Doc No. WRD-ED-0003

SOUTHERN NEVADA WATER AUTHORITY

Water Resources Division

Spring Valley Hydrologic Monitoring and Mitigation Plan (Hydrographic Area 184)

February 2009

Prepared by
Southern Nevada Water Authority
Water Resources Division
P.O. Box 99956
Las Vegas, Nevada 89193-9956

Approved by the
Nevada State Engineer
to Fulfill Requirements of
Ruling #5726
February 9, 2009

CONTENTS

This Page Intentionally Left Blank

FIGURES

This Page Intentionally Left Blank

TABLES

This Page Intentionally Left Blank

ACRONYMS

BLM	Bureau of Land Management
BWG	Biological Working Group
DOI	U.S. Department of the Interior
DTW	depth to water
HA	hydrographic area
LVVWD	Las Vegas Valley Water District
NDWR	Nevada Division of Water Resources
NEPA	National Environmental Policy Act of 1969
NSE	Nevada State Engineer
NWIS	National Water Information System
QA	quality assurance
QC	quality control
SNPLMA	Southern Nevada Public Lands Management Act
SNWA	Southern Nevada Water Authority
TRP	Technical Review Panel
USGS	U.S. Geological Survey
UTM	Universal Transverse Mercator

ABBREVIATIONS

af	acre-foot
amsl	above mean sea level
bgs	below ground surface
cfs	cubic feet per second
ft	foot
in.	inch
m	meter
mi	mile
mi^2	square mile

This Page Intentionally Left Blank

1.0 INTRODUCTION

The purpose of this document is to present the Southern Nevada Water Authority (SNWA) Hydrologic Monitoring and Mitigation Plan (Monitoring Plan) for Spring Valley hydrographic area (HA) 184. SNWA prepared this plan to meet permit conditions for SNWA groundwater rights granted under permits 54003-54015 inclusive, and 54019 and 54020 by the Nevada State Engineer (NSE) in Ruling Number 5726 (Ruling) issued on April 16, 2007 (Nevada State Engineer, 2007).

1.1 Background

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

Prior to the hearing on SNWA's Spring Valley Applications, a Stipulation for Withdrawal of Protests (Stipulation) was entered on September 8, 2006, between SNWA and the U.S. Department of the Interior (DOI), on behalf of the Bureau of Indian Affairs, the Bureau of Land Management (BLM), the National Park Service, and the U.S. Fish and Wildlife Service (also known as the DOI Bureaus). An Executive Committee composed of representatives of parties to the Stipulation was established to oversee the implementation of the Stipulation. The Stipulation requires that SNWA implement a hydrologic monitoring, management, and mitigation plan (SV3M Plan), which is presented in Exhibit A of the Stipulation. Development and implementation of a biological monitoring, management, and mitigation plan are also required as described in Exhibit B of the Stipulation. A Technical Review Panel (TRP) and Biological Working Group (BWG), composed of technical representatives of parties to the stipulation and NSE office, were also established to develop and oversee implementation of monitoring, management, and mitigation plans; to review program data; and to modify the monitoring plans, if necessary.

The Ruling presented the decision of the NSE regarding the SNWA's Spring Valley Applications. The protests to Applications 54016 through 54018 and 54021 were upheld in part, and these applications, which are located near Cleve Creek, were denied on the grounds that approval would conflict with existing rights and would threaten to prove detrimental to the public interest. The protests to Applications 54003 through 54015, 54019, and 54020 were overruled in part, and the applications were granted subject to specific conditions. These conditions included, among other requirements, the implementation of a monitoring plan with a 5-year baseline hydrologic and biologic monitoring program.

The Ruling included a staged development strategy for development of the approved water rights. A minimum 10-year period was established during which time a maximum of 40,000 af can be pumped

in any one year, with a 10-consecutive-year average of at least 35,000 af annually. At the end of the 10-year period and after a review of the findings of the staged development period, SNWA may have the opportunity to develop 60,000 afy from the Spring Valley HA.

1.2 Purpose and Scope

The objectives of the Monitoring Plan encompass those set forth for the SV3M Plan and include additional objectives for identification and assessment of potential impacts to existing water-right holders and sensitive areas within Spring Valley. The Monitoring Plan, once implemented, would be updated as changes to the SV3M Plan occur, with the approval of the NSE. This document presents the monitoring plan and implementation strategy to satisfy the requirements of the Ruling.

1.3 Previous Studies and Reports

The location of the Spring Valley HA is presented on Figure 1. Numerous studies related to Spring Valley and adjacent basins have been performed since the late 1940s. These studies have included water resource investigations, geologic and hydrogeologic investigations, recharge and discharge estimations, and other hydrologic studies. The regional hydrogeologic framework and a summary of results of previous studies have been presented in several reports. These include *Water Resource Assessment for Spring Valley* (SNWA, 2006d), *SNWA Management Plan for Groundwater Development in Spring Valley* (2006b), *Summary of Groundwater Water-Rights and Current Water Uses in Spring Valley* (2006c), *Geologic and Hydrogeologic Framework for the Spring Valley Area* (2006a), *Geology of White Pine and Lincoln counties and adjacent areas, Nevada and Utah—The geologic framework of regional groundwater flow systems* (Dixon, et al., 2007), and *Water resources of the Basin and Range carbonate-rock aquifer system, White Pine County, Nevada, and adjacent areas in Nevada and Utah* (Welch, Bright, and Knochenmus, 2007).

Since the applications were filed in 1989, LVVWD and SNWA have worked to define the basin characteristics and hydrologic baseline conditions in Spring Valley. This has been done by acquiring groundwater and surface water data and conducting hydrologic and geologic investigations within Spring Valley and adjacent basins. The SV3M plan has been modified and expanded in agreement with the TRP and BWG to meet the monitoring objectives of the Stipulation and Ruling, with the intent that one hydrologic monitoring plan can be used to fulfill the requirements of both documents.

The status and data collected as of January 2008, for each element of the SV3M Plan were presented in the *Spring Valley Stipulation Agreement Hydrologic Monitoring Plan Status and Data Report* (2008).

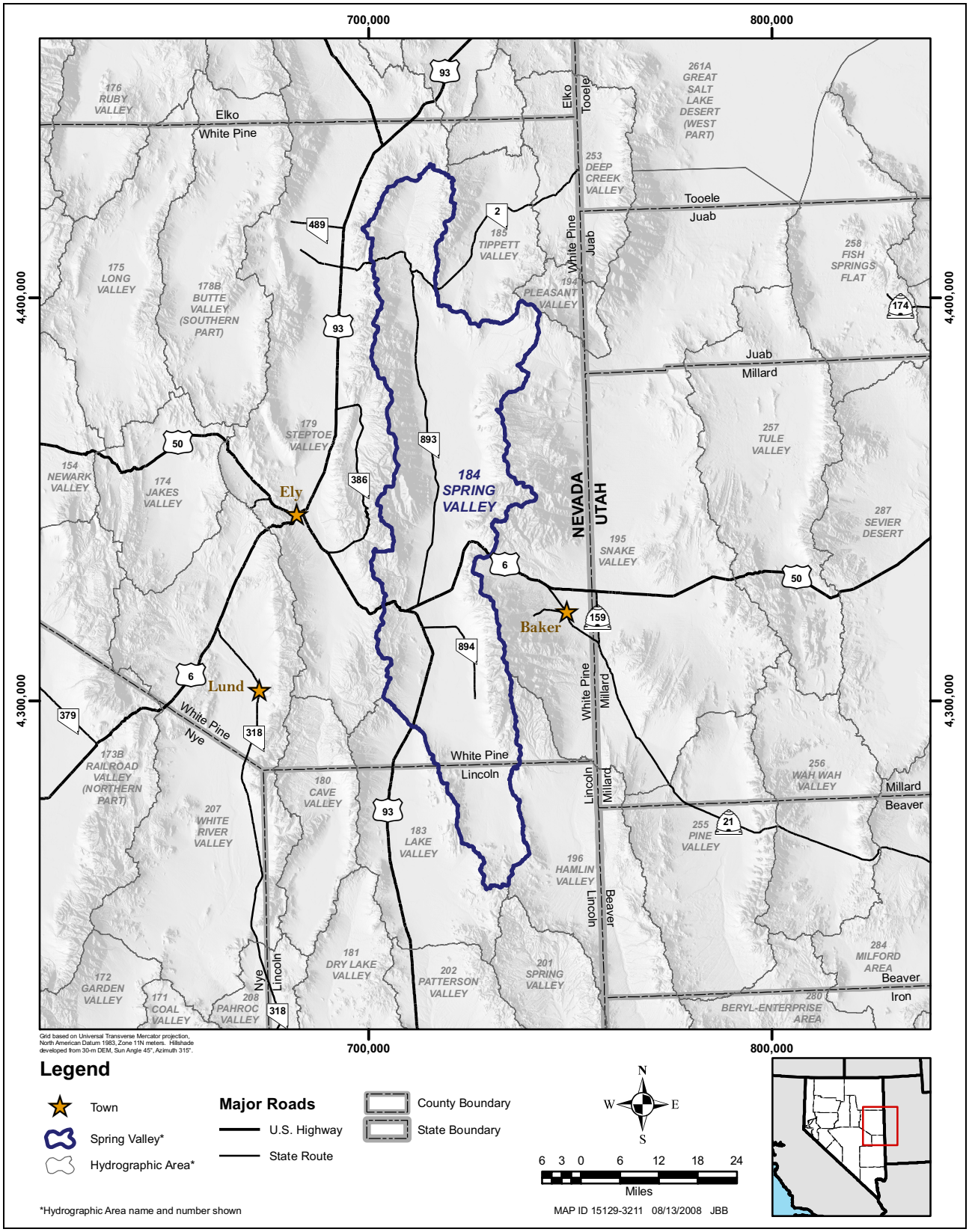

Figure 1
Spring Valley Hydrographic Area 184

This Page Intentionally Left Blank

2.0 MONITORING PLAN REQUIREMENTS

The Stipulation and Ruling present specific objectives and requirements addressed within the Monitoring Plan. This section summarizes the key requirements. The tasks that satisfy these requirements are presented in Section 3.0.

2.1 Stipulation Agreement

The goals stated in the Stipulation are (1) to manage the development of groundwater by SNWA in the Spring Valley HA without causing injury to Federal Water Rights and/or unreasonable adverse effects to Federal Resources in the Area of Interest, (2) to accurately characterize the groundwater gradient from the Spring Valley HA to the Snake Valley HA via Hamlin Valley, and (3) to avoid any effect on Federal Resources located within the boundaries of the Great Basin National Park from groundwater withdrawal by SNWA in the Spring Valley HA.

Additional common goals are (1) to manage the development of groundwater by SNWA in Spring Valley HA in order to avoid unreasonable adverse effects to wetlands, wet meadow complexes, springs, streams, and riparian and phreatophytic communities (Water-Dependent Ecosystems) and to maintain biologic integrity and ecological health of the Area of Interest over the long term; (2) to avoid any effect to Water-Dependent Ecosystems within the boundaries of the Great Basin National Park; and (3) to avoid an unreasonable degradation of the scenic values of and visibility from the Great Basin National Park due to a potential increase in airborne particulates and loss of surface vegetation that may result from groundwater withdrawals by SNWA in Spring Valley.

