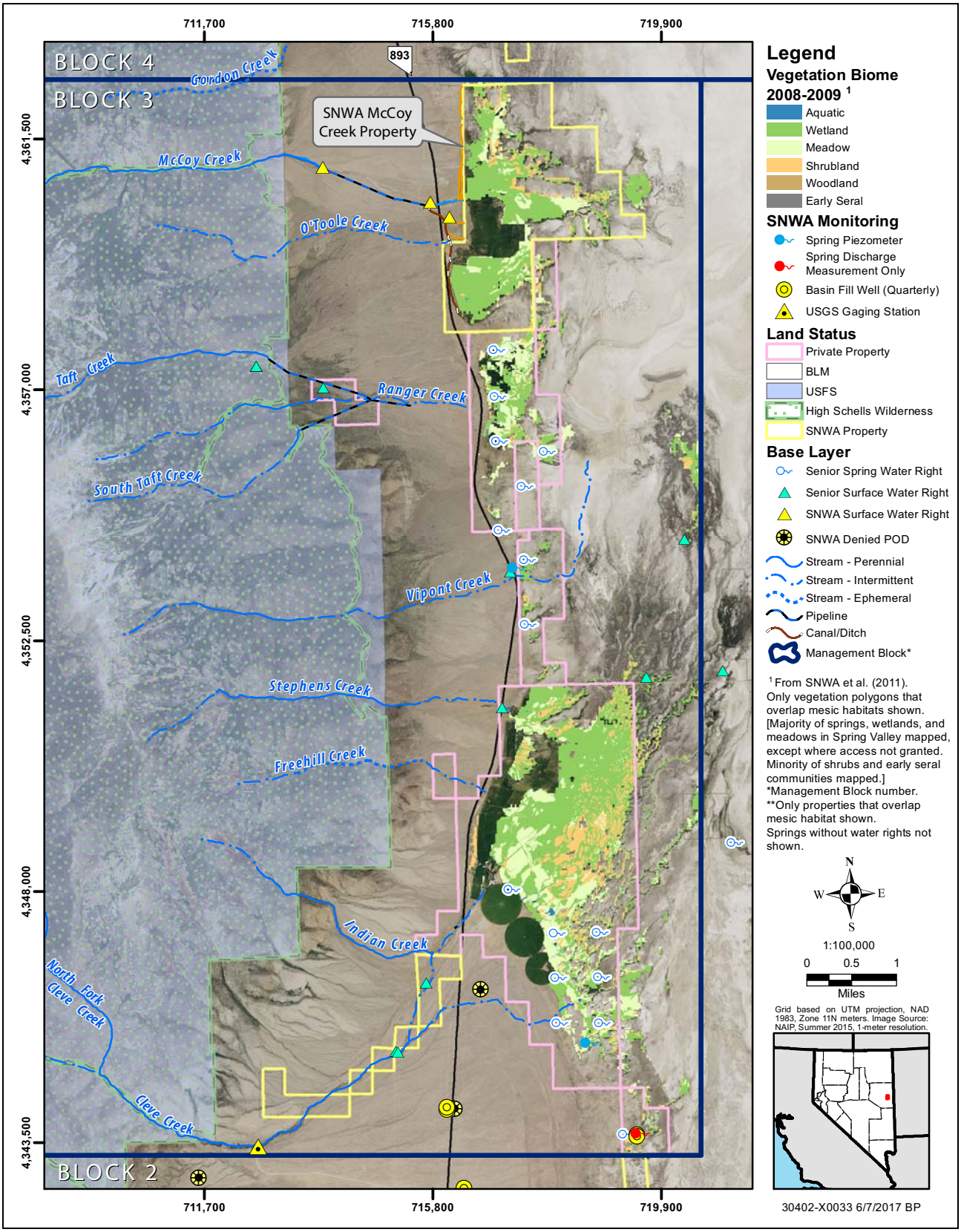
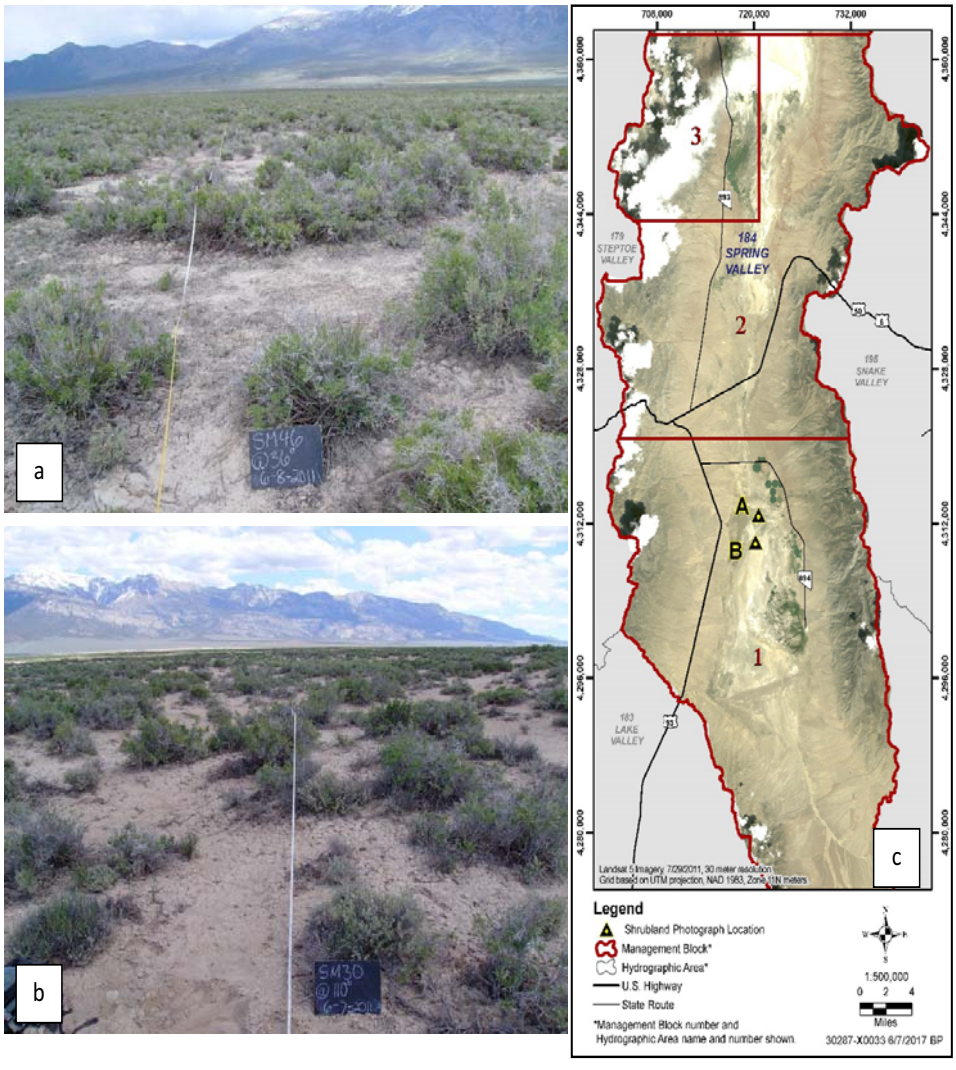


Figure 6-43
Vegetation Biomes and Water Rights in Management Block 3



a) Medium-density shrubland on the valley floor of south Spring Valley. June 8, 2011. Dominant species: rubber rabbitbrush and black greasewood.

b) Low-density shrubland on the valley floor of south Spring Valley. June 7, 2011. Dominant species: black greasewood.

c) Photograph locations overlaid on July 29, 2011 Landsat imagery.

Clouds and cloud shadows can be seen on the western portion of the map. NDVI data influenced by clouds or cloud shadows were filtered out of the datasets. Annual precipitation was above average in 2011 (Ely, Nevada precipitation gauge, http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?nv2631).

Figure 6-45
Medium-Density and Low-Density Shrublands, Spring Valley

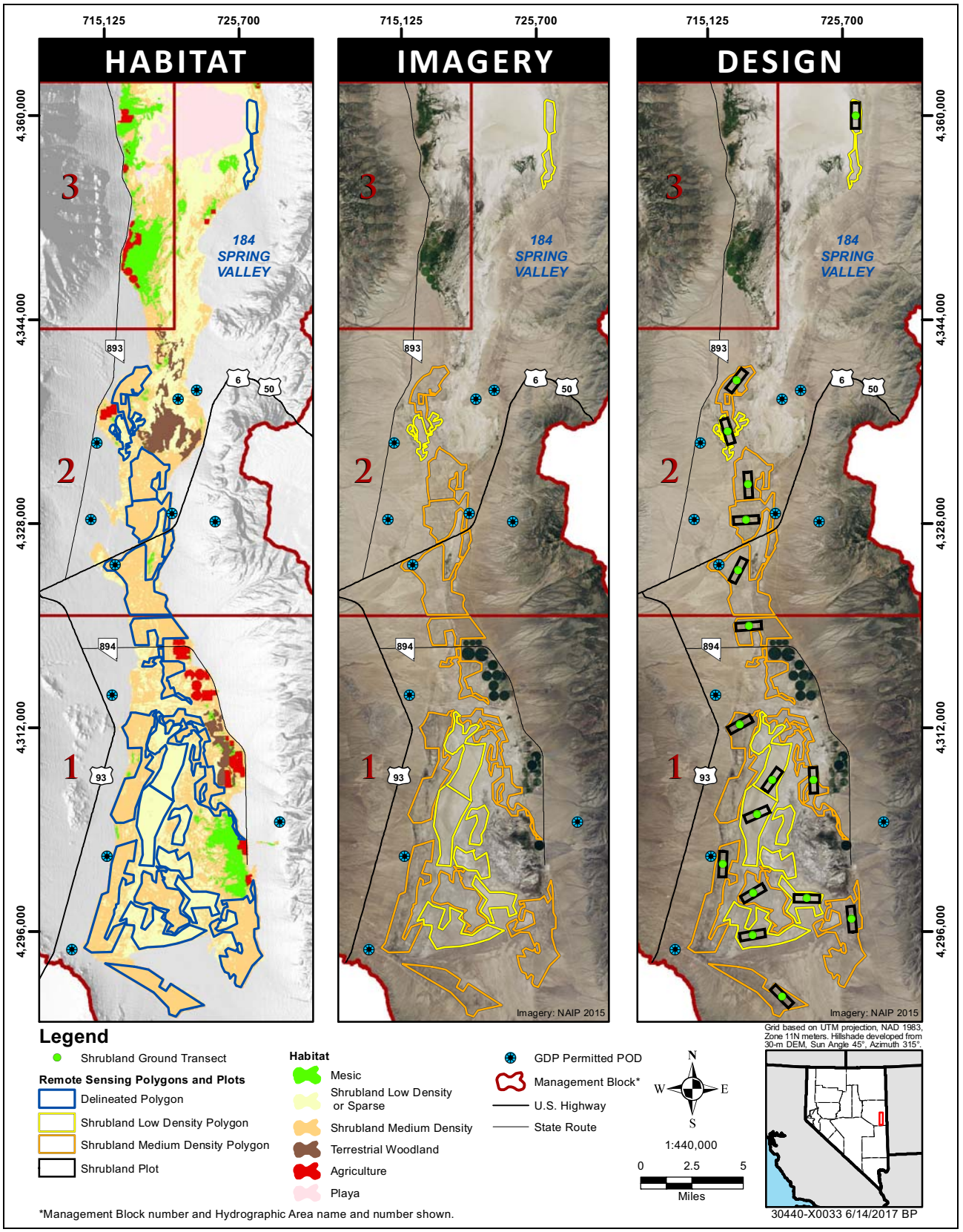
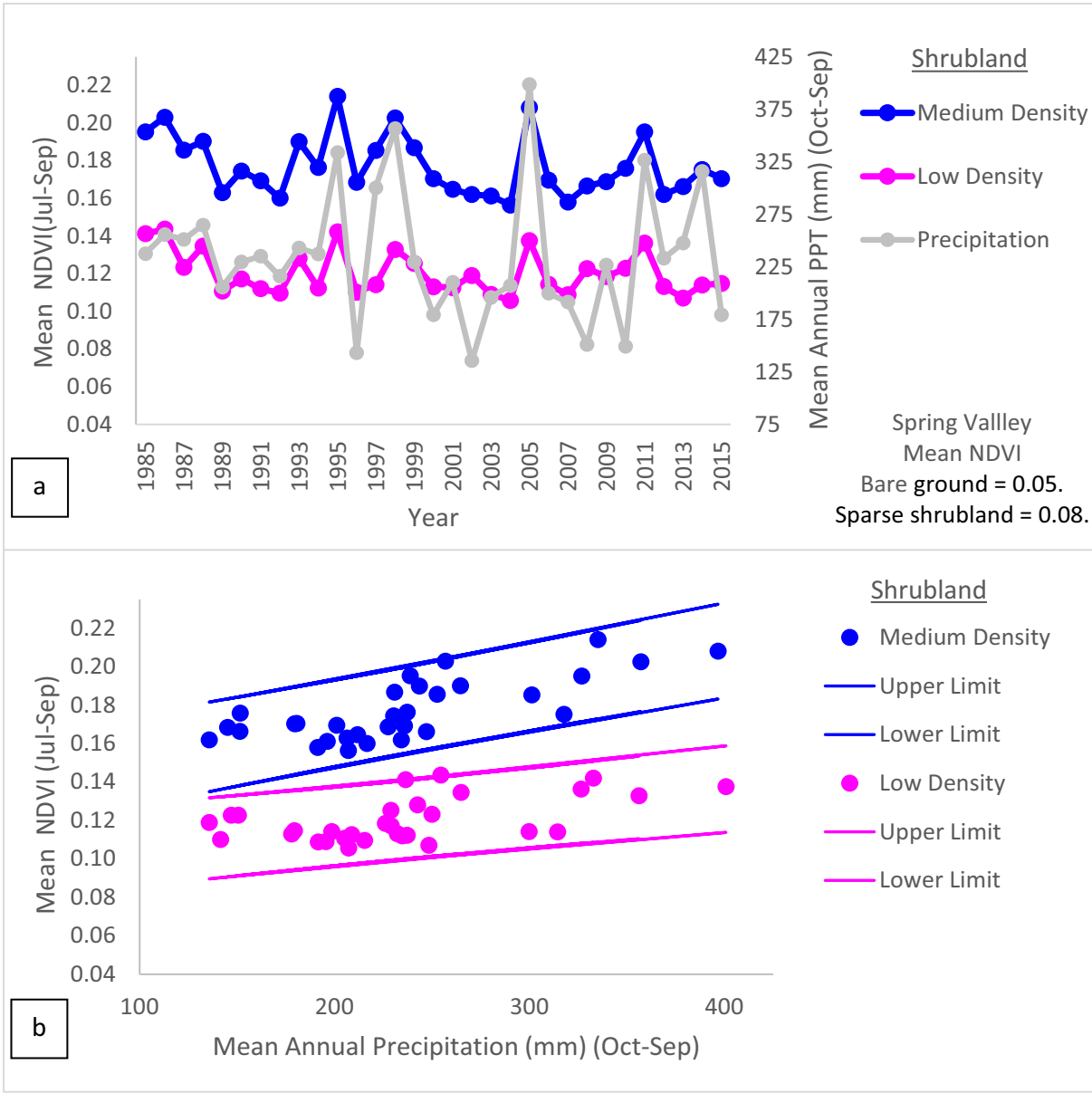