A summary of the key elements of the Monitoring Plan described in the SV3M Plan follows:

- General Requirements
  - Design and implement a baseline hydrologic data collection program.
- Monitor Well Data Collection
  - Collect water-level data at 10 existing monitor wells on a quarterly basis.
  - Collect water-level data at 15 existing monitor wells on a continuous basis.
  - Install two monitor wells in the vicinity of Shoshone Ponds. Water-level data will be collected continuously from each well.

- Install two monitor wells between the Interbasin Monitoring Zone (Zone), as described in Section 3.2.2.1, and the two SNWA production wells located closest to the Zone. Water-level data will be collected continuously at these near-Zone wells.

- Record quarterly water-level data in all SNWA exploratory wells in Spring Valley. The TRP will identify selected exploratory wells for continuous monitoring subsequent to the beginning of groundwater withdrawals should the TRP agree additional monitoring is needed.

• Spring, Hamlin, and Snake Valleys Hydrologic Relationship

- Develop a network of four carbonate and two basin-fill monitor wells to characterize the hydraulic gradient from the Spring Valley HA to the Snake Valley HA via Hamlin Valley within the Zone. One of the wells is planned to be installed in the immediate vicinity of Big Springs in southern Snake Valley.

• Future Production Well Monitoring

- Record groundwater production and continuous water-level data in all future SNWA production wells in Spring Valley when operational.

• Surface Water Streams and Springs

- Install 12 shallow piezometers adjacent to spring locations determined by the TRP. Water-level data will be collected continuously from each location. One additional mountain block spring (Rock Spring) was added to the monitor program by the TRP for collection of spring discharge data only.

- Operate and maintain surface-water gages at Cleve Creek and Big Springs Creek.

- Collect two sets of synoptic-discharge measurements during irrigation and non-irrigation periods for the Big Springs Creek and Lake Creek surface water system from Big Springs to Preuss Lake. The two sets of measurements will be repeated every five years following the start of groundwater withdrawals in Spring Valley HA by SNWA.

• Baseline Water Chemistry

- Perform chemical analyses of selected parameters on three rounds of samples collected from wells, piezometers, and surface water sites determined by the TRP. The program will consist of three sampling events at 6-month intervals. Samples will be collected at 40 locations per event.

- Perform an additional round of sampling every five years after the commencement of groundwater production.

- Modeling
  - Develop, calibrate, and maintain a numerical flow model of the regional groundwater flow system.
- Reporting
  - Provide data collected, as required by the Stipulation, to other Stipulation parties within 90 days using a shared data repository administered by SNWA.
  - File an Annual SV3M Plan Data Report with the TRP and NSE by March 31 of each year detailing the findings of the SV3M Plan monitoring program.

The Stipulation also directs that a plan be created for biologic monitoring, resource management, and mitigation. The plan must include the collection of baseline data and identification of research and study needs.

2.2 Ruling Requirements

A summary of the Monitoring Plan requirements specified in the Ruling is presented below.

- Develop a monitoring and mitigation program approved by the NSE.
- Conduct monitoring that will provide data to ensure existing water rights are protected.
- Collect a minimum of five years of biological and hydrological baseline data. The baseline monitoring program must be approved by the NSE prior to the export of any groundwater resources from Spring Valley under the permits.
- File an annual data report with the NSE by March 15 of each year detailing the findings of the NSE-approved Monitoring Plan. This report is separate from the SV3M Plan annual report presented in Section 2.1. One combined annual data report is proposed to be prepared for the SV3M Plan and NSE Monitoring Plan dependent upon approval of the NSE.
- Update a NSE-approved groundwater flow model every five years during the initial staged development period. At the end of the staged development period, SNWA will submit the updated groundwater flow model with the data obtained during the staged development period and provide predictive results for 10, 25, and 100 years.
- Modify or curtail pumping under specific conditions. If pumping effects impact existing rights, conflict with the protectible interests in existing domestic wells, as set forth in NRS §533.024, threaten to prove detrimental to the public interest or are found to not be environmentally sound, SNWA will be required to curtail pumping and/or mitigate the impacts to the satisfaction of the NSE.

2.3 Existing Water Rights

The Monitoring Plan includes three additional elements not included in the Stipulation SV3M Plan which documents baseline conditions associated with and potential influences on existing water rights. These include additional spring and groundwater monitoring in the vicinity of the Cleveland Ranch, spring discharge monitoring of Turnley Spring located on Sacramento Pass, and an additional monitor well one mile north of the northernmost production well on the east side of Spring valley based upon the well configuration at time of commencement of water export from the basin. A description of each of these three elements of the Monitoring Plan is presented in Section 3.7.

3.0 MONITORING PLAN STRATEGY AND IMPLEMENTATION

The objectives of the Monitoring Plan encompass those set forth for the SV3M Plan and include additional objectives for identification and assessment of potential impacts to existing water-right holders and sensitive areas within Spring Valley. As changes to the SV3M Plan occur, the Monitoring Plan, once implemented, will be updated with the approval of the NSE.

3.1 Baseline Hydrologic Monitoring Program

The Monitoring Plan will focus on establishing a comprehensive network to collect baseline and future hydrologic data. The network will include monitoring at Cleve Creek in Spring Valley and Big Springs Creek in Snake Valley; valley-floor and higher-elevation springs; monitor wells completed in the basin fill, carbonate, and volcanics; and precipitation stations spatially distributed across the valley. Data will be collected at a frequency to meet requirements and provide representative data on temporal fluctuations.

Acquisition of baseline hydrologic and hydrogeochemical data will follow the program presented in the SV3M Plan, with modifications as determined by the TRP and appropriate approval by the Executive Committee or NSE when required. This program, with additional monitoring specifically associated with existing water-right holders at the Cleveland Ranch and Turnley Spring, will meet the objectives of the Ruling.

3.2 Monitor Wells

Data collected under this Monitoring Plan will provide representative hydrologic data on the valley aquifer systems. The plan includes monitoring of new and existing wells completed in basin fill, carbonate, and volcanic materials at strategic locations to provide representative data spatially and vertically across the study area. Monitor well locations were selected with consideration of hydrogeologic conditions at each location. Geologic reconnaissance, including stratigraphic and structural field mapping and aerial photo analysis, surface geophysics, and review of existing hydrogeologic data, was performed to assist in well selection. The Monitoring Plan monitor well network consists of locations selected through consensus with the TRP. The network also includes monitor wells within the Zone to assist in the evaluation of the relationship of groundwater flow between Spring, Hamlin, and Snake valleys.

3.2.1 Existing Well Network

SNWA will record water levels quarterly in 10 representative monitor wells and continuously in 15 representative monitor wells in the Spring Valley and Hamlin Valley HAs. The data collection interval of the continuous measurements was determined by the TRP to be hourly. The approved

monitor well locations, including completion information and measurement frequency, are presented on Figure 2. Well construction data and recent groundwater level data for each location is presented in Table 1. Map identification numbers relate to Table D.1-1 in the SNWA Water Resources Assessment for Spring Valley, June 2006, which was submitted to the NSE on June 30, 2006.

The wells were selected to (1) serve as monitoring points between SNWA's future production wells and existing water-right holders as well as Federal Water Rights and Federal Resources; (2) provide spatially distributed hydrologic data from basin-fill, carbonate, and volcanic aquifers within Spring and Hamlin valleys in order to analyze and produce annual groundwater-level contour and water-level drawdown maps; (3) calibrate the groundwater flow model(s); and (4) evaluate the effects of SNWA's groundwater withdrawals.

Modification of this element of the Monitoring Plan, including any addition, subtraction, or replacement of the wells initially selected by the TRP or the frequency of monitoring for these wells, would be made through consensus recommendations from the TRP, or as required by the NSE. Alternate locations may be used if private property access is not granted.

3.2.2 New Monitor Well Locations

In the Stipulation, the DOI Bureaus agreed to expedite the National Environmental Policy Act (NEPA) and other clearances, within the limits of applicable laws, to help meet the requirements of this Monitoring Plan. The construction of the new monitor wells is contingent upon private property accessibility and issuance of appropriate rights-of-way by various Federal and State agencies.

3.2.2.1 New Monitor Wells in the Interbasin Groundwater Monitoring Zone

An objective of the Monitoring Plan is to effectively characterize the hydraulic gradient between Spring, Hamlin, and Snake valleys. This area was identified by the establishment of the Zone. The Zone boundary is presented on Figure 3.

SNWA, in consultation with the TRP, is required to construct and equip four monitor wells in the carbonate-rock aquifer and two monitor wells in the basin-fill aquifer within the Zone. The locations for the six SNWA monitor wells within the Interbasin Monitoring Zone agreed upon by the TRP are presented on Figure 3 and listed in Table 2. Carbonate Well 184W502M has already been installed. Right-of-way process applications, including NEPA compliance, for the five new well locations were submitted to the BLM for approval on November 26, 2007. The five new wells will be completed to a depth approximately 250 to 300 ft below the water table depending upon hydrogeologic conditions encountered during drilling. The estimated time frame for well completion is 2009.

In addition to the new SNWA wells, four existing wells completed in the basin fill are located in the Zone and are included in the existing well monitoring program, as presented in Section 3.2.1.

SNWA will not file any applications with the NSE to change the points of diversion of any SNWA permits to a point of diversion within the Zone for a period of five years following the completion of

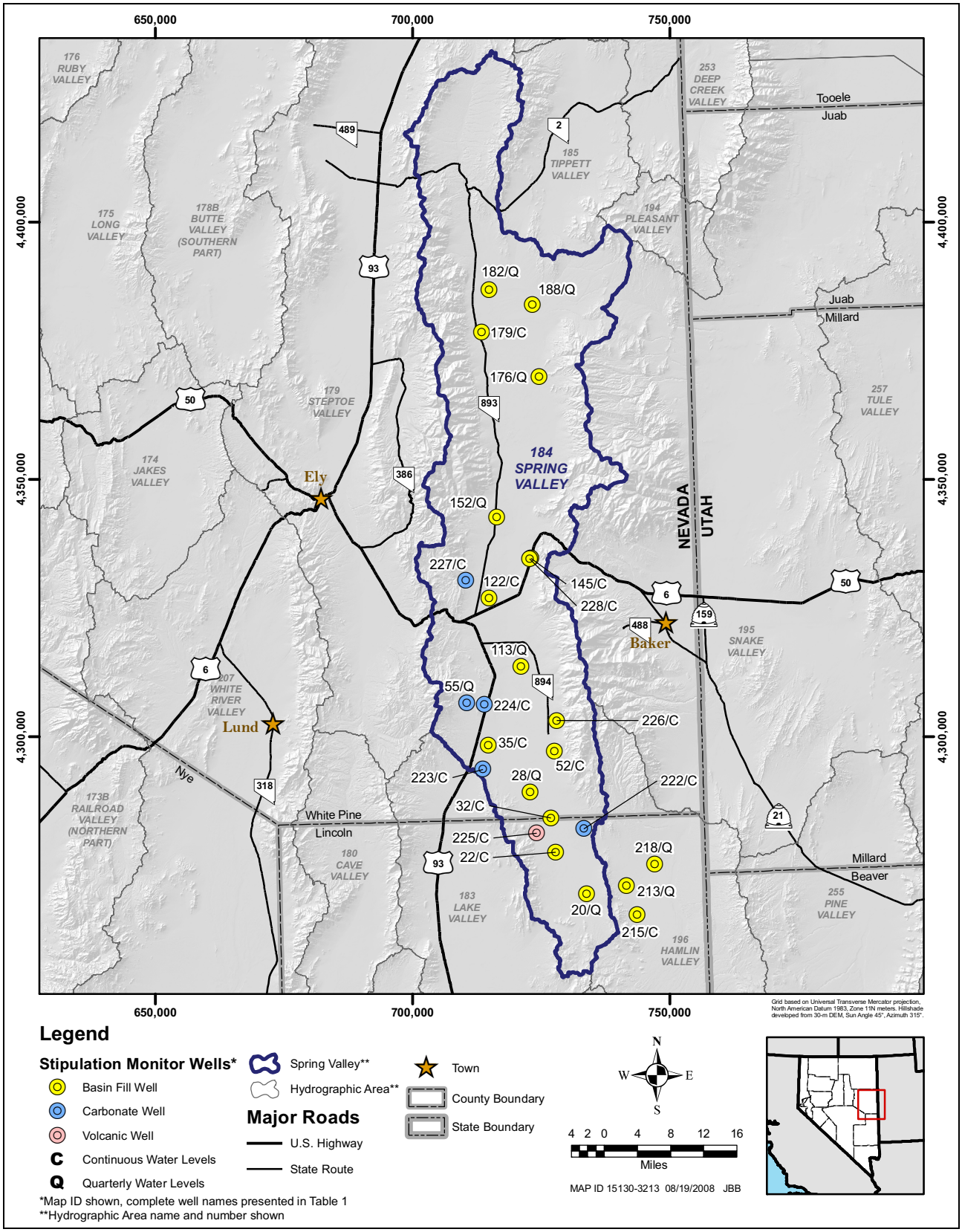

Figure 2
Existing Well Network Locations

Table 1
Existing Well Network Locations

Map ID	HA	Station Local Number	Site Number Common Name	Location		NDWR Log Number	Completion Date	Estimated Surface Elevation (ft amsl)	Drill Depth (ft bgs)	Well Depth (ft bgs)	Well Diameter (in.)	Perforated Interval (ft bgs)	Gravel Pack (Open) Interval (ft bgs)	Date of First DTW Meas.	Date of Last DTW Meas.	Last DTW Meas. (ft bgs)	Aquifer	Monitor Frequency
				UTM Northing (m)	UTM Easting (m)													
22	184	184 N09 E68 30AAAB1	383704114225001 USGS-MX (Spring Valley S.)	4,277,594	727,759	22176	8/7/1980	6,003	700	679	11	559 to 679	50 to 700	8/7/1980	7/9/2008	225	Basin Fill	Continuous
32	184	184 N10 E68 31CD 1	384039114232701 USGS-MX	4,284,275	726,871	--	--	5,913	--	150	2	--	50 to 150	7/1/1980	7/9/2008	119	Basin Fill	Continuous
35	184	184 N11 E66 23AB 1	384831114314301 USGS-MX	4,298,411	714,632	--	--	5,843	102	102	2	--	50 to 102	7/1/1980	7/9/2008	47	Basin Fill	Continuous
52	184	184 N11 E68 19DCDC1	384745114224401 USGS-MX (Spring Valley)	4,297,305	727,553	--	--	5,899	200	200	2	--	50 to 200	1/1/1981	7/9/2008	98	Basin Fill	Continuous
122	184	184 N14 E66 24BDDD1	390352114305401 USGS-MX (Spring Valley N.)	4,326,895	714,873	--	--	5,840	--	160	2	--	50 to 160	1/1/1981	5/29/2008	39	Basin Fill	Continuous
145	184	184 N15 E67 26CA 1	390803114251001 USGS-MX	4,334,741	722,962	--	--	5,719	--	200	2	--	50 to 200	1/1/1981	7/8/2008	41	Basin Fill	Continuous
179	184	184 N19 E66 11B 1	393211114320701	4,378,628	713,379	--	4/22/1960	5,762	--	400	--	--	50 to 400	4/22/1960	7/8/2008	42	Basin Fill	Continuous
215	196	196 N08 E69 35DC 2	383023114115302 USGS-MX (Hamlin Valley S.)	4,265,403	743,597	--	8/7/1980	5,779	435	435	2	--	50 to 435	8/7/1980	5/29/2008	173	Basin Fill	Continuous
222	184	184 N09 E68 11 BD 2	184W502M	4,282,117	733,293	102843	1/24/2007	6,188	1,828	1,800	8	495 to 1,779	60 to 1,828	1/24/2007	7/9/2008	481	Carbonate	Continuous
223	184	184 N11 E66 34 DD 2	184W504M	4,293,713	713,647	102158	11/18/2006	5,919	1,040	1,020	8	309 to 999	58 to 1,040	11/20/2006	7/9/2008	100	Carbonate	Continuous
224	184	184 N12 E66 26 BA 2	184W506M	4,306,214	713,939	102132	10/19/2006	6,002	1,160	1,140	8	427 to 1,120	80 to 1,160	10/19/2006	7/9/2008	215	Carbonate	Continuous
225	184	184 N09 E67 11 DB 1	184W508M	4,281,309	724,070	102139	12/19/2006	6,055	1,180	1,160	8	376 to 1,139	237 to 1,180	12/19/2006	7/9/2008	277	Volcanic	Continuous
226	184	184 N11 E68 05 BC 2	SPR7007M	4,303,143	727,972	--	8/18/2007	6,070	1,040	1,020	8	300 to 1,000	112 to 1,040	8/18/2007	7/8/2008	152	Basin Fill	Continuous
227	184	184 N14 E66 09 AB 2	SPR7005M	4,330,472	710,370	--	7/11/2007	6,397	1,412	1,406	8	665 to 1,385	452 to 1,412	9/6/2007	5/30/2008	492	Carbonate	Continuous
228	184	184 N15 E67 26 CD 2	SPR7008M	4,334,638	722,753	--	7/25/2007	5,740	960	946	8	226 to 946	69 to 960	9/6/2007	7/8/2008	14	Basin Fill	Continuous
20	184	184 N08 E68 14A 1 USBLM	383351114180201	4,269,505	733,844	--	--	6,182	--	495	6	50 to 495	50 to 495	7/15/1964	7/9/2008	407	Basin Fill	Quarterly
28	184	184 N10 E67 22AA 1	384310114261401 USGS-MX (Spring V Central)	4,289,331	722,826	--	--	5,857	--	100	2	--	50 to 100	7/1/1980	7/9/2008	65	Basin Fill	Quarterly
55	184	184 N12 E66 21CD 1	184 N12 E66 21CD 1	4,306,564	710,561	10440	9/13/1966	6,397	631	631	6	3 to 631	3 to 631	9/13/1966	7/9/2008	569	Carbonate	Quarterly
113	184	184 N13 E67 33DDA 1	385636114265501	4,313,592	721,084	--	--	5,770	--	--	36	--	--	6/1/1980	7/8/2008	7.7	Basin Fill	Quarterly
152[a]	184	184 N16 E66 36DBAD1	391224114293601 USBLM - Cleve Creek Well	4,342,684	716,360	--	--	5,862	--	--	--	--	--	3/7/1990	5/29/2008	208	Basin Fill	Quarterly
176	184	184 N18 E67 01CCAA1	392703114230501	4,369,958	724,523	--	--	5,591	45	42	38	--	--	7/16/1964	7/8/2008	35	Basin Fill	Quarterly
182	184	184 N20 E66 13AB 1	184 N20 E66 13AB 1	4,386,884	714,869	9157	6/26/1966	5,771	907	296	16	135 to 296	--	6/15/1966	7/8/2008	128	Basin Fill	Quarterly
188	184	184 N20 E67 26ABBD1	393442114231801 USBLM	4,383,957	723,237	--	--	5,709	--	130	6	--	50 to 130	6/21/1950	7/8/2008	118	Basin Fill	Quarterly
213	196	196 N08 E69 15B 1	383325114134901	4,271,102	741,541	--	--	5,732	--	110	6	--	50 to 110	7/15/1964	5/29/2008	70	Basin Fill	Quarterly
218	196	196 N08 E70 06B 1	383533114102901 USBLM - Monument Well	4,275,166	747,014	548	7/22/1947	5,674	--	164	6	111 to 115/ 152 to 164	--	7/22/1947	5/29/2008	90	Basin Fill	Quarterly

[a]The Cleve Creek well will be replaced by a new monitor well approximately 1 mile to the north.
-- Information not available
Coordinates and elevations are approximate and will be updated based upon professional survey results.
Well construction data is based upon best available information from well logs, MX Project Report and direct field measurements.
Data will be field verified during program implementation.
Map identification numbers relate to Table D.1-1 in SNWA (2006d).