Figure D-1
Shrubland Remote Sensing Polygons and Plots and Ground Transects



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

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

Figure 6-48
Time Series and Prediction Intervals for NDVI and Precipitation in Shrubland Polygons, Management Blocks 1 and 2

Figure 6-54
Swamp Cedar ACEC, Spring Valley

April 2017 (SNWA Photo)

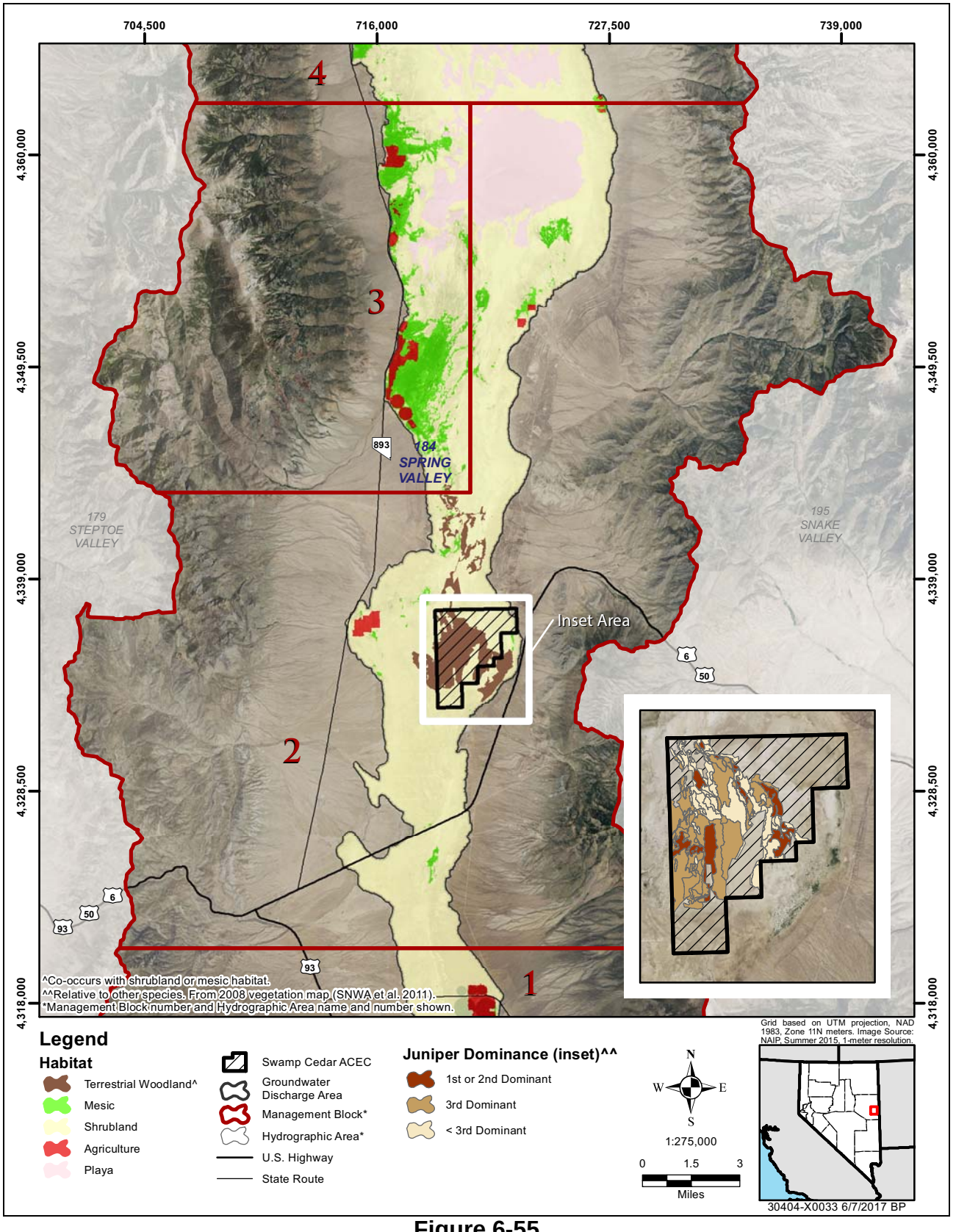


Figure 6-55
Woodland Habitat and the Swamp Cedar ACEC in Management Block 2