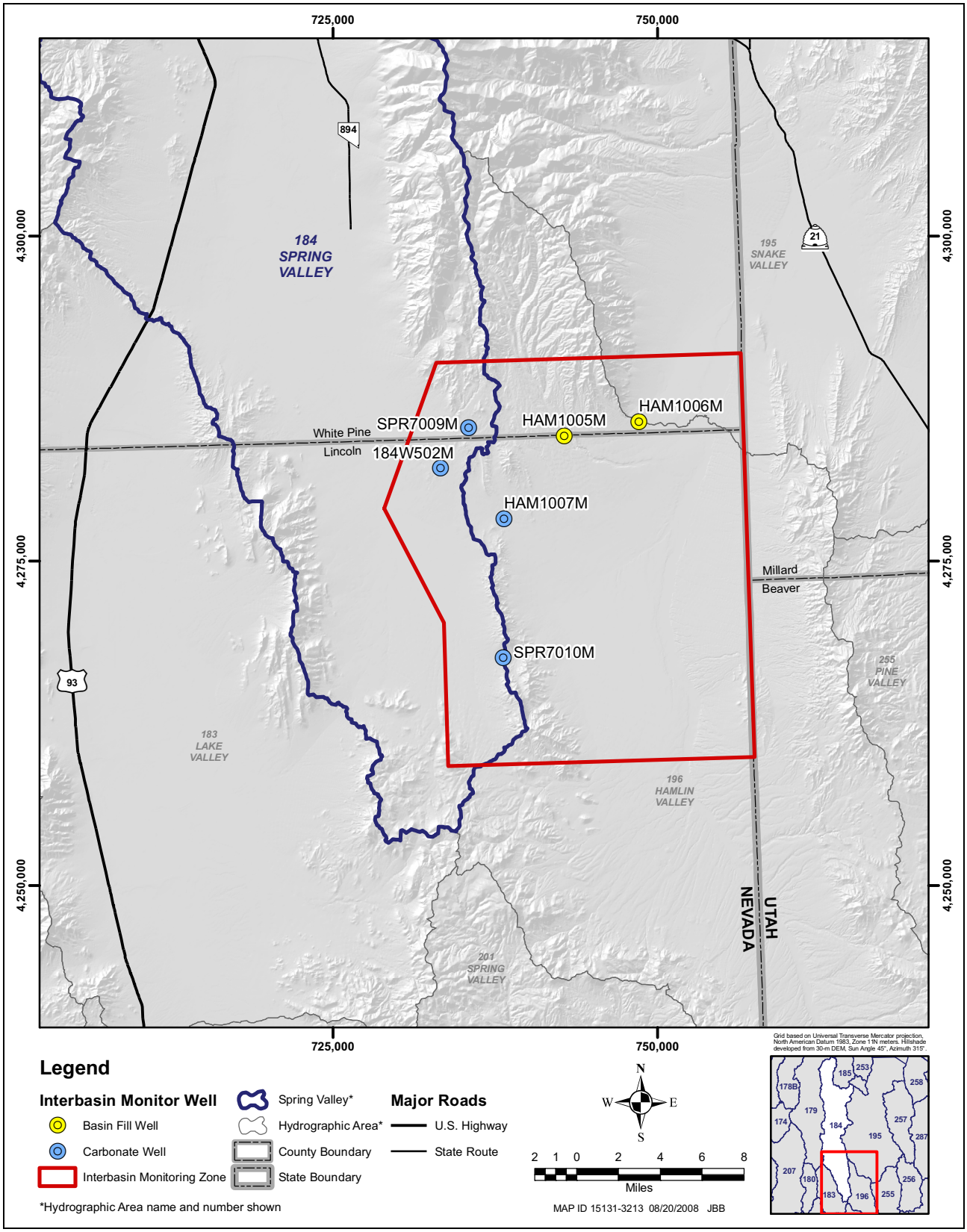

Figure 3
SNWA Interbasin Monitoring Zone Well Locations

Table 2
SNWA Interbasin Monitoring Zone Well Locations

Site Number	Well Alias Name	Well Common Name	Location		Estimated Surface Elevation (ft amsl)
			UTM Northing (m)	UTM Easting (m)	
Basin Fill					
196 N10 E69 02 BBA 1	HAM1005M	Wash Alluvial Well	4,284,588	742,819	6,397
196 N95 E70 32 AAD 1	HAM1006M	Big Springs Well	4,285,699	748,554	5,797
Carbonate					
184 N10 E68 36 ACC 1	SPR7009M	North Carbonate Well	4,285,242	735,445	6,494
196 N09 E69 20 BCB 1	HAM1007M	Troughs Carbonate Well	4,279,203	737,774	6,025
184 N08 E69 29 CBB 1	SPR7010M	Limestone Hills Well	4,267,545	738,113	6,458
184 N09 E68 11 BD 2	184W502M[a]	184W502M	4,282,117	733,293	6,188

[a]Existing Well
Coordinates and elevations are approximate and will be updated based upon professional survey of well location.

the six monitoring wells within the Zone or ten years from the date of the execution of the Stipulation, whichever is shorter.

3.2.2.2 New Monitor Wells between the Zone and the nearest SNWA Production Wells

SNWA, in consultation with the TRP, is required to install and equip two new monitor wells between the Zone and the two future SNWA production wells that are constructed closest to the Zone boundary. Proposed locations of the two new monitor wells are presented on Figure 4. Monitor wells SPR7025M and SPR7026M are proposed for completion in basin-fill and carbonate aquifers, respectively. Completion depths for the two locations are estimated between approximately 1,180 and 1,530 ft bgs, respectively. The final completion depth will be dependent upon hydrogeologic conditions encountered during drilling and will correspond to the completion depths of the nearest SNWA production wells. The TRP is currently reviewing the locations and design of the monitor wells. Near-zone monitor well locations, design, and installation schedule has not been finalized and is dependent upon TRP approval.

Continuous water-level measurements will be recorded at the two near-Zone wells. To ensure baseline aquifer conditions are established, SNWA will strive to construct the wells, install monitoring equipment, and provide access to the wells at least two years prior to any groundwater withdrawals other than those required for aquifer testing and construction water.

3.2.2.3 New Monitor Wells in the Vicinity of Shoshone Ponds

SNWA, in consultation with the TRP, will construct and equip two monitor wells in the vicinity of Shoshone Ponds. Section 2DIII of the SV3M Plan requires that two monitor wells be constructed

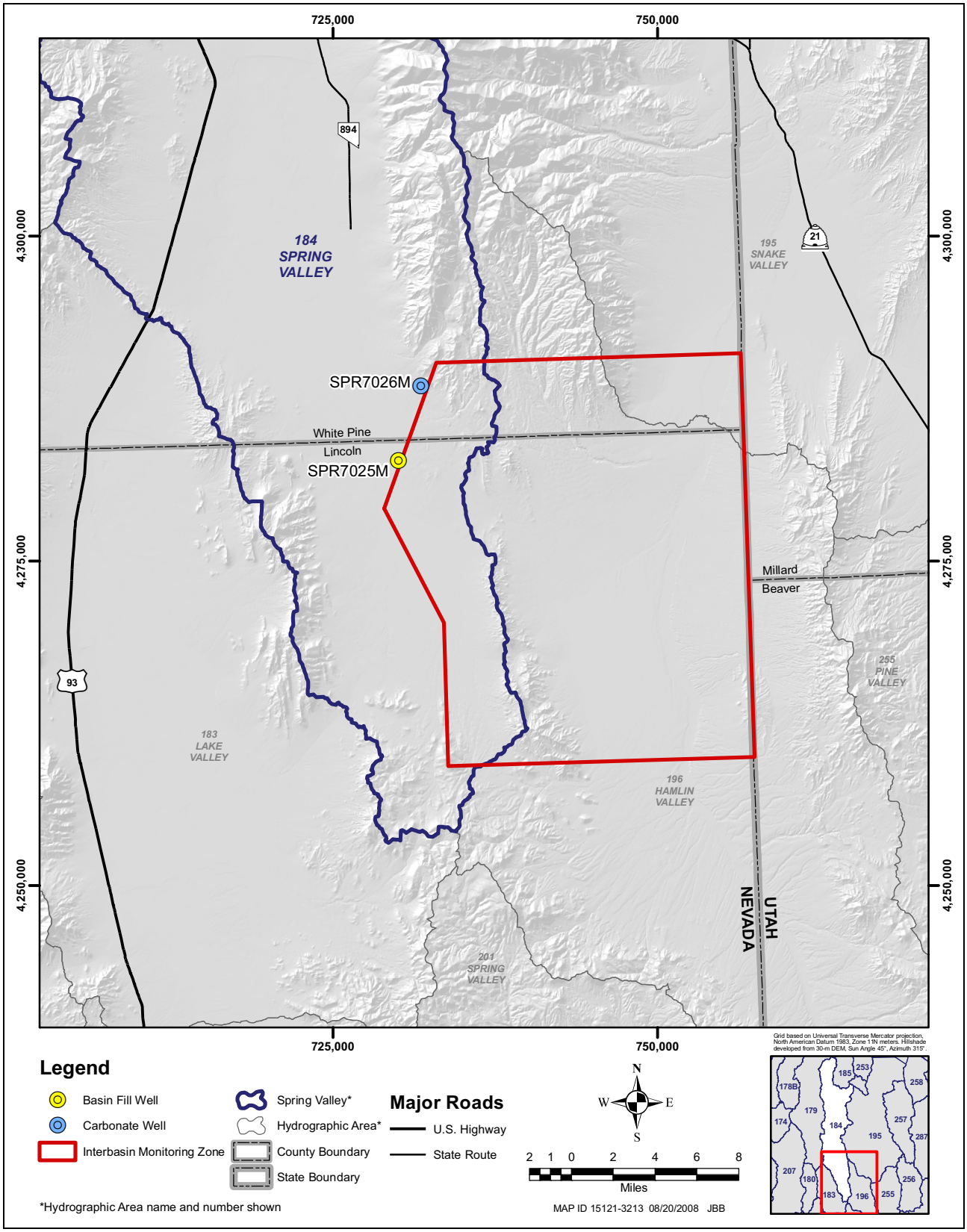

Figure 4
Proposed Near-Zone Monitor Well Locations in Spring Valley

between Shoshone Ponds and the nearest production well locations. Two 4-in. diameter monitor wells are planned for completion in the basin-fill aquifer located approximately 0.7 mi south-southeast of Shoshone Ponds. This location is between Shoshone Ponds and the closest anticipated SNWA production well location. The well locations have been selected and approved by the TRP. The wells were originally located 0.4 miles south-southeast of Shoshone Ponds. However, the wells were relocated due to the recent establishment of an Area of Critical Environmental Concern in the Shoshone Ponds area. The wells are estimated to be completed at approximately 300 and 700 ft bgs. Final completion depths will be dependent upon hydrogeologic conditions encountered during drilling. The two locations, SPR7024M and SPR7024M2, are presented on Figure 5. SNWA will continuously monitor the water levels in the two wells.

Right-of-way process applications including NEPA compliance for the two well locations were submitted to the BLM for approval on July 3, 2008. The estimated time frame for well completion is Fall 2009, dependent upon BLM approval.

SNWA will not withdraw any quantity of groundwater for beneficial use, in accordance with any permit issued pursuant to SNWA Application No. 54019, for a period of three years from the completion of the last of these two monitor wells or four years from the issuance of the permit for the SNWA carbonate-rock aquifer production well constructed closest to the Shoshone Ponds.

3.2.3 Exploratory and Production Well Monitoring

SNWA will record groundwater production and water-level data at all future operational SNWA production wells on a continuous basis. SNWA will record water levels in all existing and future SNWA exploratory wells at least quarterly. Following the beginning of groundwater production pursuant to any SNWA permits, the TRP will select a representative number of exploratory wells for which SNWA will continuously record water levels.

As of August 2008, SNWA has installed eight 8-in. diameter exploratory and six 20-in. diameter test wells. Locations of the wells are presented on Figure 6. Seven of the eight 8-in. wells are being monitored as part of the SV3M Plan. Well construction, aquifer testing and groundwater chemistry data for the exploratory and test wells are presented in *Spring Valley Stipulation Agreement Hydrologic Monitoring Plan Status and Data Report* (2008).

3.3 Aquifer Characterization

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

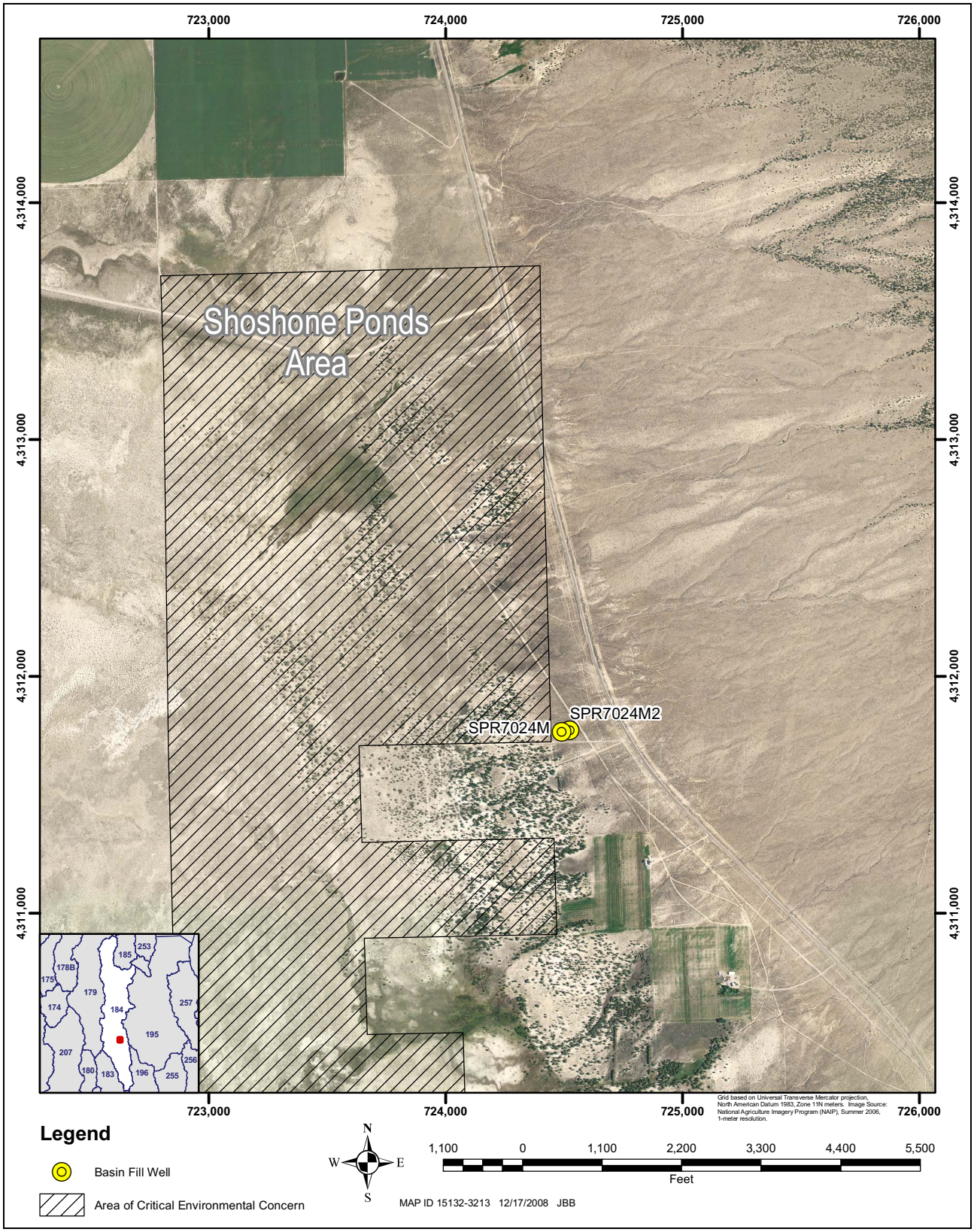

Figure 5
Location of Monitor Wells near Shoshone Ponds

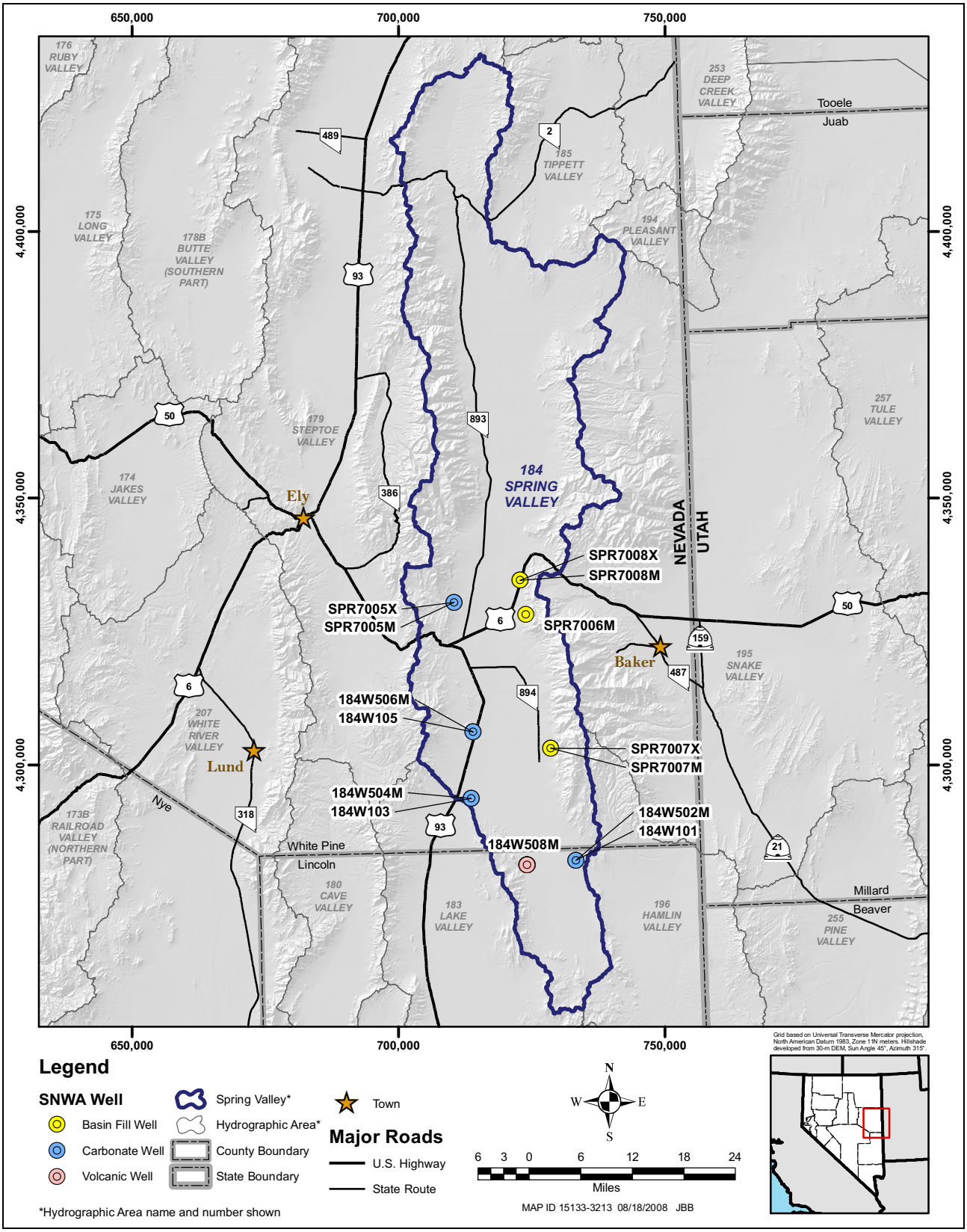

Figure 6
SNWA Exploratory and Test Wells in Spring Valley (as of August 2008)

Well performance step tests and 72- to 120-hour constant-rate tests have been performed on the six SNWA test wells. These locations (184W101, 184W103, 184W105, SPR7005X, SPR7007X, and SPR7008X) are presented on Figure 6. A Hydrologic Analysis Report, including hydrologic data, test analysis, and water chemistry results, is currently being prepared for each test well location. Similar testing may also be performed on selected future test wells. A Geologic Analysis Report, presenting drilling and downhole geophysical data, lithologic descriptions, and structural evaluation, is also being prepared for each location. These reports will be provided to the NSE and summarized in the Annual Data Report.

In addition, as required by the SV3M Plan, one constant-rate aquifer test will be performed by pumping the SNWA basin-fill aquifer production well located closest to the boundary between the Spring Valley and Hamlin Valley HAs. Similarly, one constant-rate aquifer test will be performed by pumping the SNWA carbonate production well located closest to the boundary between the Spring Valley and the Hamlin Valley HAs. In the event that SNWA constructs a production well at the point of diversion specified in Application No. 54019, SNWA will perform one constant-rate aquifer test to address parameters determined by the TRP.

3.4 Spring and Stream Monitoring

3.4.1 Spring and Associated Piezometer Monitoring

The TRP and SNWA agreed upon 13 locations to be included in the spring monitoring program. These springs are listed in Table 3 and presented on Figure 7. Piezometers are planned for installation, if technically practical, at 12 locations to provide baseline water-level data associated with each of the springs. Spring discharge data will be collected, if possible, during site visits at locations where measurements can be correlated to piezometer water levels. At one location, Rock Spring, discharge is planned to be measured continuously. At this site, a piezometer will not be installed because of the hydrogeologic conditions.

The sites were determined by the TRP, in coordination with BWG. The sites were selected to provide a geographic distribution across the valley and include both valley floor, range front, and mountain block springs. The sites also include basin-fill and carbonate locations. SNWA will continuously monitor the water level in each piezometer using a pressure transducer and data logger. SNWA will strive to construct the piezometers, install monitoring equipment, and provide access for sampling the groundwater, at least two years prior to the withdrawal of any groundwater permitted by the NSE other than that needed for aquifer tests and well construction.

Right-of-way process applications including NEPA compliance for the spring locations were submitted to the BLM for approval on October 9, 2007. The estimated time frame for piezometer completion is early 2009.

3.4.2 Stream Discharge Measurements

SNWA will directly, or indirectly through funding by a mutually agreed-upon third party, operate and maintain stream gages on Cleve Creek and Big Springs and report such measurements over the

Table 3
Spring Monitoring Locations

Spring Name	Location		Geology
	UTM Northing (m)	UTM Easting (m)	
4WD Spring	4,335,263	716,235	Alluvium/Fan Margin
Blind Spring	4,298,008	724,733	Alluvium/Valley Floor
Keegan Spring	4,369,762	714,908	Alluvium/Fan Margin
Layton Spring	4,331,746	720,069	Alluvium/Valley Floor
Minerva Spring	4,301,007	726,143	Alluvium/Fan Margin
Rock Spring (discharge only)	4,340,195	726,796	Carbonate/Mountain Block
South Millick Spring	4,353,608	725,148	Alluvium/Valley Floor
Stonehouse Spring	4,406,492	710,547	Alluvium/Valley Floor
Swallow Spring	4,302,902	728,648	Alluvium/Range Front
The Seep	4,306,264	724,091	Alluvium/Valley Floor
West Spring Valley Complex 1	4,353,816	717,270	Alluvium/Fan Margin
Willow Spring	4,397,093	713,757	Alluvium/Valley Floor
Unnamed 5 Spring	4,340,632	718,890	Alluvium/Valley Floor

Coordinates are approximate and will be updated upon installation of piezometer.

Internet via the U.S. Geological Survey (USGS) National Water Information System or other appropriate website(s) throughout the duration of the Monitoring Plan. Stream measurement locations and recent discharge measurements are listed in Table 4 and presented on Figure 8.

3.4.3 Big Springs Synoptic Discharge Measurement Study

Contingent upon private property access, SNWA will collect, or fund the collection of, at least two sets of synoptic-discharge measurements (also known as "gain/loss runs") from the spring orifice to Pruess Lake for the Big Springs Creek surface water system. The Big Springs Study area is presented on Figure 9. These data will be collected during the irrigation and non-irrigation seasons at least one year prior to groundwater production by SNWA, and again during the irrigation and non-irrigation seasons every five years following the start of groundwater production. The TRP will recommend the number of measurement sites during the discharge study. Measurements at each site are planned to include discharge, water temperature, pH, and electrical conductivity. The performance and scope of the study is dependent upon private property access.

SNWA will work with the TRP to collect data to investigate the relationship between discharge at Big Springs and hydraulic head in the basin-fill and regional carbonate-rock aquifers. This investigation includes the installation, equipping, and maintenance of Well HAM1006M located in the immediate vicinity of Big Springs. This well is included as part of the Zone Monitoring Network, Section 3.2.2.1.