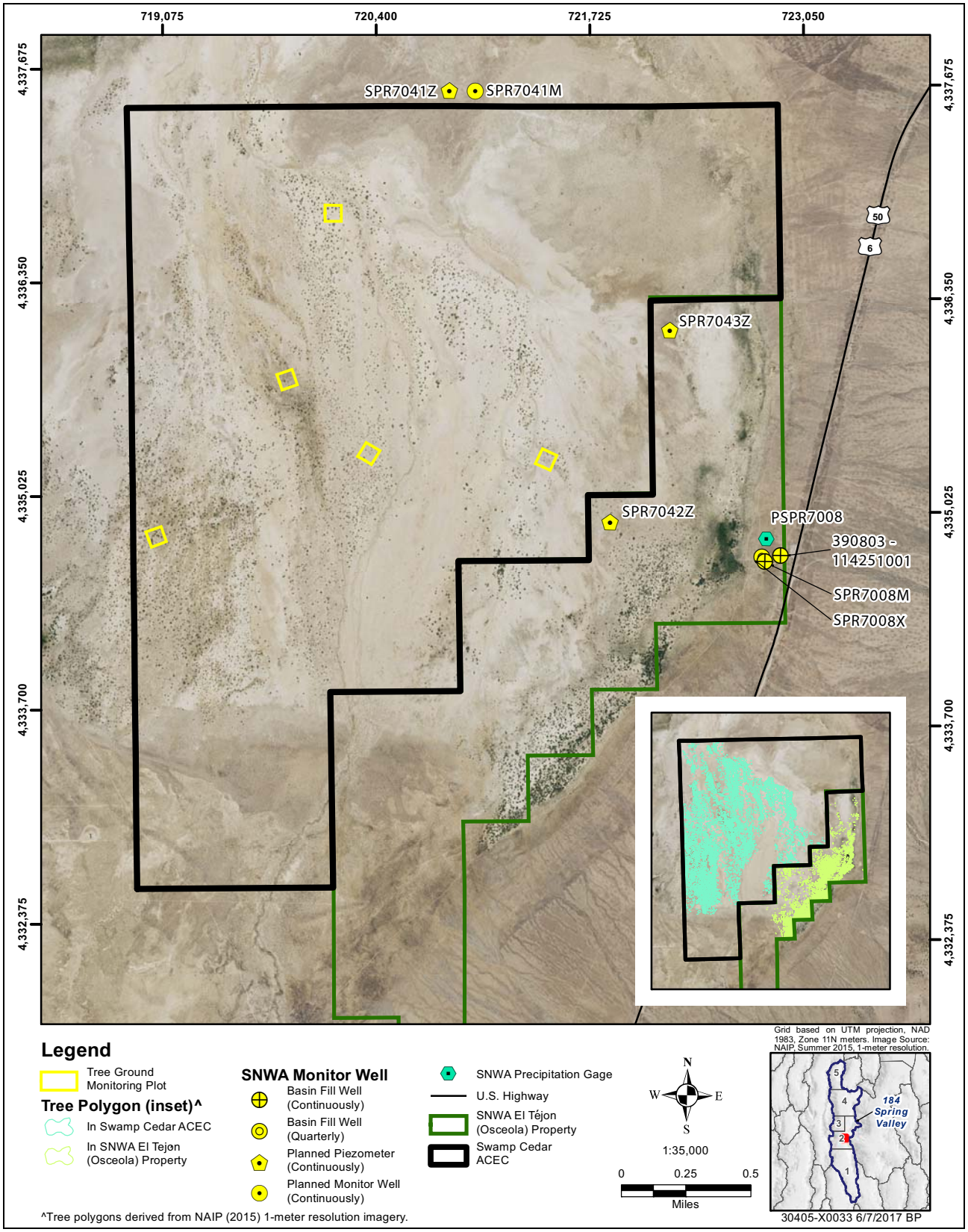


Figure 6-58
Woodland in Swamp Cedar ACEC and Adjacent SNWA Property

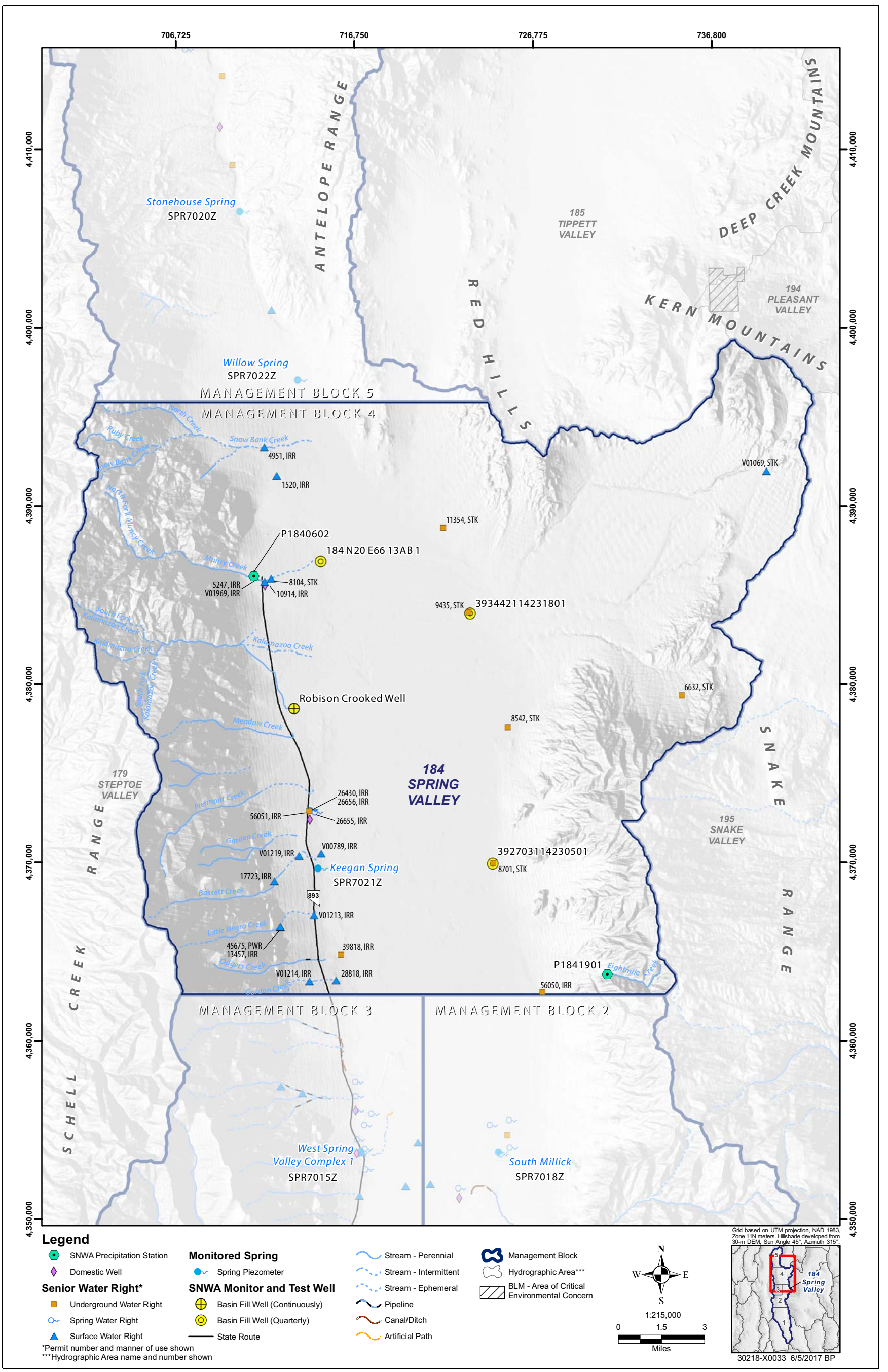


Figure 6-19
Management Block 4 Senior Water Rights and Hydrologic Monitoring Network

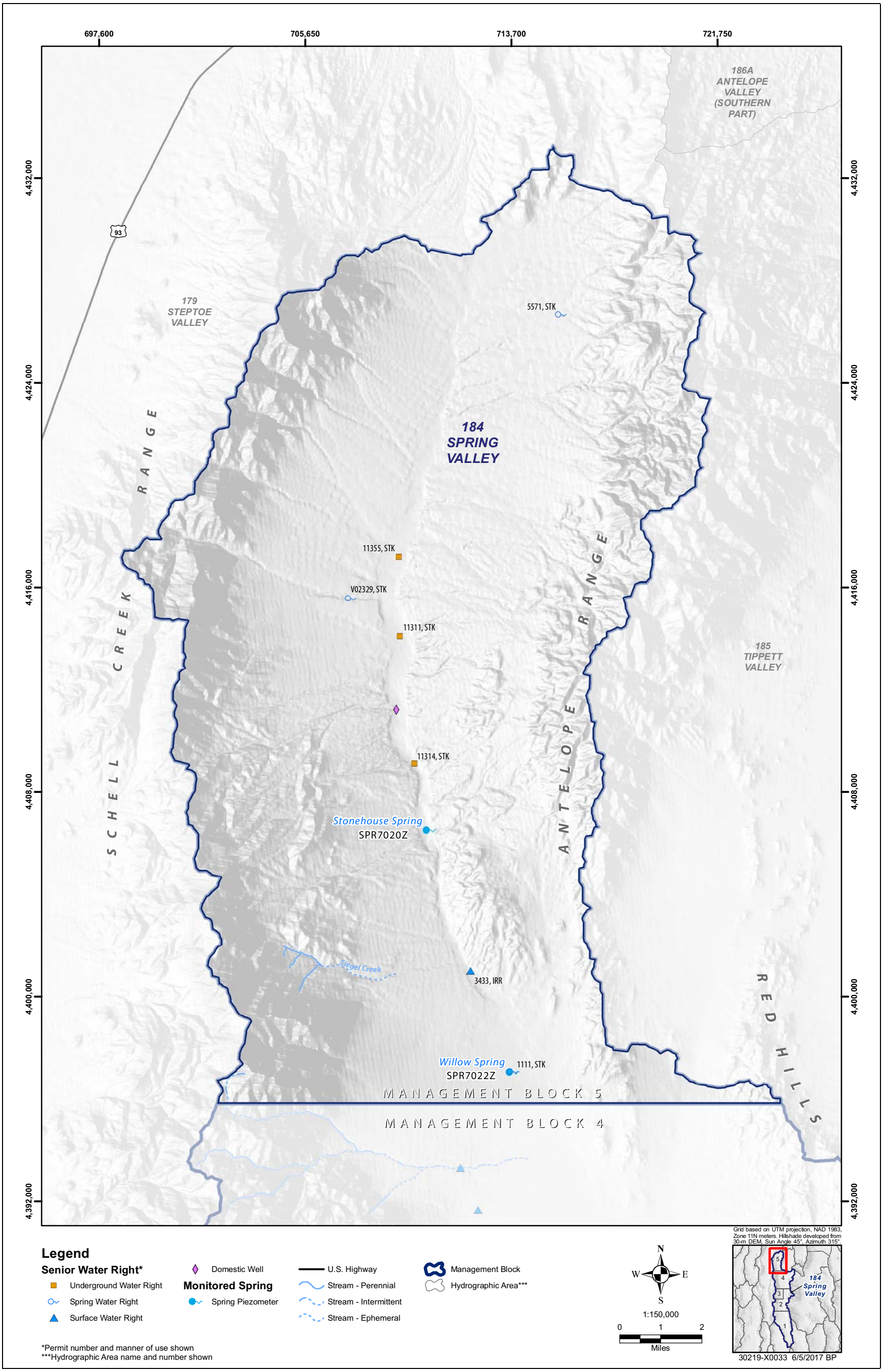


Figure 6-21
Management Block 5 Senior Water Rights and Hydrologic Monitoring Network

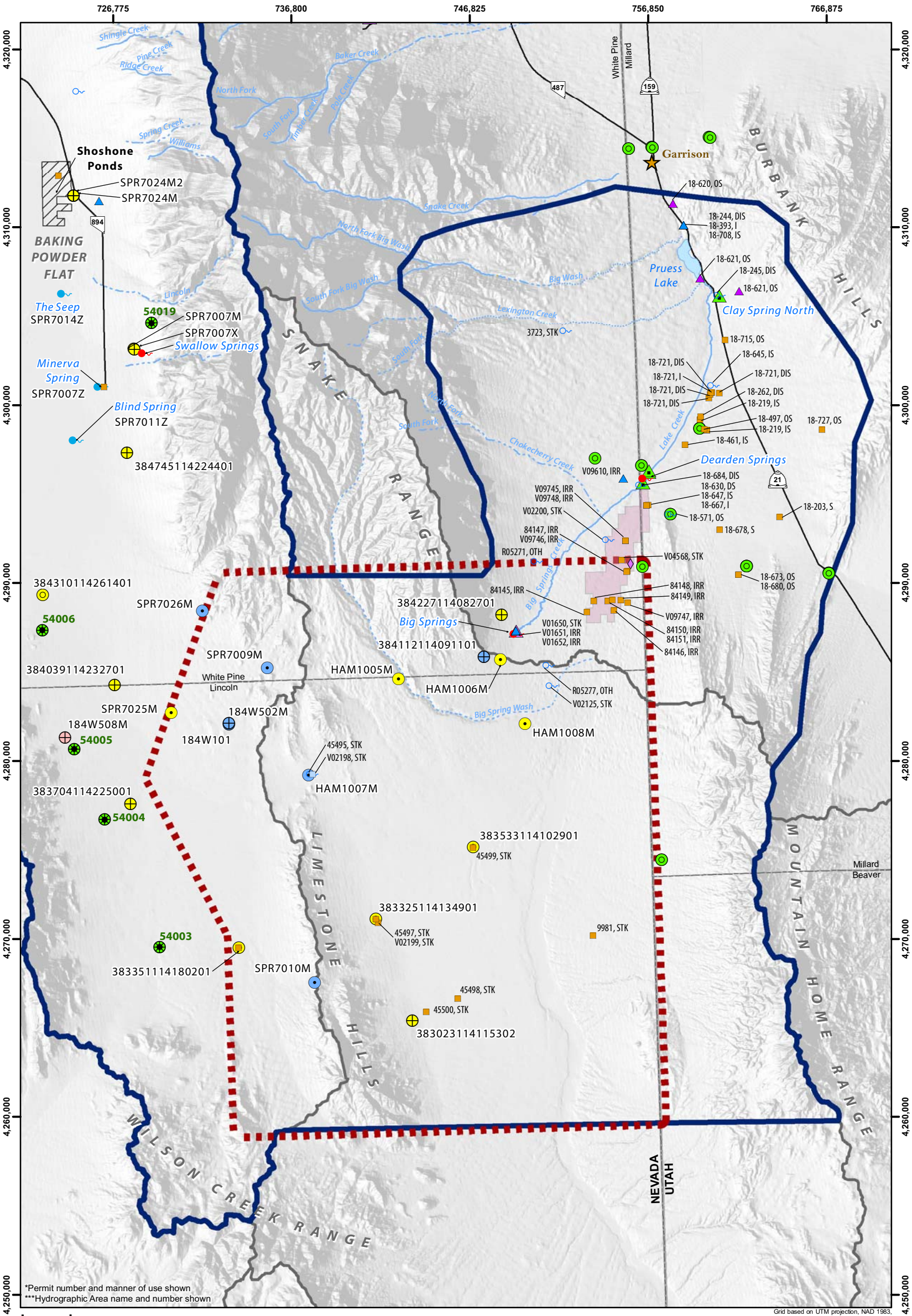
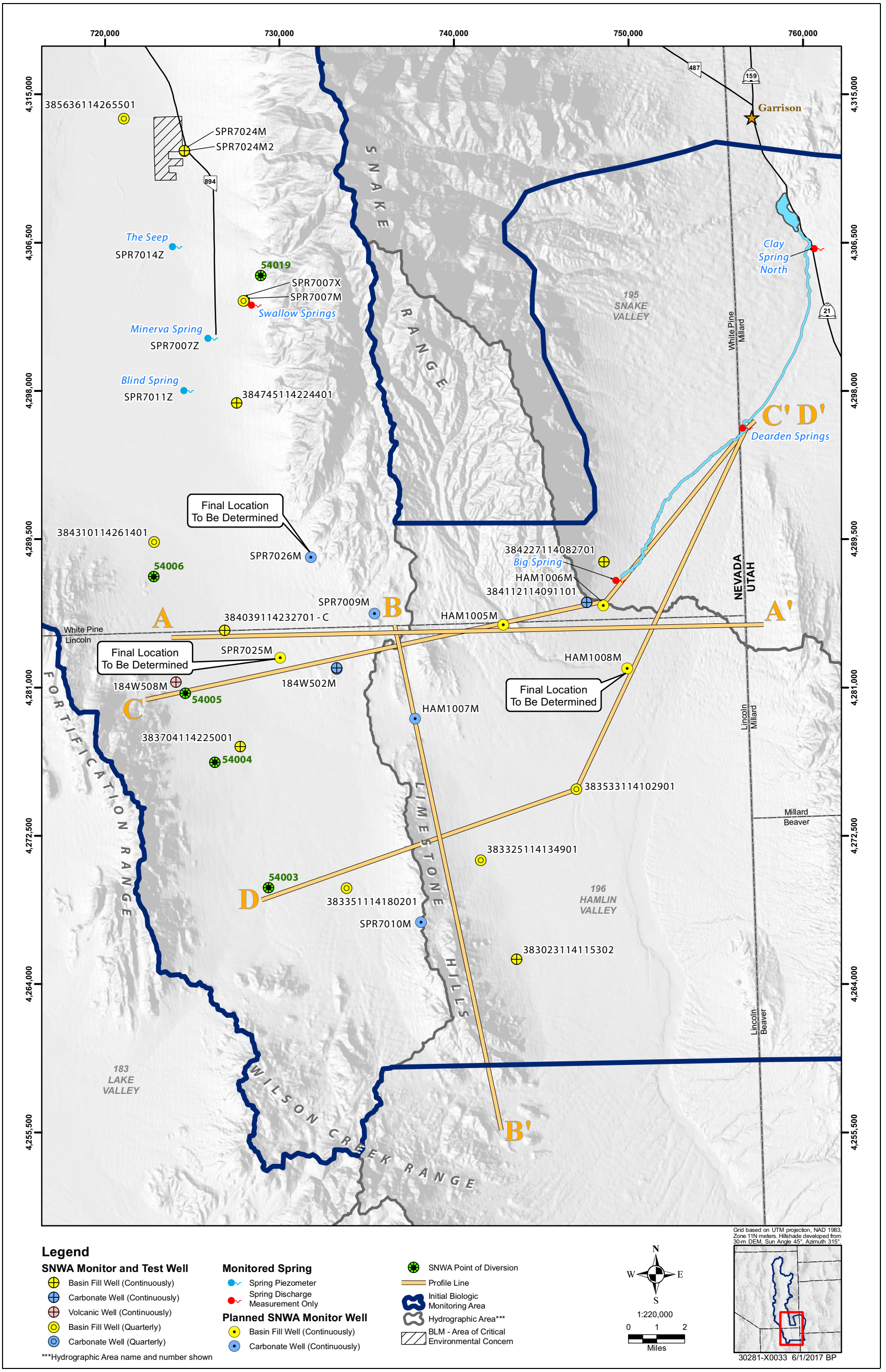