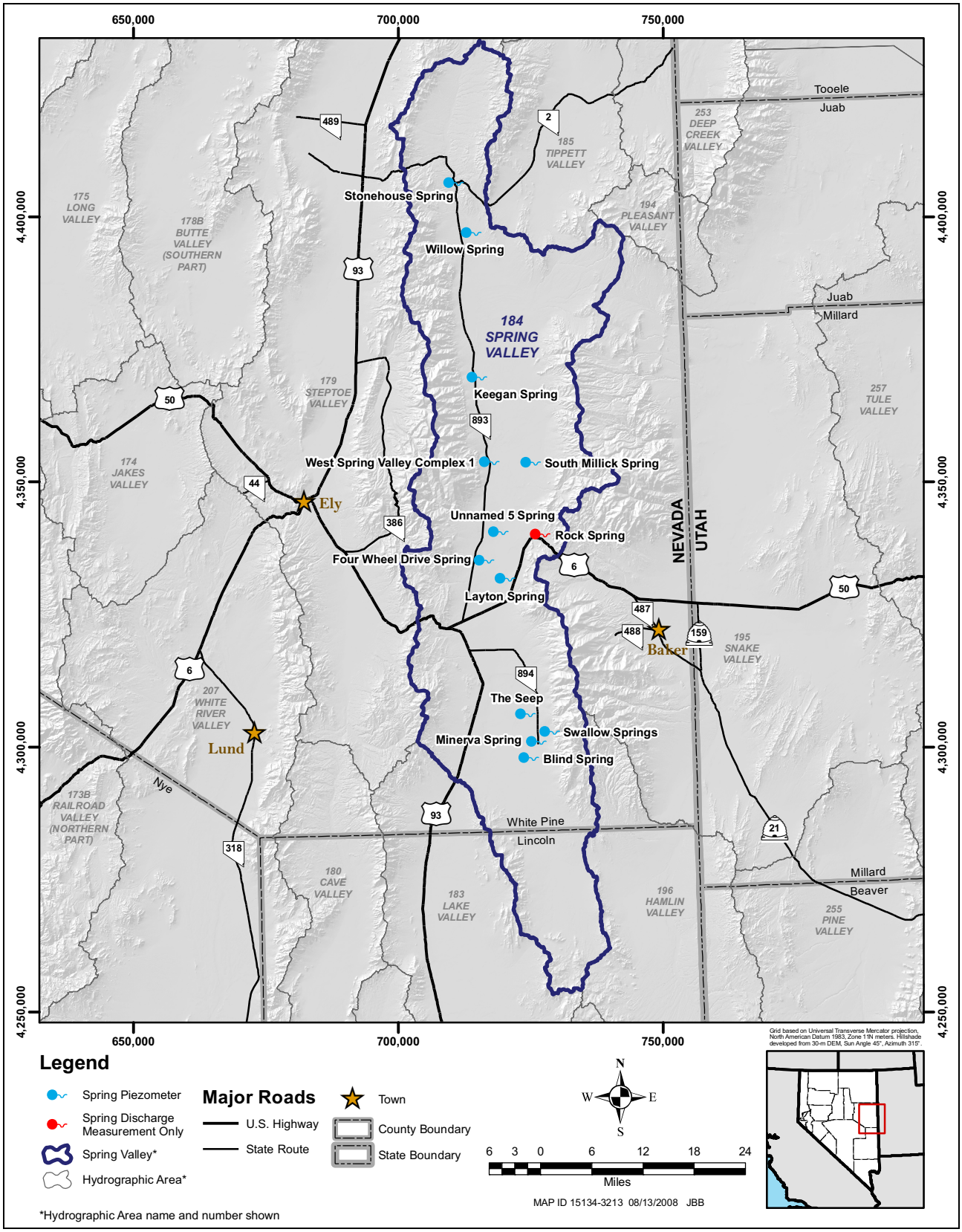

Figure 7
Spring Monitoring Network, Spring Valley

Table 4
Stream Monitoring Locations

Station Number	Station Name	Basin Number	Stream Number	Location		Watershed (mi^2)	Discharge (cfs)	Date
				UTM Northing (m)	UTM Easting (m)			
1841611	Cleve Creek near Ely	184	18416	4,343,423	712,669	32.0	6.62	2/5/2008
1951901	Big Springs at Gaging Station	195	19519	4,287,293	749,422	N/A	10.0	2/11/2008

3.5 Precipitation Stations

Three high-altitude precipitation stations in Spring Valley are operated by USGS through a joint funding agreement with SNWA. SNWA operates one long-term valley floor station named Shoshone 5N, located on the eastside of the valley at the Bransford Ranch. SNWA is also working with the National Weather Service to establish an additional valley floor station located at the Robison Ranch in northwest Spring Valley. The stations are listed in Table 5 and presented on Figure 10.

3.6 Water Chemistry Baseline Data Monitoring Program

Monitoring of groundwater and surface water chemistry will be implemented to establish baseline conditions. The sampling program will consist of the collection of 40 samples from representative springs, streams, and monitor wells determined by the TRP. Three sampling events will be performed at 6-month intervals to provide baseline data. SNWA will collect and analyze water chemistry for the parameters listed in Table 6.

Subsequent sampling will be performed once every five years following the start of groundwater production by SNWA. In consultation with the BWG, the TRP may change any aspect of this water chemistry sampling program, including, but not limited to, the addition and/or deletion of sampling sites, the addition and/or deletion of water-chemistry parameters, and an increase or decrease in sampling frequency. SNWA may subcontract this obligation to a third party, if approved by the TRP.

3.7 Existing Water-Rights Monitoring

The SV3M Plan, which establishes an extensive monitoring network, will provide a means to document baseline and long-term hydrologic conditions in order to identify and quantify potential effects of SNWA pumping on Federal resources. Additional monitoring associated with existing water-rights holders are included in the NSE Monitoring Plan.

Additional monitoring activities will be performed at three areas: (1) groundwater and spring discharge monitoring will be performed in the vicinity of Cleveland Ranch owned by The Church of Jesus Christ of Latter-Day Saints; (2) spring discharge measurements will be collected at Turnley Spring located at Sacramento Pass; and (3) an additional deep basin-fill or carbonate monitor well

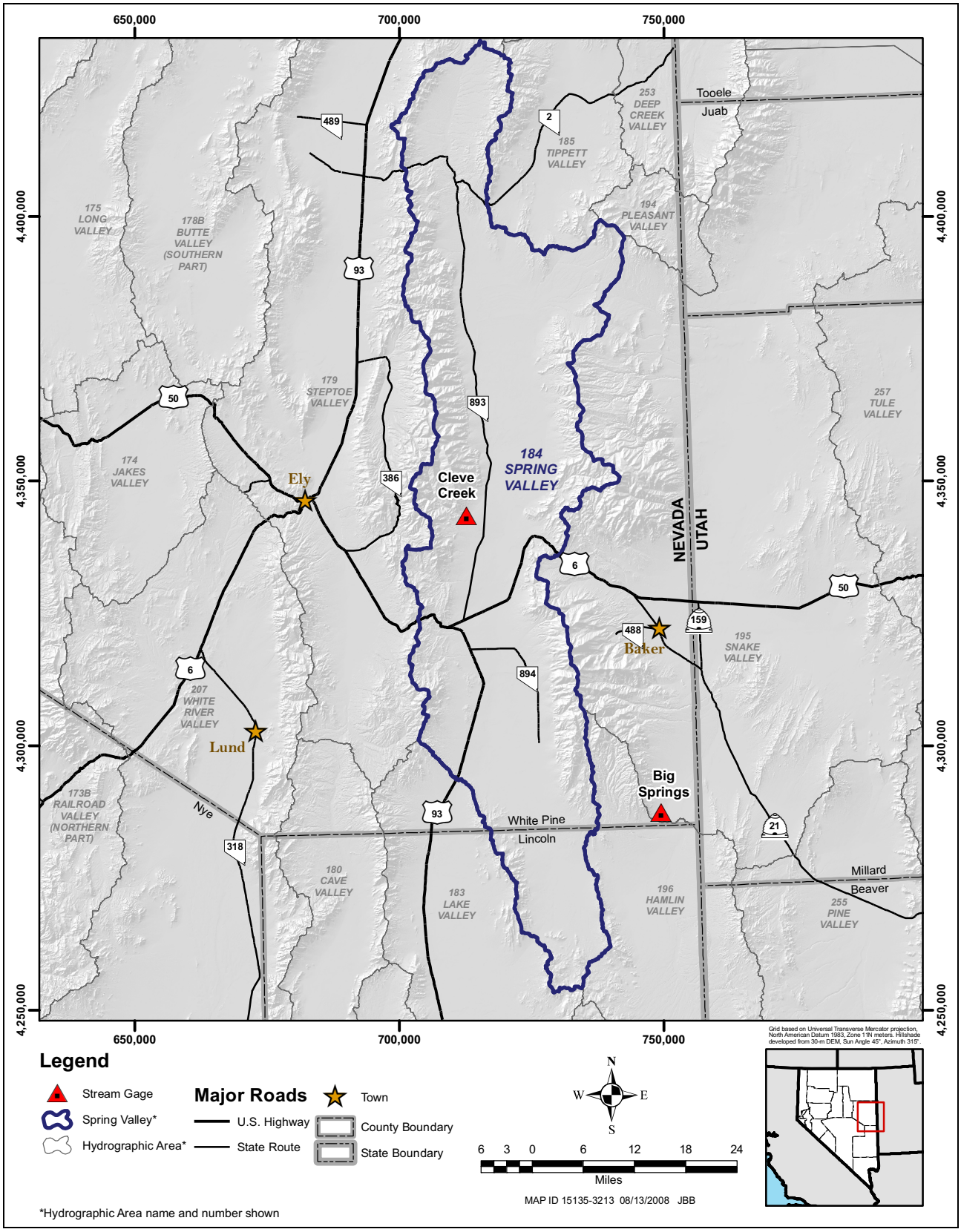

Figure 8
Cleve Creek and Big Springs Discharge Gaging Stations

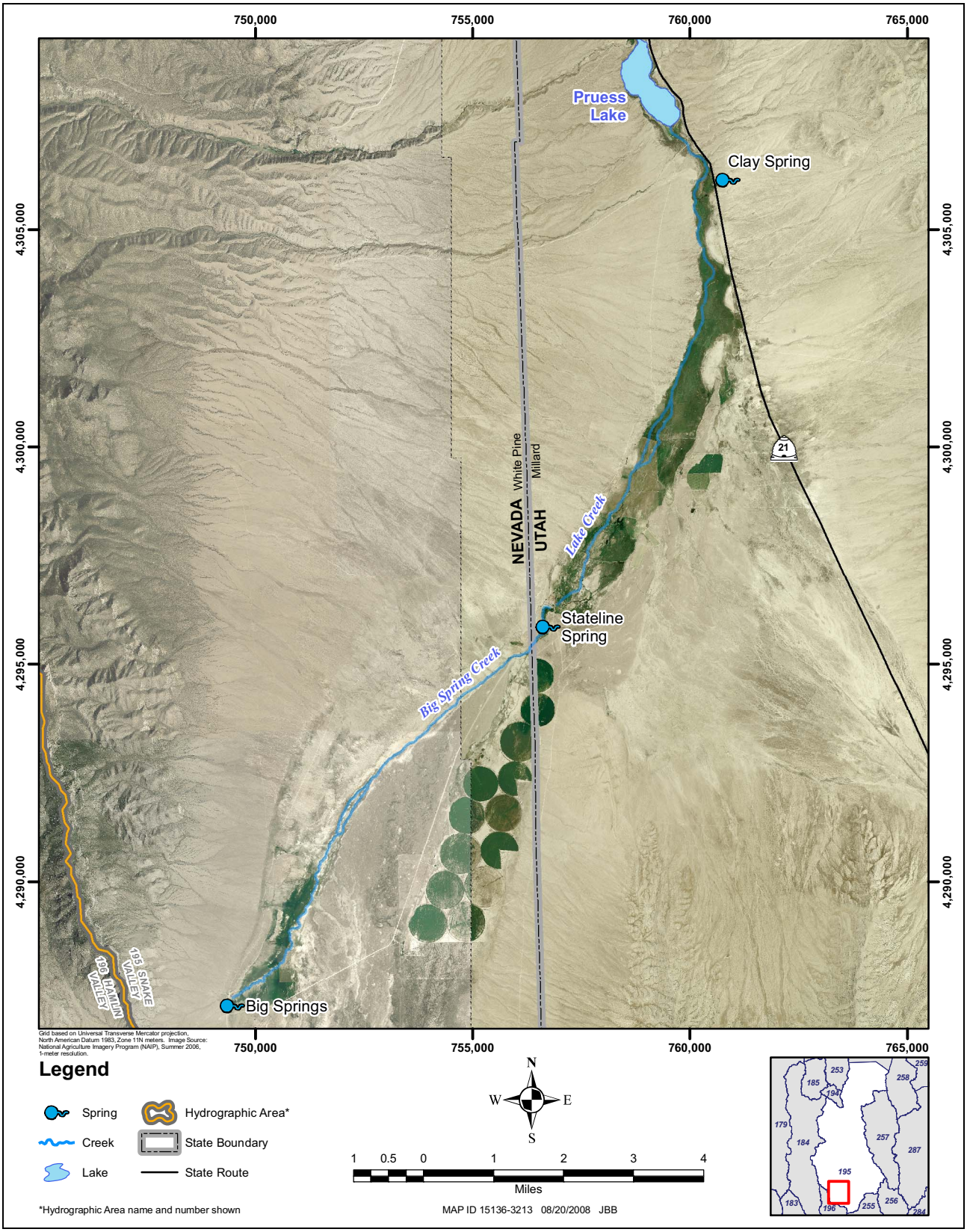

Figure 9
Big Springs Synoptic Discharge Measurement Study Area, Snake Valley

Table 5
Precipitation Station Locations

USGS Site Number	Station Name	Altitude (ft amsl)	Location	
			UTM Northing (m)	UTM Easting (m)
391913114143101	Bulk Precipitation Station NW of Mt. Moriah	9,300	4,355,938	737,691
390946114364901	Bulk Precipitation Station on Cave Mountain	10,650	4,337,545	706,106
385409114185401	Mt. Washington Bulk Precipitation Station	10,440	4,309,376	732,764
--	Shoshone 5N	5,930	4,310,746	725,419
--	Robison Ranch	5,695	4,378,103	713,347

will be completed approximately one mile north of the northern-most production well on the east side of the valley. The location of the Cleveland Ranch and Turnley Spring are presented on Figure 11.

Monitoring locations in the vicinity of Cleveland Ranch are presented on Figure 12 and will consist of the following elements:

- Eliminate the Cleve Creek well (site #391224114293601) from the current SV3M Plan. Approximately one mile north of the Cleve well, on SNWA-approved BLM right of way, advance a borehole and install a monitor well to a depth that intersects the surficial water table. Install a separate monitor well approximately 200 ft deeper than the adjacent shallow well. The goal of nesting the wells is to determine and monitor changes to the vertical hydraulic gradient. Replacement of the Cleve well will provide improved well integrity and documentation of site lithology and hydrogeologic conditions.

- Drill two boreholes and complete nested shallow and deep monitor wells near the springs in the southeast part of Section 29, T16N, R67E. The shallow well will be completed to intersect the surficial water table. The deeper well will be screened in a permeable horizon approximately 100 to 200 ft below the shallow well open interval. A device to gage the discharge of the main spring will be installed at this location if practical. The actual gage and well locations will be determined in consultation with the NSE and a representative from The Church of Jesus Christ of Latter-Day Saints.

- Install a piezometer and a device to gage spring discharge at a significant spring located in the southwest part of Section 20, T16, R67E.

Spring discharge monitoring at Turnley Spring was discussed in a telephone conference call with Rick Felling of the NSE office and Katherine and William Rountree. It was agreed that the spring will be monitored initially on a six-week interval if technically practical and if access to the site by the private property owner is granted. Representatives of SNWA met with the Rountrees on September 8, 2008, and reviewed the spring collection and distribution system. A monitoring procedure and initial six-week monitoring frequency was agreed upon and is currently being performed.

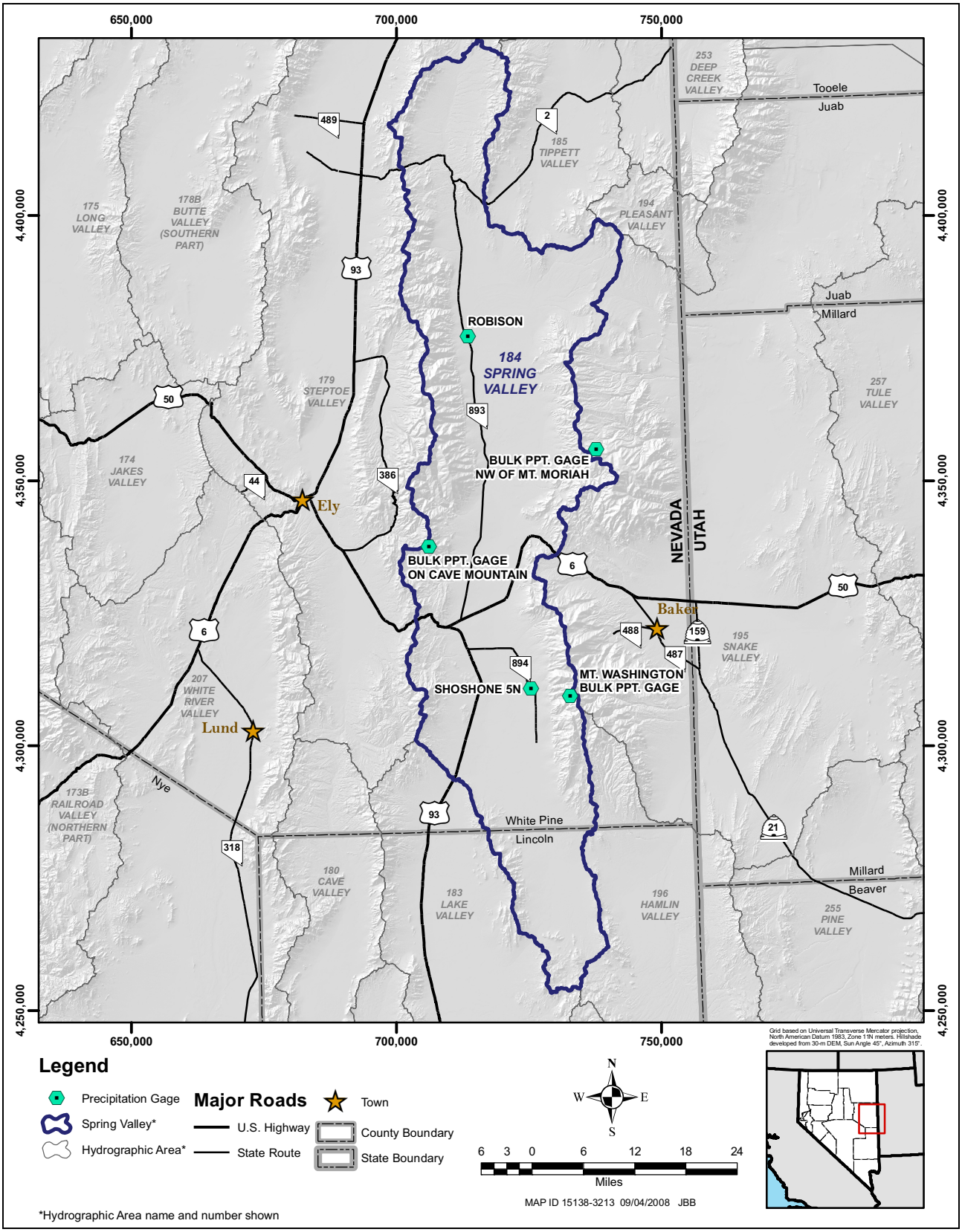

Figure 10
Precipitation Network in Spring Valley

Table 6
Water Chemistry Parameters

Field Parameters	Major Ions	Isotopes	Metals
Water temperature Air temperature pH Electrical conductivity Dissolved oxygen	TDS Calcium Sodium Potassium Chloride Bromide Fluoride Nitrate Phosphate Sulfate Carbonate alkalinity Alkalinity Silica Magnesium	Oxygen-18 Deuterium Tritium Chlorine-36 Carbon-14 Carbon-13	Arsenic Barium Cadmium Chromium Lead Mercury Selenium Silver Manganese Aluminum Iron

One additional monitor well, intended to observe deeper water levels within the basin-fill or carbonate aquifer, will be installed approximately one mile north of the northernmost production well on the east side of the valley. The location has not yet been determined and will be based upon the configuration of production wells at the commencement of water export from the basin.

3.8 Data Collection Methodology and Quality Control Procedures

All data collection and processing will be performed following SNWA procedures, which meet or exceed industry standards. Applicable standards from organizations, such as the American Society for Testing and Materials, the U.S. Environmental Protection Agency, and 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.