Figure 7-1
SNWA GDP PODs, Senior Water Rights, and Hydrologic Monitoring Network



Legend

SNWA Monitor and Test Well

- Basin Fill Well (Continuously)
- Carbonate Well (Continuously)
- Volcanic Well (Continuously)
- Basin Fill Well (Quarterly)
- Carbonate Well (Quarterly)

***Hydrographic Area name and number shown

Monitored Spring

- Spring Piezometer
- Spring Discharge Measurement Only

Planned SNWA Monitor Well

- Basin Fill Well (Continuously)
- Carbonate Well (Continuously)

- SNWA Point of Diversion
- Profile Line
- Initial Biologic Monitoring Area
- Hydrographic Area***
- BLM - Area of Critical Environmental Concern

N W E S

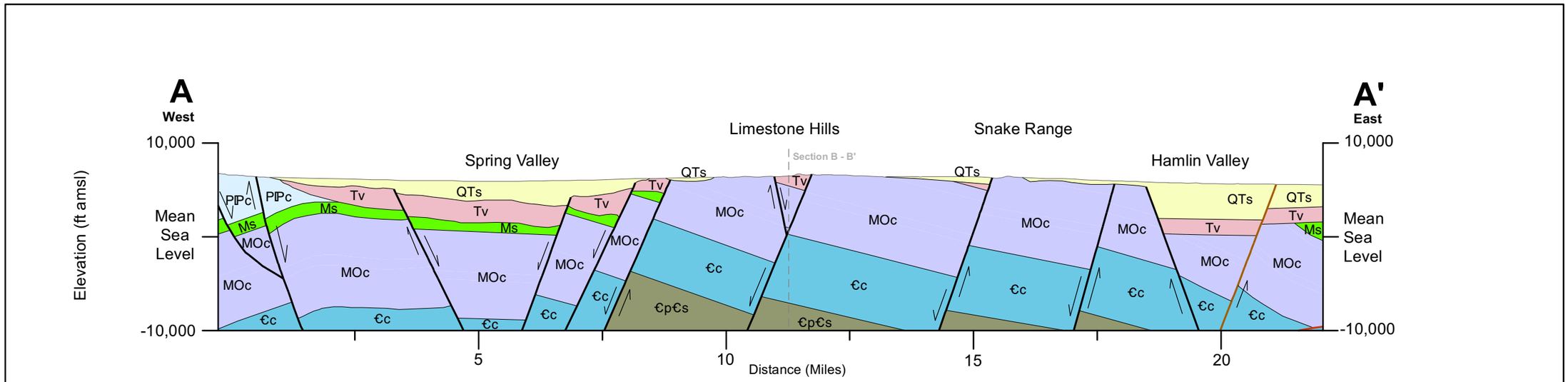
1:220,000

0 1 2 Miles

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

30281-X0033 6/1/2017 BP

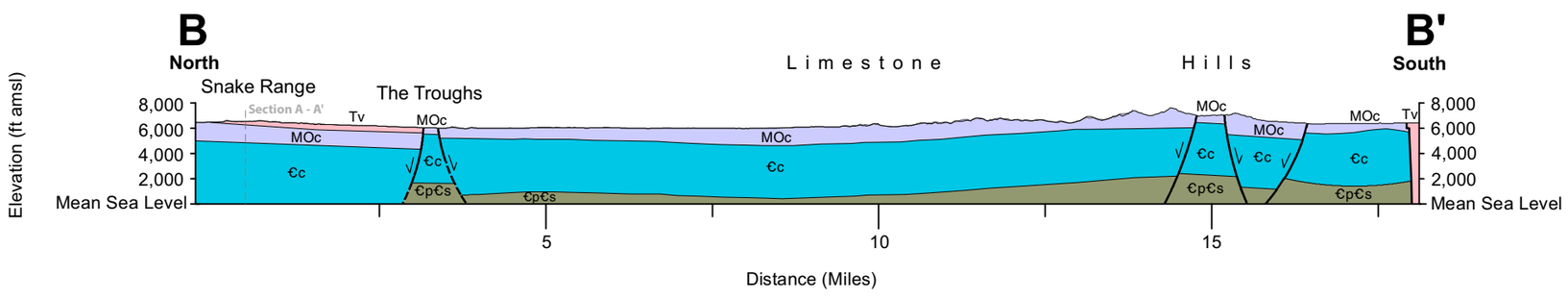
Figure 7-2
Geologic and Monitor Well Profile Locations



Source: SNWA, 2011c

Hydrogeologic Profile A - A'

1:150,000



Vertical Exaggeration = 0

Hydrogeologic Profile B - B'

1:150,000

Legend

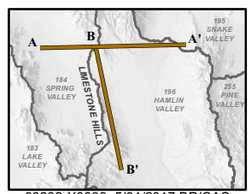
Hydrogeology

Map Unit - Description

QTs	Quaternary-Tertiary sediments
Tv	Tertiary volcanic rocks
PIPc	Permian-Pennsylvanian carbonate rocks
Ms	Mississippi siliciclastic rocks
MOc	Mississippian-Ordovician carbonate rocks
€c	Cambrian carbonate rocks
€p€s	Cambrian-pre-Cambrian clastic rocks