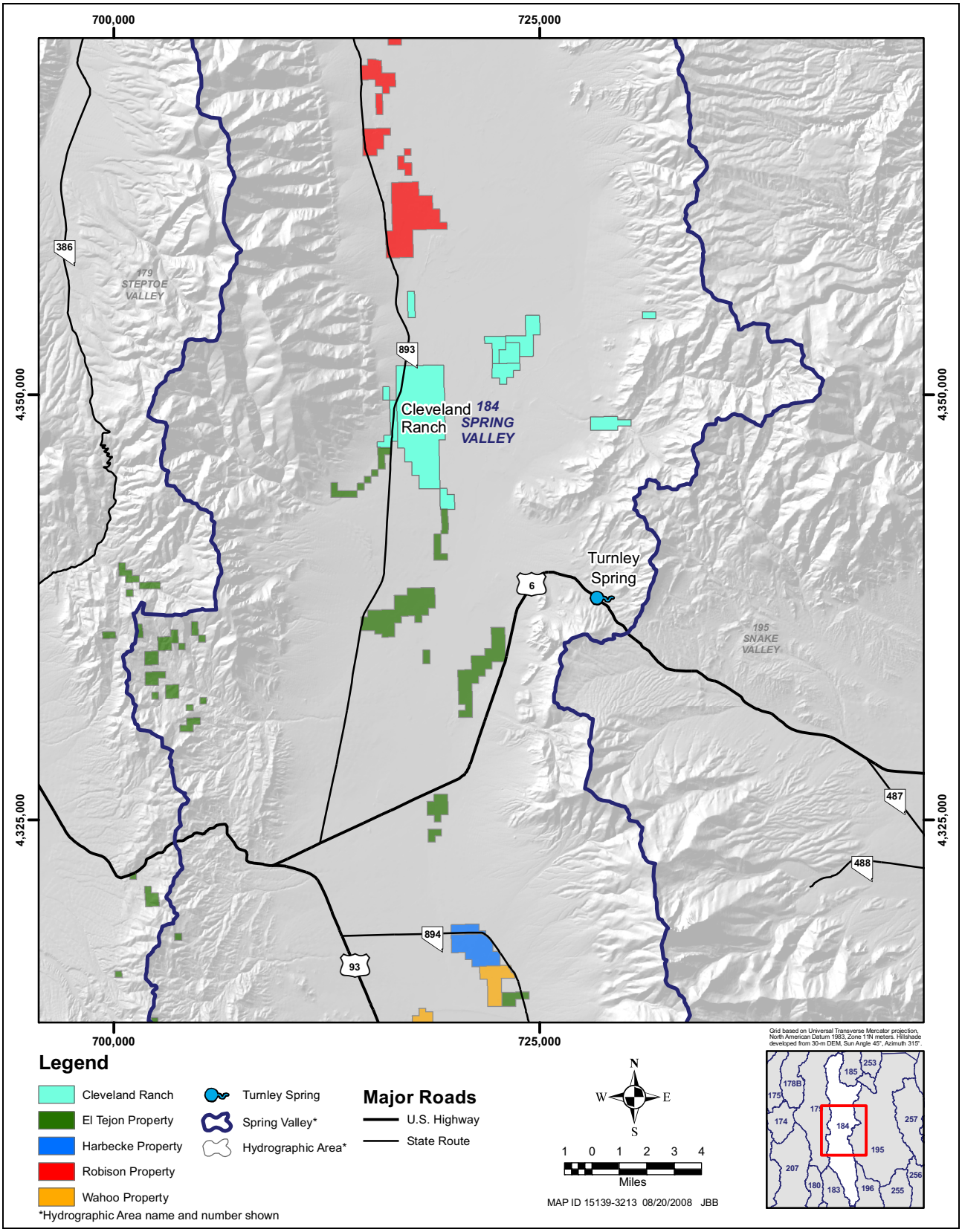

Figure 11
Location of Cleveland Ranch and Turnley Spring

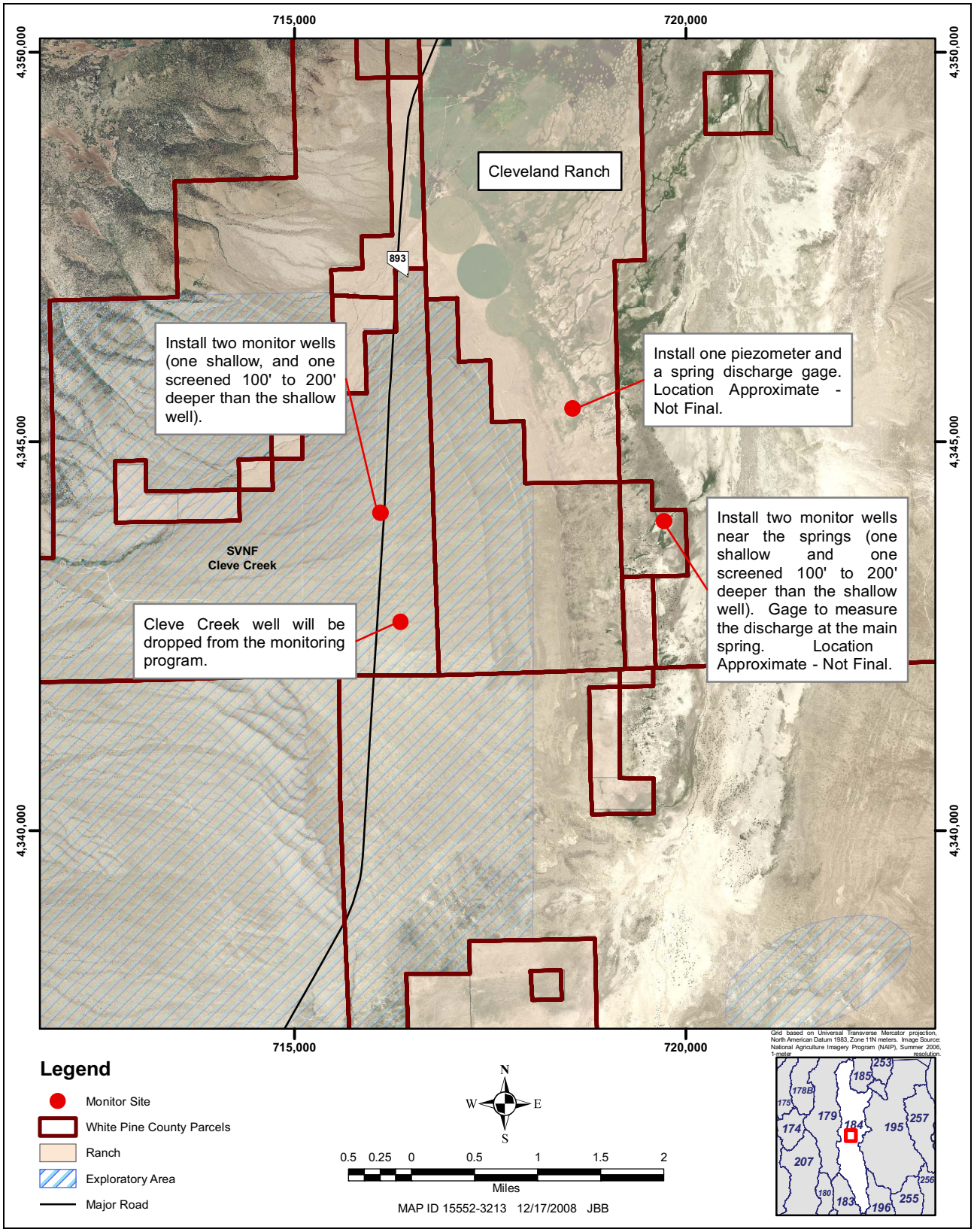

Figure 12
Monitoring Locations Associated with Cleveland Ranch

This Page Intentionally Left Blank

4.0 DATABASE DEVELOPMENT AND REPORTING

4.1 Database Management

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

4.2 Reporting

Using data derived from groundwater level measurements of all production and monitor wells used in this Monitoring Plan, SNWA will produce groundwater contour maps and water-level change maps for both the basin-fill and carbonate-rock aquifers (1) at the end of baseline data collection, and (2) annually thereafter at the end of each year of groundwater withdrawals by SNWA, or at a frequency agreed upon by the TRP, or as required by the NSE.

Water-level and production data will be submitted to the NSE quarterly in electronic format as specified by the NSE. Data will be made available to the TRP representatives within 90 calendar days of collection using a shared data-repository website—www.snwa.com/exchange—which is administered by SNWA. Water chemistry laboratory reports will be made available to the TRP and NSE within 90 calendar days of receipt.

SNWA will report the results of all monitoring and sampling pursuant to this Monitoring Plan in an annual monitoring report submitted to the TRP and the NSE by March 15 of each year that this Monitoring Plan is in effect. The annual monitoring report will include SNWA's proposed schedule of groundwater withdrawals (testing and production) for the immediately succeeding two calendar years. DOI Bureaus may, at their option, provide comments on the report to the NSE.

This Page Intentionally Left Blank

5.0 NUMERICAL MODELING OF REGIONAL GROUNDWATER FLOW

Numerical groundwater modeling will be one component of the adaptive management program developed for the basin-fill and regional carbonate-rock aquifer systems. The Stipulation parties agreed that the Monitoring Plan must include a well-calibrated regional groundwater flow system numerical model. SNWA will develop one model, which will satisfy the requirements of both the Stipulation and Ruling. SNWA will maintain, update, and operate the model, in cooperation with the TRP, and may subcontract this obligation to a third party, if approved by the TRP. The cost of all modeling described herein will be borne by SNWA.

The model results must be qualified based on a comparison of the accuracy of the model and the capability of the model to predict actual conditions. If any effects of SNWA's groundwater production in the Spring Valley HA on groundwater levels and spring flows are measured, refinement and calibration of the model will be necessary to achieve better agreement with the actual field measurements. Furthermore, the collection of additional hydrologic, geologic, geophysical, and/or geochemical data may indicate that modification of the conceptual and numerical model of the regional groundwater flow system is needed.

During the initial staged development period, SNWA will update the groundwater flow model approved by the NSE every five years. At the end of the staged development period, SNWA will submit the updated model with the data obtained during the staged development period and provide predictive results for 10, 25, and 100 years.

The Stipulation parties will share all hydrologic, geologic, geophysical, and geochemical information collected. This data will be evaluated by the TRP for inclusion into the model.

SNWA will provide model output for evaluation by the TRP or Executive Committee 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, unless otherwise recommended by the TRP or required by the NSE.

This Page Intentionally Left Blank

6.0 MANAGEMENT AND MITIGATION ACTIONS

The SV3M Plan, Section 3.E, presents criteria and a process for the TRP to initiate consultation, management, or mitigation actions. The TRP is tasked with reviewing water-level responses and model results to determine if potential injury to Federal Water Rights and/or unreasonable adverse effects to Federal Resources and if any effects on federal resources within the boundaries of Great Basin National Park are occurring or are predicted to occur due to ongoing or proposed groundwater withdrawals by SNWA in Spring Valley.

SNWA shall mitigate any injury to Federal Water Rights and/or unreasonable adverse effects to Federal Resources and/or effects to Federal Resources within the boundaries of Great Basin National Park agreed upon by the Stipulation parties as determined through the process described in Section 3.E.II of the SV3M Plan or after the NSE determines whether there are any such effects due to groundwater withdrawals by SNWA in Spring Valley.

SNWA shall follow the same management and mitigation actions relative to any effects or injury to private water-right holders. Additionally, SNWA will implement management and mitigation actions as required by NSE.

Mitigation measures may include, but are not limited to one or more of the following:

- Geographic redistribution of groundwater withdrawals;
- Reduction or cessation in groundwater withdrawals;
- Provision of consumptive water supply requirements using surface and groundwater sources;
- Augmentation of water supply for federal and existing water rights and federal resources using surface and groundwater sources; and
- Other measures as agreed to by the Stipulation parties and/or required by the NSE.

This Page Intentionally Left Blank

7.0 REFERENCES

Dixon, G.L., Rowley, P.D., Burns, A.G., Watrus, J.M., Donovan, D.J.,and Ekren E.B., 2007, Geology of White Pine and Lincoln counties and adjacent areas, Nevada and Utah—The geologic framework of regional groundwater flow systems: Southern Nevada Water Authority, Las Vegas, Nevada, Doc. No. HAM-ED-0001.

Nevada State Engineer (The Office of the State Engineer of The State of Nevada), 2007, The ruling (#5726) in the matter of applications 54003 through 54021, inclusive, filed to appropriate the underground waters of the Spring Valley hydrographic basin (184), White Pine County, Nevada.

SNWA, see Southern Nevada Water Authority.

Southern Nevada Water Authority, 2006a, Geologic and hydrogeologic framework for the Spring Valley Area—Presentation to the Office of the Nevada State Engineer: Southern Nevada Water Authority, Las Vegas, Nevada, 122 p.

Southern Nevada Water Authority, 2006b, SNWA management plan groundwater development in Spring Valley—Presentation to the Office of the Nevada State Engineer: Southern Nevada Water Authority, Las Vegas, Nevada, 25 p.

Southern Nevada Water Authority, 2006c, Summary of groundwater water-rights and current water uses in Spring Valley—Presentation to the Office of the Nevada State Engineer: Southern Nevada Water Authority, Las Vegas, Nevada, 97 p.

Southern Nevada Water Authority, 2006d, Water resources assessment for Spring Valley—Presentation to the Office of the Nevada State Engineer: Southern Nevada Water Authority, Las Vegas, Nevada, 167 p.

Southern Nevada Water Authority, 2008, Spring Valley stipulation agreement hydrologic monitoring plan status and data report: Doc. No. WRD-ED-0001, Las Vegas, Nevada, 76 p.

Welch, A.H., Bright, D.J., and Knochenmus, L.A., eds., 2007, Water resources of the Basin and Range carbonate-rock aquifer system, White Pine County, Nevada, and adjacent areas in Nevada and Utah: U.S. Geological Survey Scientific Investigations Report 2007-5261, 96 p.

This Page Intentionally Left Blank