Regional Faults

- Normal Fault
- Thrust Fault
- Quaternary Normal Fault



30282-X0033 5/31/2017 BP/CAC

Figure 7-3
Geologic Profile for Limestone Hills Area

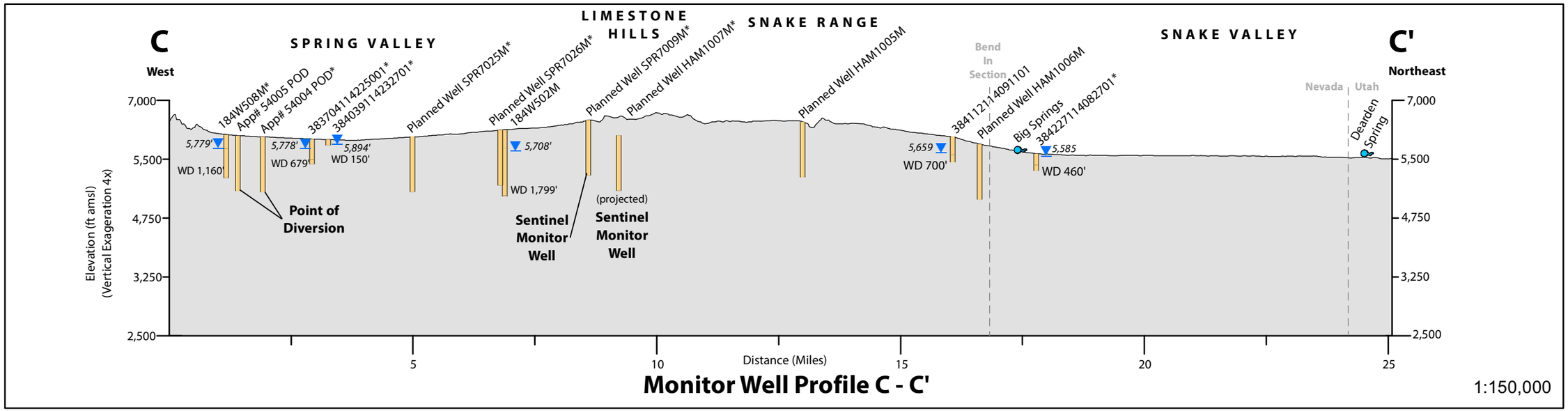


Figure 7-4
Profile of Monitor Well Locations

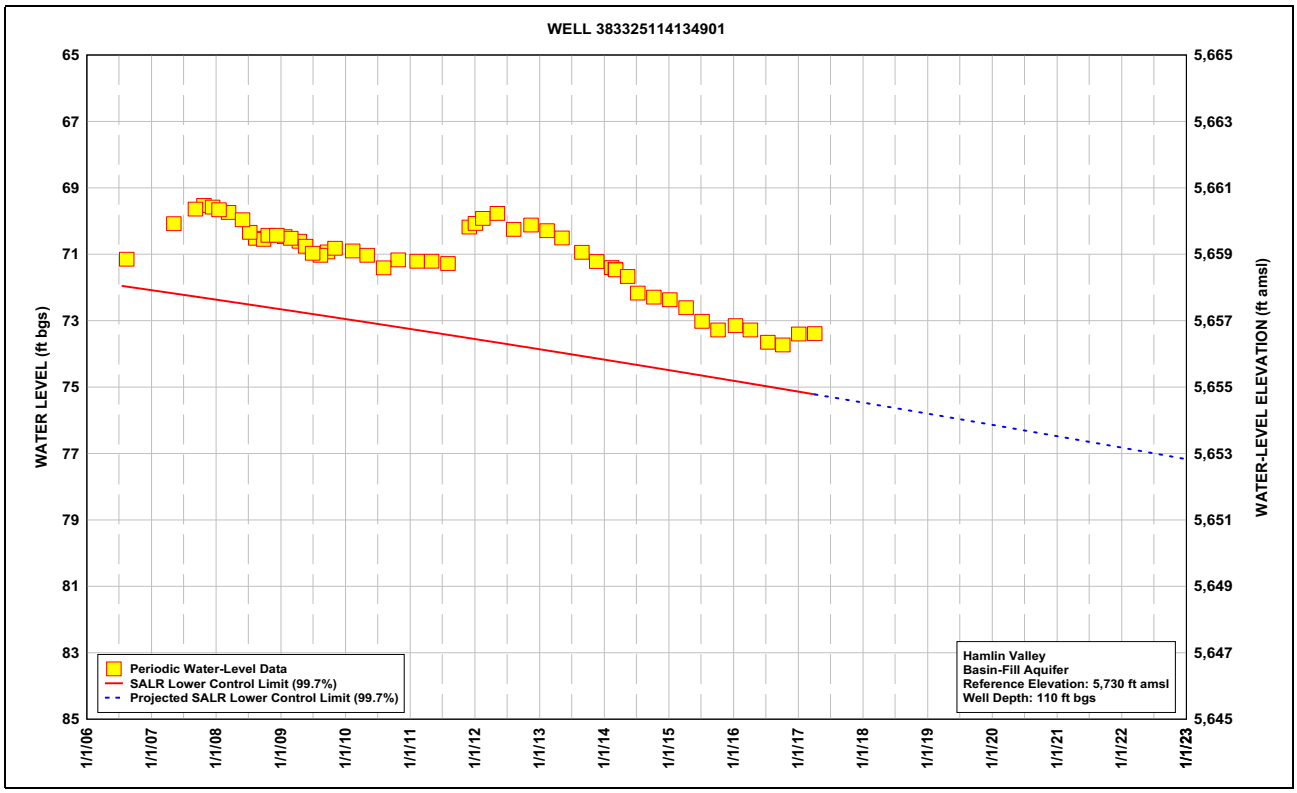


Figure 7-5
Well 383325114134901 (Hyde Well) - Trigger

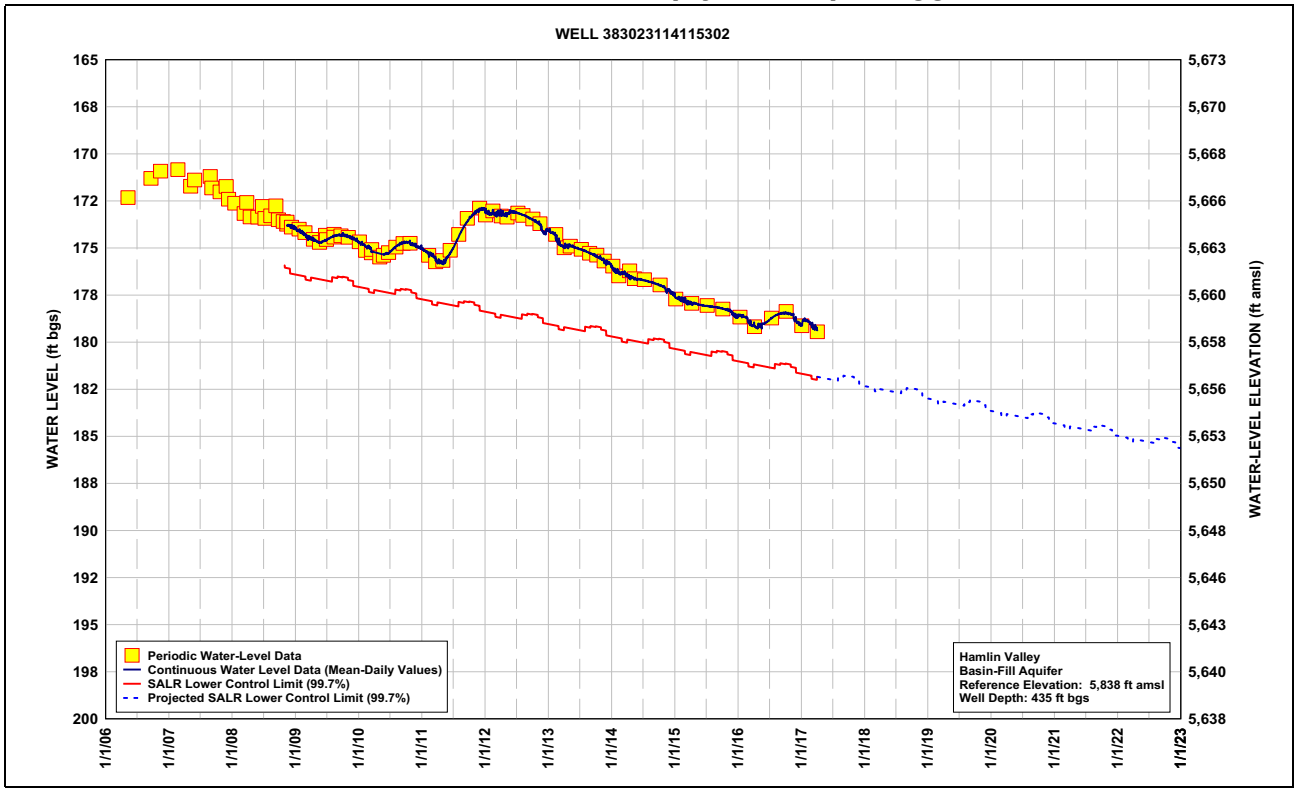


Figure 7-6
Well 383023114115302 - Trigger

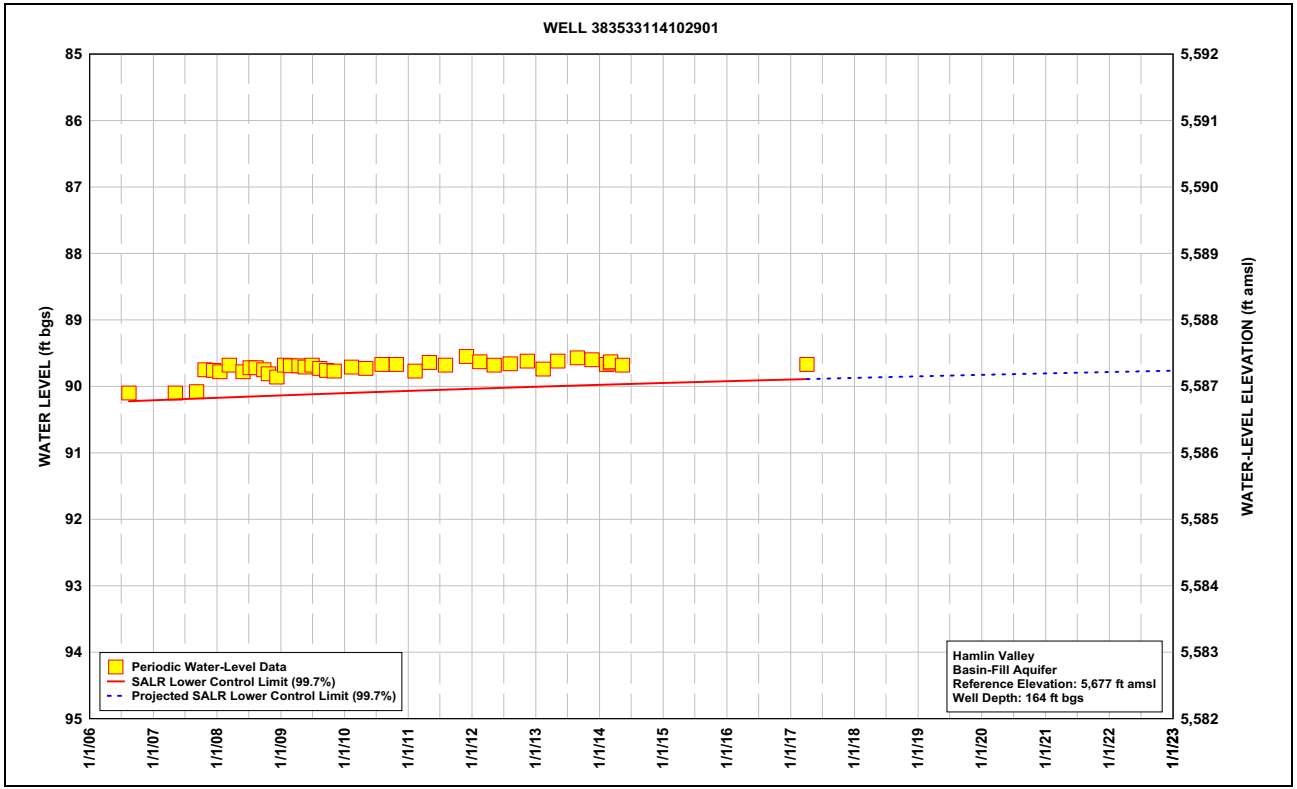


Figure 7-7
Well 383533114102901 (Monument Well) - Trigger

Table 7-6
Mitigation Actions for Senior Water Rights in Northern Hamlin, Nevada

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

[a]CER - Certificated, VST - Vested

[b]OGW - Other Groundwater, SPR - Spring, UG - Underground

[c]Rounded to the nearest 0.1 mile. Distance measured from the listed resource to SNWA POD No. 54003.

[d]Acre-feet per season

*The reported annual duty is not explicitly documented on the certificate, reserved right, or vested claim, but reported as such by the NDWR Hydrographic Abstract query.

1.0 INTRODUCTION

1.1 Remand of Rulings 6164-6167

Nevada State Engineer (NSE) Rulings 6164-6167 granted Southern Nevada Water Authority (SNWA) groundwater rights in Spring, Cave, Dry Lake, and Delamar valleys (Hydrographic Areas 184, 180, 181, and 182, respectively) (Nevada Division of Water Resources (NDWR), 2012a-d). These water rights are to be used for the SNWA Clark, Lincoln, and White Pine Counties Groundwater Development Project (GDP) (SNWA, 2012f).

On December 13, 2013, the Seventh Judicial District Court of the State of Nevada remanded Rulings 6164-6167 on four issues (*White Pine County and Consolidated Cases, et. al. v. Nevada State Engineer*) (Remand Order). One of the four issues was to "Define standards, thresholds or triggers so that mitigation of unreasonable effects from pumping of water are neither arbitrary nor capricious in Spring Valley, Cave Valley, Dry Lake Valley and Delamar Valley". A second issue was "The addition of Millard and Juab counties, Utah in the mitigation plan so far as water basins in Utah are affected by pumping of water from Spring Valley Basin, Nevada" (Seventh Judicial District Court of the State of Nevada, 2013, at page 23).

This report presents the evidence and scientific rationale for thresholds, triggers, and monitoring, management, and mitigation actions in the 2017 Delamar, Dry Lake and Cave Valleys (DDC) and Spring Valley Monitoring, Management, and Mitigation (3M) Plans (SNWA, 2017d and e). In accordance with the Remand Order, the thresholds, triggers and actions are designed to avoid unreasonable effects from SNWA GDP pumping to hydrologic and environmental resources in Nevada and Utah.

The approach and process used to develop the 3M Plans are consistent with the Remand Order and modern approaches to responsible groundwater development. First, unreasonable effects to hydrologic and environmental resources are defined. Next, objective thresholds and triggers are established to determine when management and mitigation actions will be implemented, and management and mitigation actions are identified to avoid unreasonable effects and comply with Nevada water law. Finally, a hydrologic monitoring network and hydrologic and environmental monitoring activities are established to enable effective implementation of the triggers and actions and support responsible groundwater development.

1.2 Requests to the Nevada State Engineer

SNWA submits the following requests to the NSE:

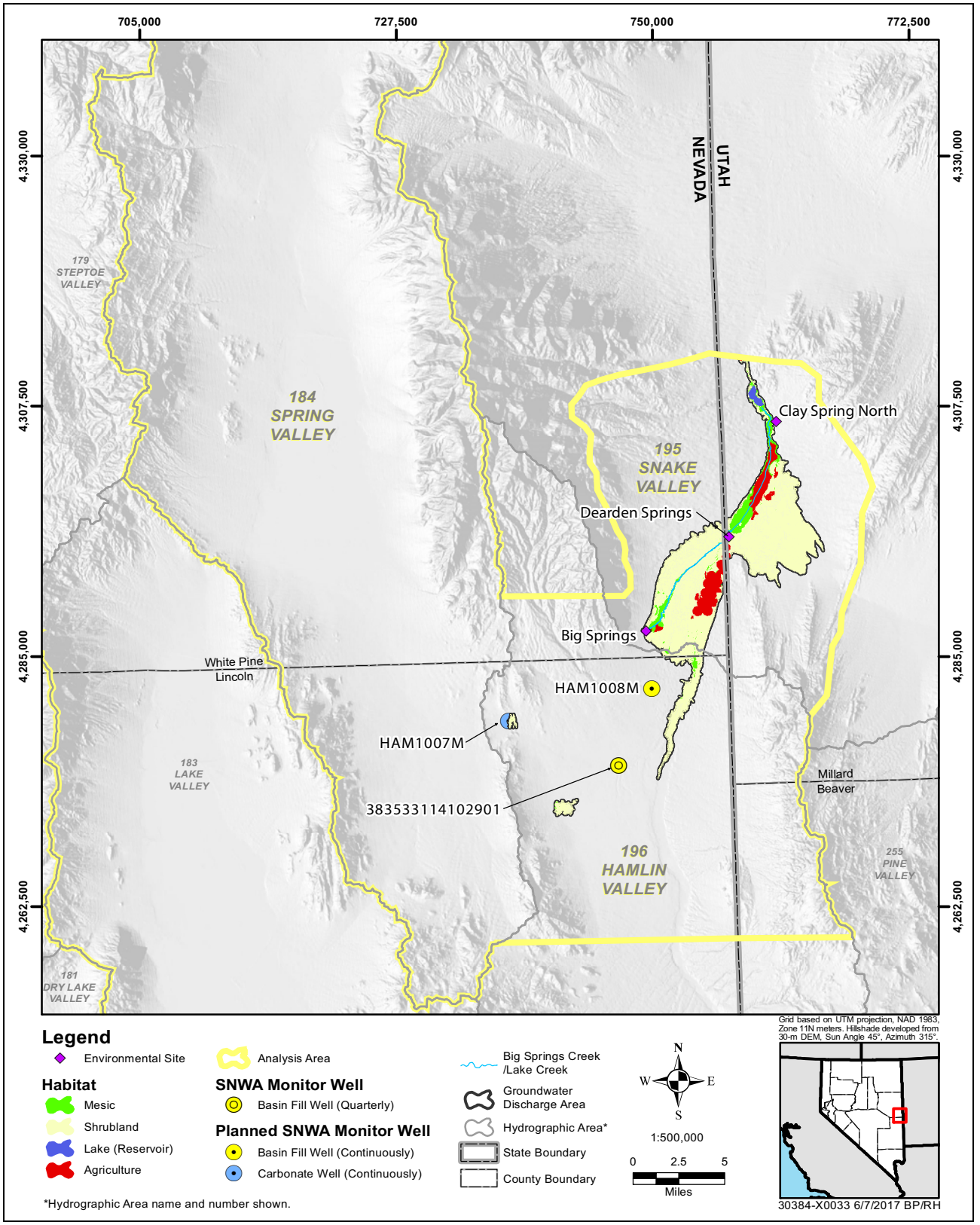
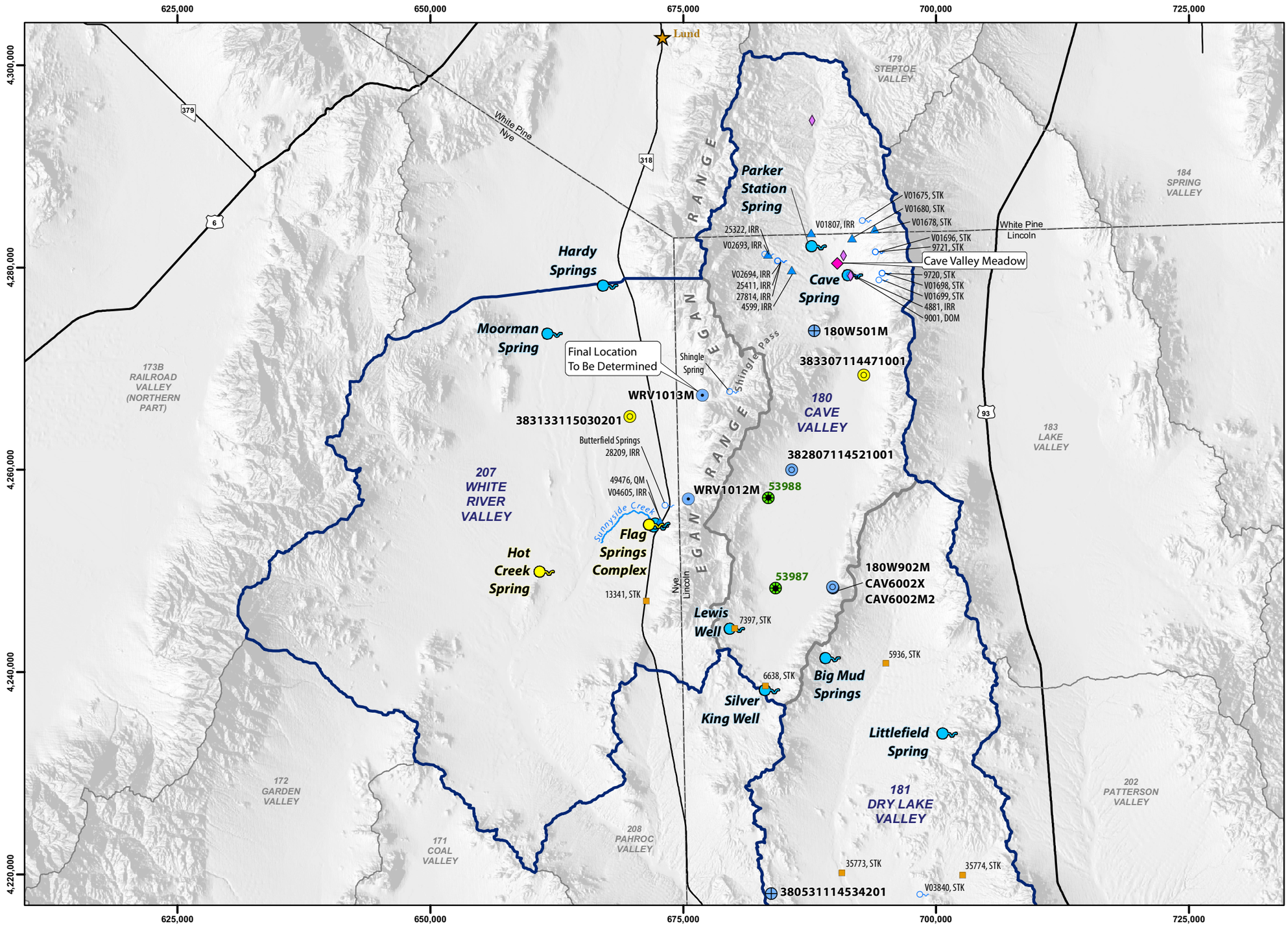


Figure 7-8
Habitats in Northern Hamlin and Southern Snake Valleys
Groundwater Discharge Areas



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**

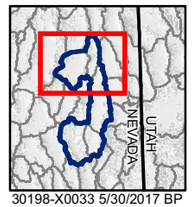
*Permit number and manner of use shown

**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°.



30198-X0033 5/30/2017 BP

Figure 8-1
Cave Valley GDP PODs, Senior Water Rights, and Hydrologic Monitoring Network

Figure 8-3
Cave Spring, May 2016

Figure 8-4
Cave Spring, October 2016

Figure 8-5
Parker Station, October 2013

Figure 8-8
Silver King Well, October 2016 with water tuck in background (looking west) 63

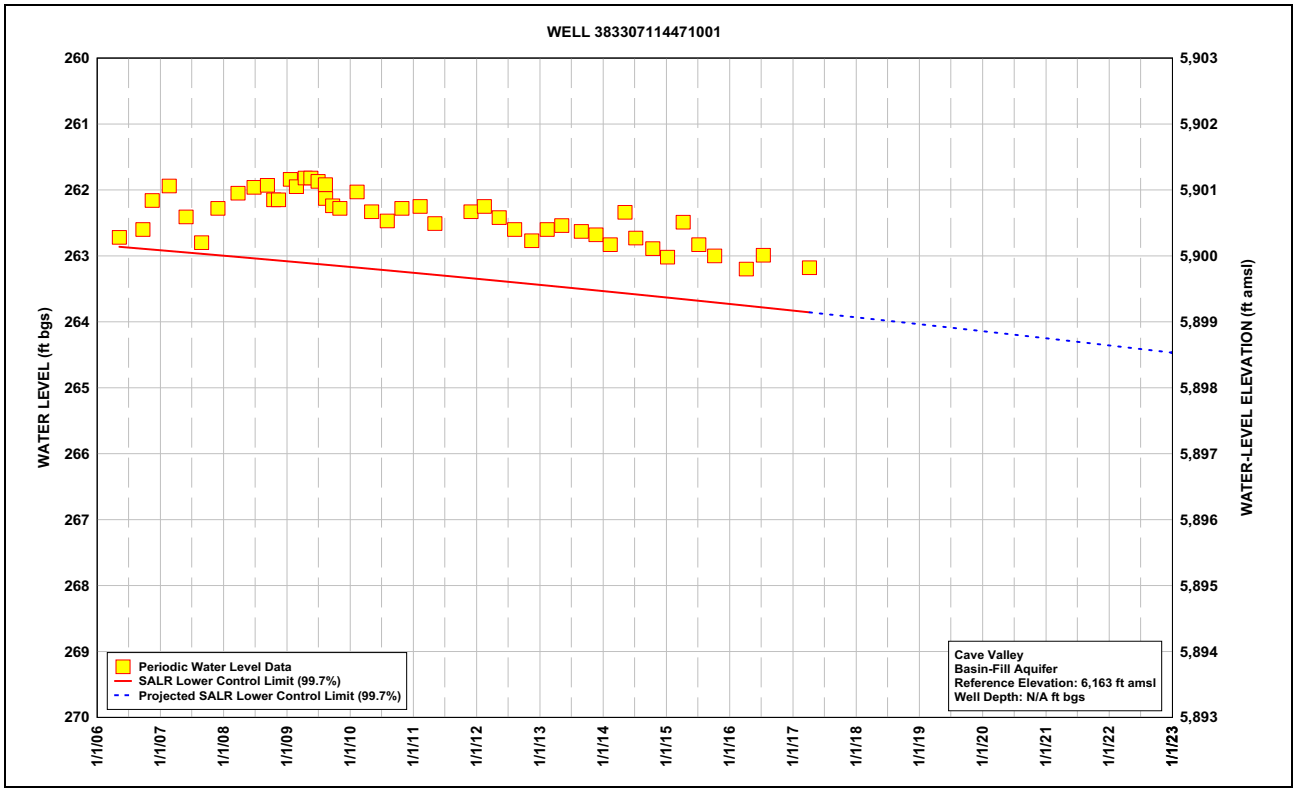


Figure 8-14
Well 383307114471001 - Trigger

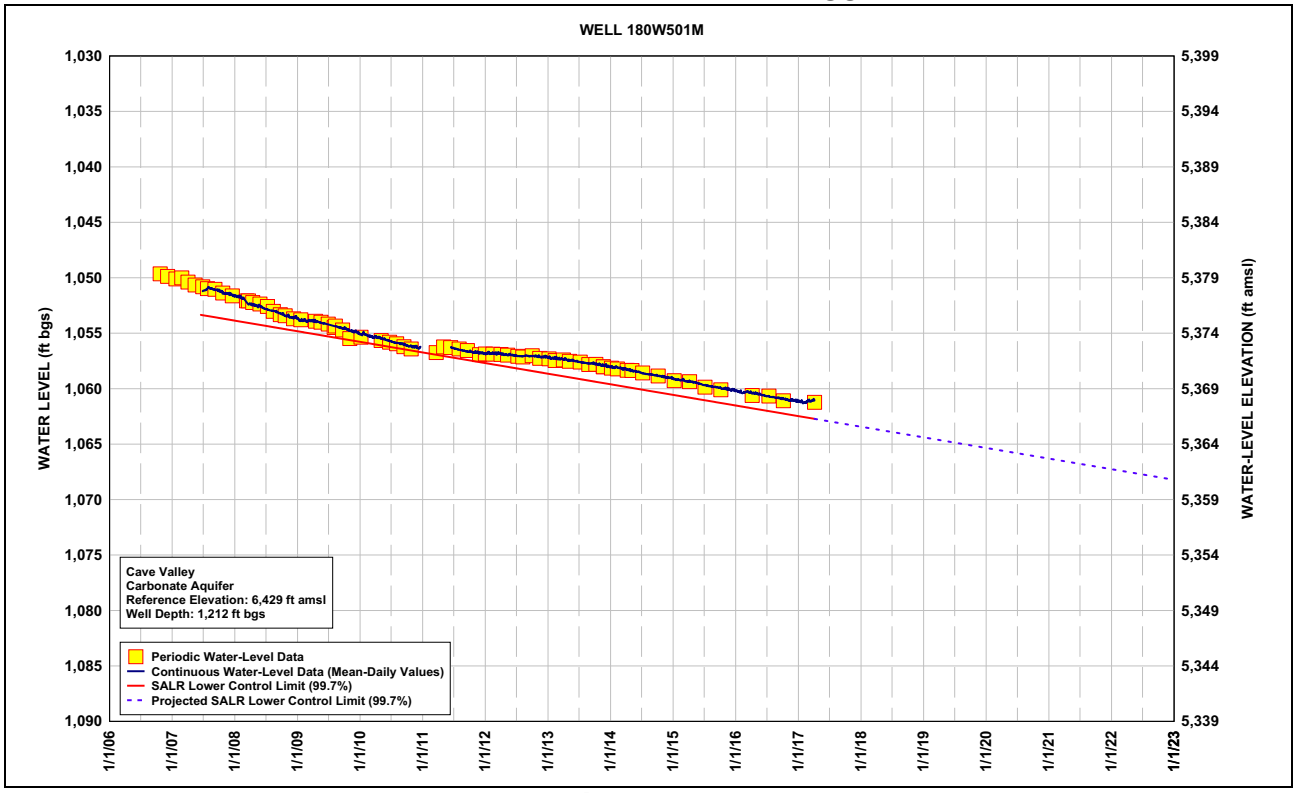


Figure 8-15
Monitor Well 180W501M - Trigger

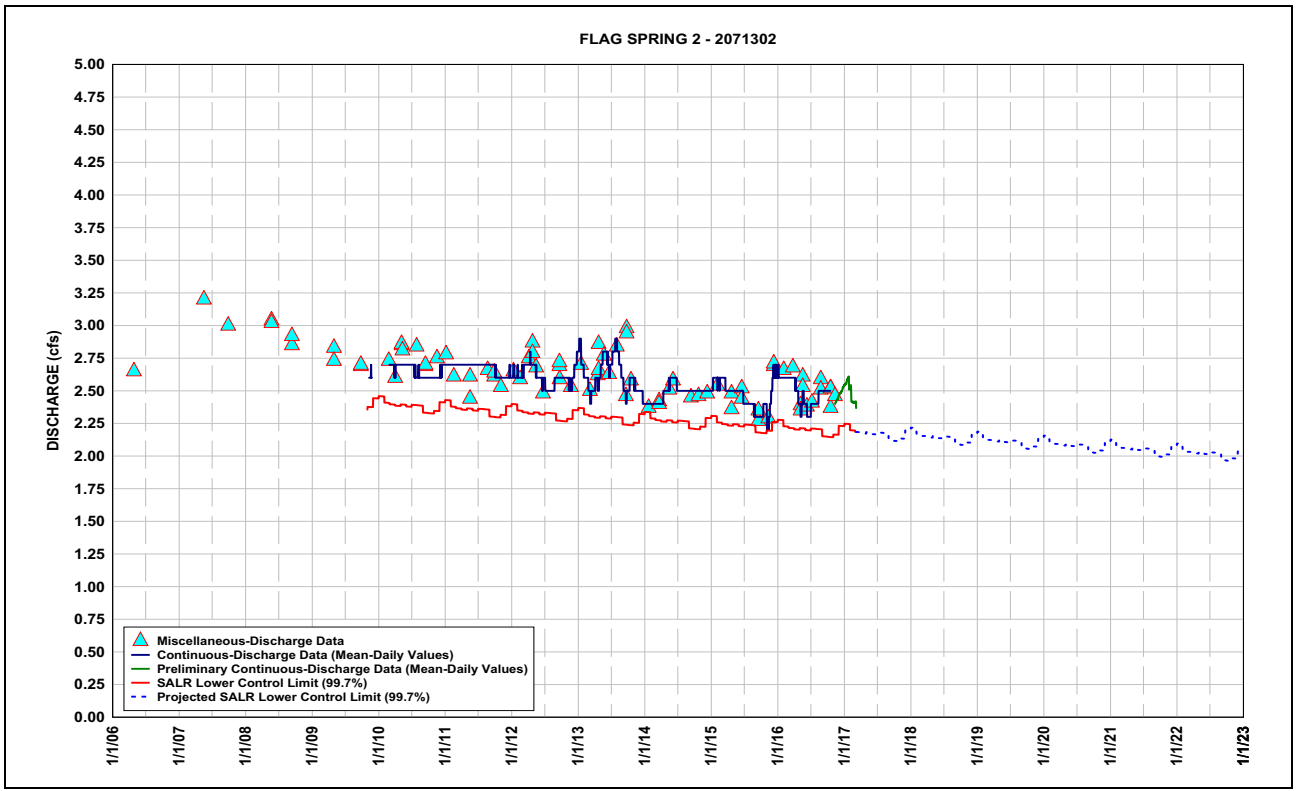


Figure 8-16
Flag Spring No. 2 - Trigger

Table 8-1
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**	**8,735**	>15

[a] To advance to the next stage, SNWA will be 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.

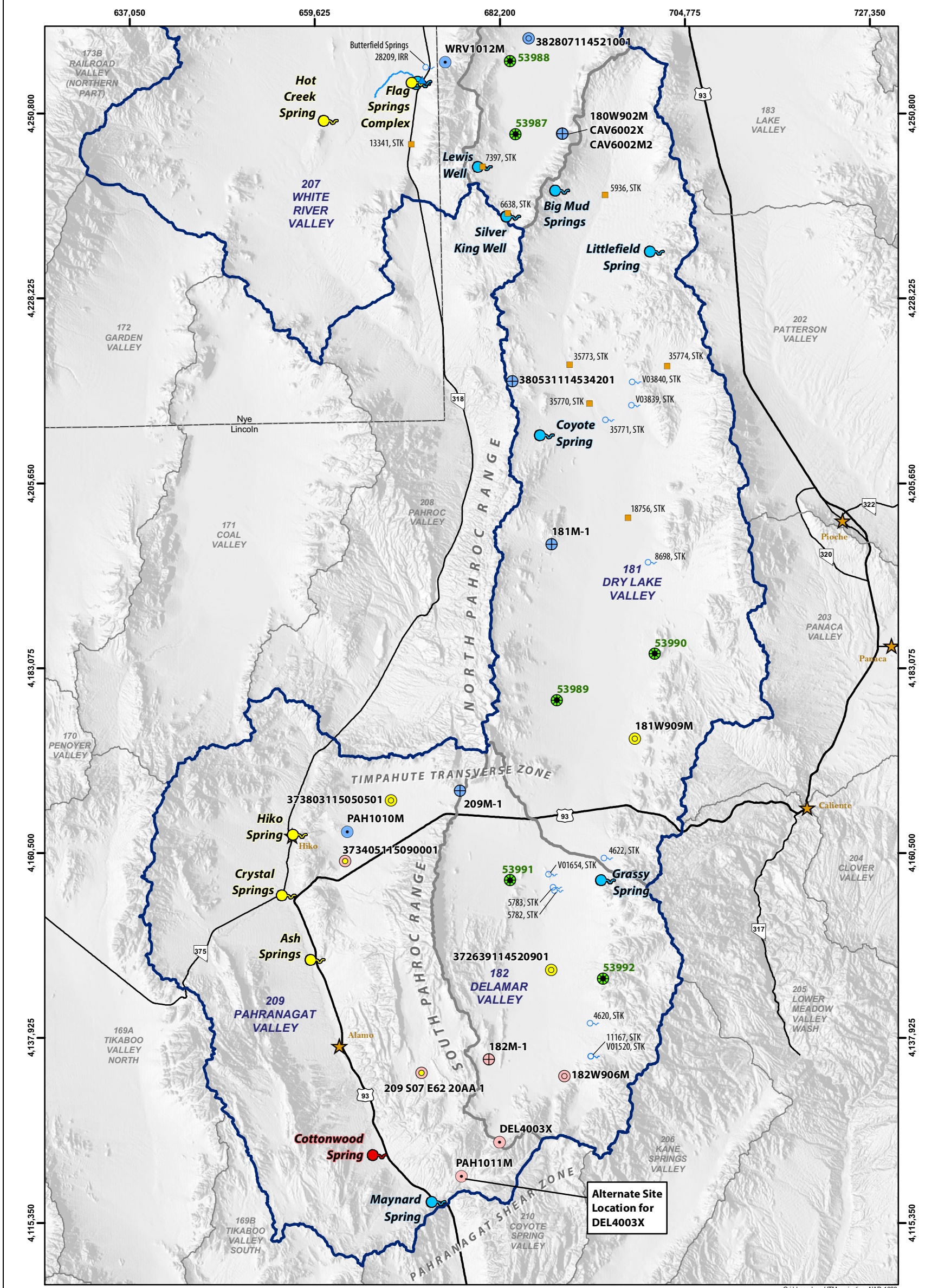


Figure 9-1
Dry Lake and Delamar Valley GDP PODs, Senior Water Rights, and Hydrologic Monitoring Network

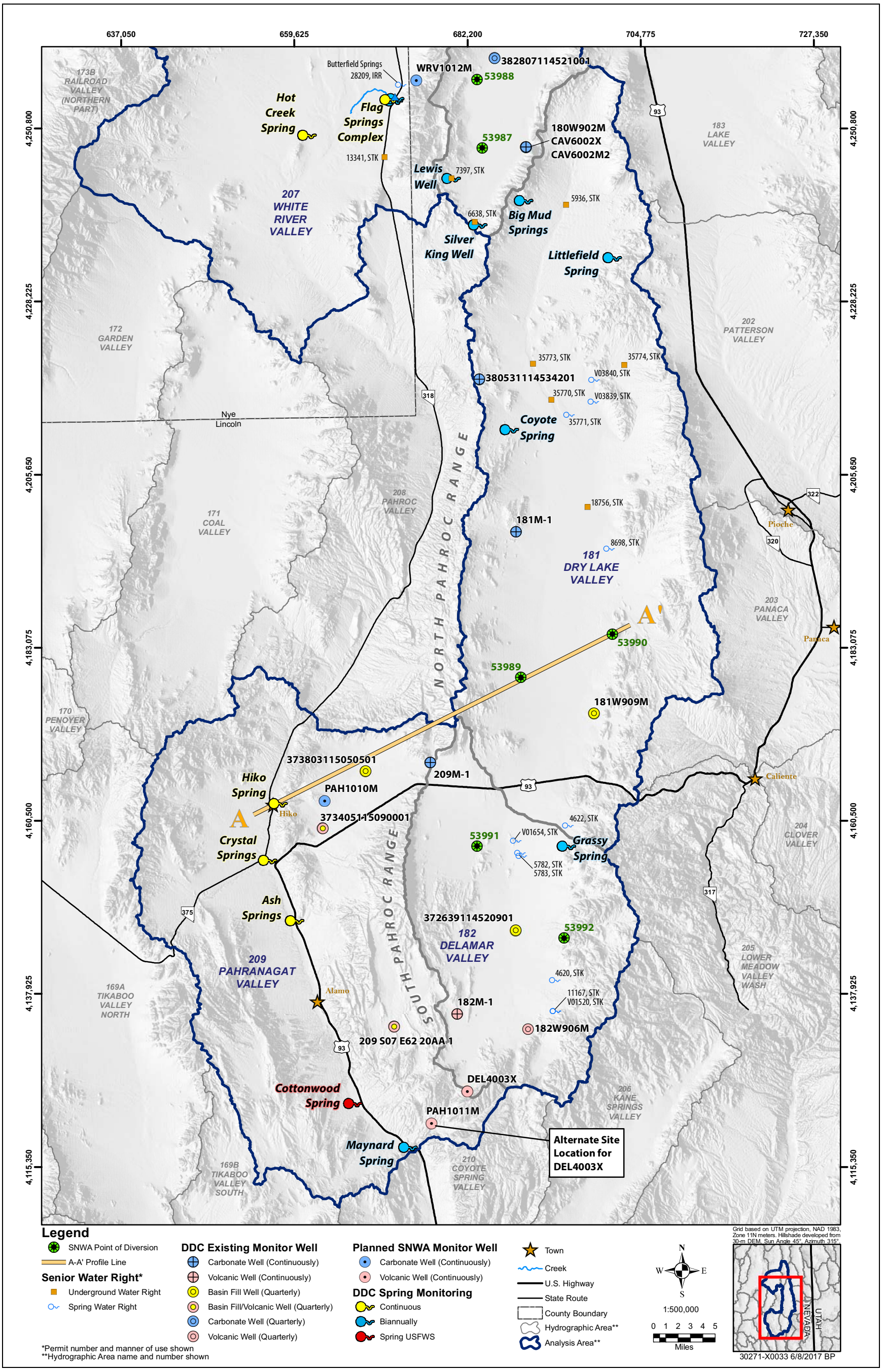
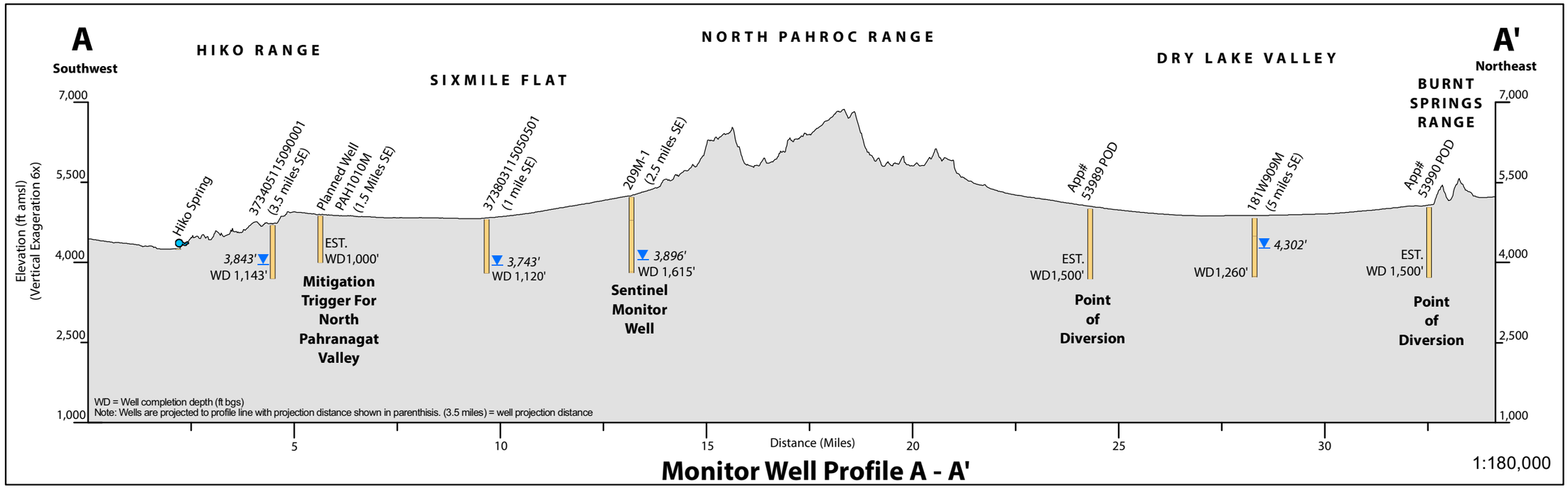
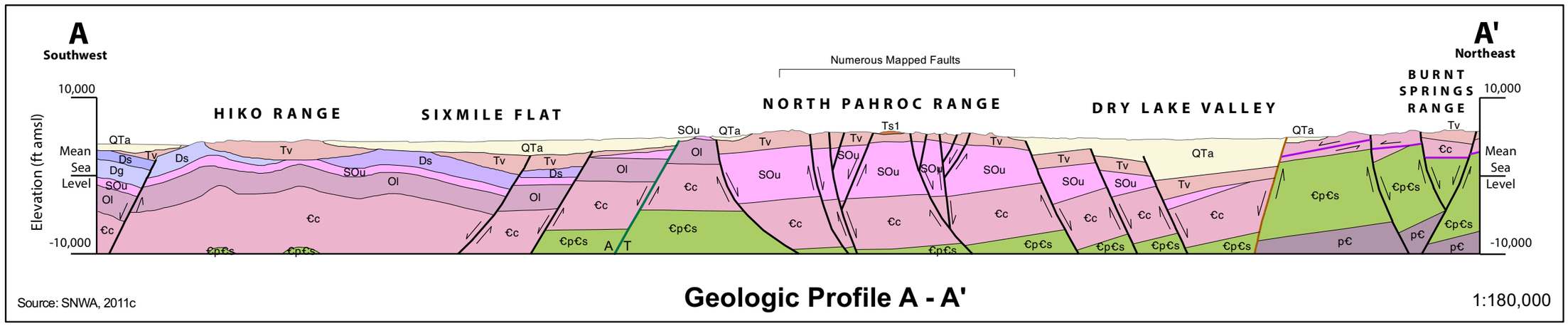


Figure 9-3
Geologic and Monitor Well Profile Location



Monitor Well Profile A - A'



Source: SNWA, 2011c

Geologic Profile A - A'

1:180,000

Legend

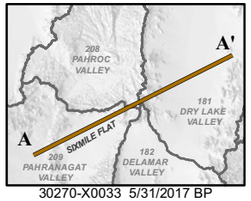
- Well
- Groundwater Elevation (ft amsl)

Explanation of Geologic Units

- QTa — Quaternary and Tertiary basin-fill deposits
- Tv — Tertiary volcanic ash-flows, flows and ash-fall tuffs
- Ts1 — Tertiary fluvial and lacustrine sediments
- DS — Devonian and Silurian sedimentary rocks, undivided
- Dg — Upper and Middle Devonian Guilmette Formation
- SOu — Silurian and Upper Ordovician dolomite, undivided
- Ol — Middle and Lower Ordovician, mostly Eureka Quartzite and the Pogonip Goup
- €c — Cambrian carbonate sedimentary rocks, undivided
- €p€s — Middle Cambrian to Late Proterozoic sedimentary rocks
- p€ — Late to Early Proterozoic metamorphosed and crystalline Precambrian basement rocks

Faults

- Normal Fault
- Strike-Slip and Oblique-Slip Fault (T / A)
- Detachment Fault
- Quaternary Normal Fault



30270-X0033 5/31/2017 BP

Figure 9-4
Geologic and Monitor Well Profile - Dry Lake PODs to Hiko Spring

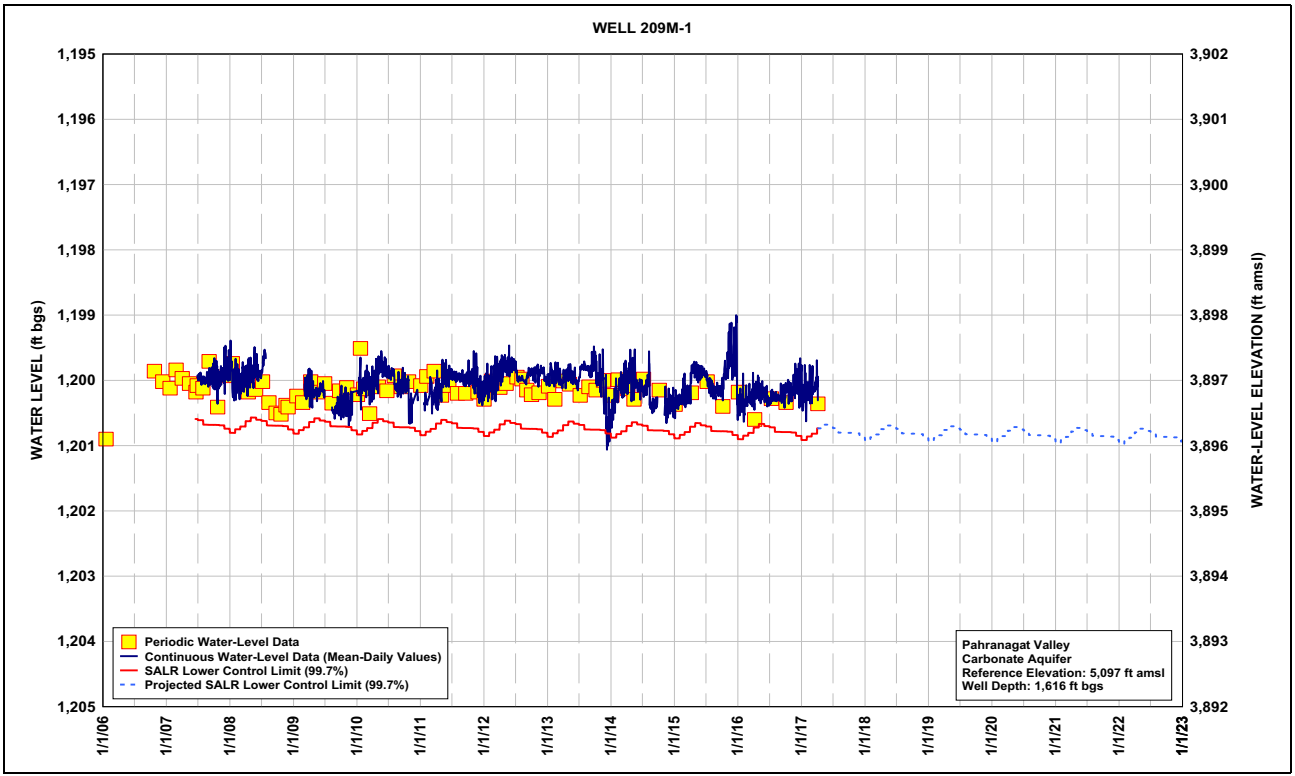


Figure 9-5
Monitor Well 209M-1 - Trigger

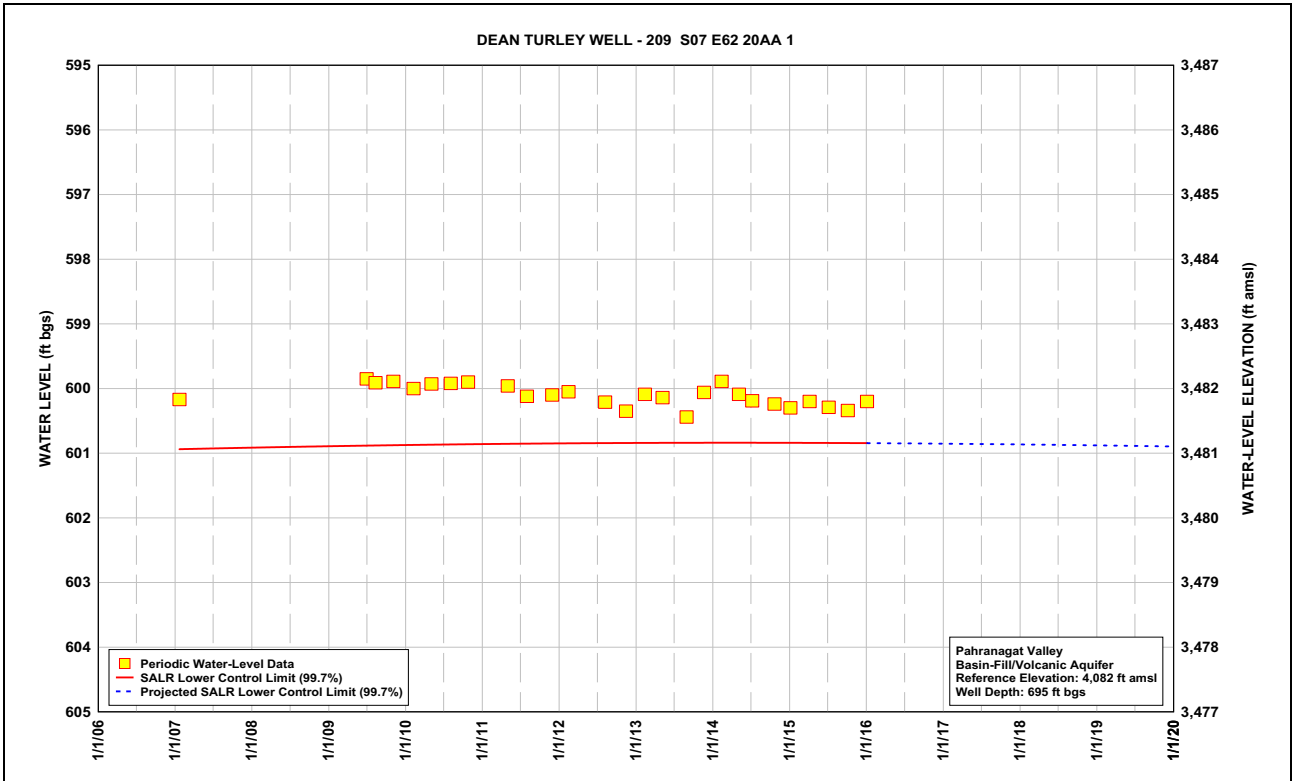


Figure 9-6
209 S07 E62 20AA1- Trigger

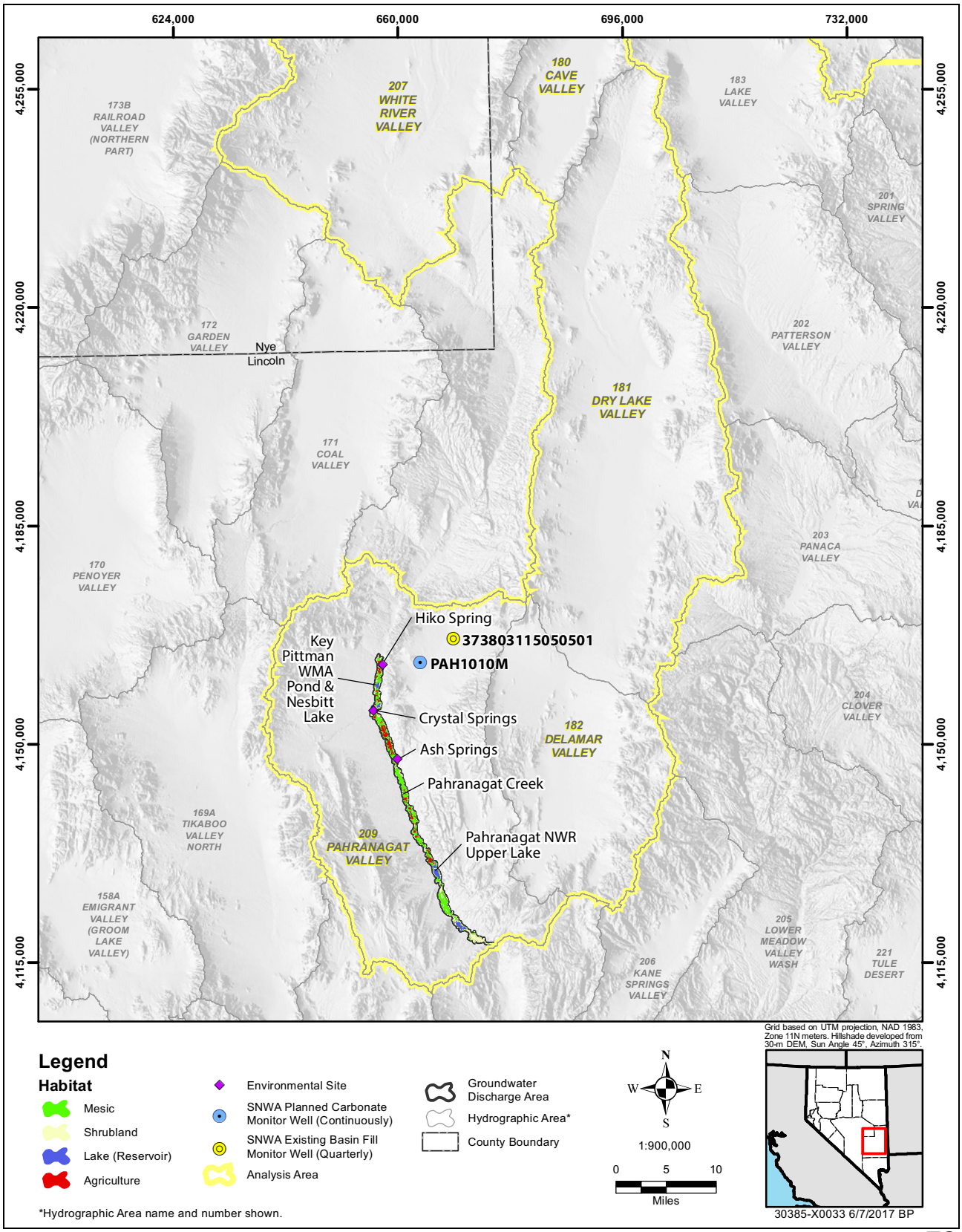


Figure 9-7

Habitats in Dry Lake, Delamar, and Pahranagat Valleys Groundwater Discharge Areas