Table 4-4
Estimated Average Annual Streamflow for Perennial Streams within Snake Valley

Station Number	Station Name	Average Annual Streamflow
1950101	Indian Farm Creek near Callao, UT	4.24
1950401	Birch Creek above Trout Creek near Trout Creek, UT	4.39
1950701	Smith Creek above Diversion and Trail Head	4.66
1950801	Hampton Creek above Forest Boundary	0.728
1950901	Hendrys Creek at Bridge to Rock Quarry	2.62
1951002	Silver Creek 0.8 miles above Forest Boundary	5.10
1951101	Weaver Creek above Sage Creek	0.383
1951201	Strawberry Creek at National Forest Boundary	1.46
1951508	Snake Creek (Site 8)	9.50
1951605	Big Wash at Hidden Canyon Guest Ranch	1.44
1951701	Lexington Creek at National Forest Boundary	0.226

drained by Pahranagat Wash, then enters Arrow Canyon and finally joins the Muddy River in the Muddy River Springs Area (HA 219). The second drainage area is the Meadow Valley Wash drainage area. This area drains Spring Valley (HA 201), Eagle Valley (HA 202), Dry Valley (HA 198), Panaca Valley (HA 203), Clover Valley (HA 204), and Lower Meadow Valley Wash (HA 205). Below the confluence with Meadow Valley Wash, the Muddy River drains California Wash (HA 218).

The Muddy River is a perennial stream from its source springs near Moapa, Nevada, until completely diverted at Wells Siding by the Moapa Valley Irrigation Company. The flow is steady throughout the year except when affected by floods. While floods are infrequent events on the Muddy River, they can greatly influence annual discharge totals.

Gaging stations have been operated on the Muddy River and its tributaries since the early 1900s. The gaging stations have been described in Volume 2 and their locations are shown on Figure 4-3. Annual discharges for the gaging stations are reported in Appendix B of Volume 2.

4.2 Springs

Springs are found within all of the Project Basins but in greater numbers in Spring and Snake valleys than in Cave, Dry Lake, Delamar, and Coyote Spring valleys. The sections that follow provide a summary of the springs documented in the Project Basins. Additional descriptions and details for these springs as well as additional springs within the larger study area are provided in Volume 3.

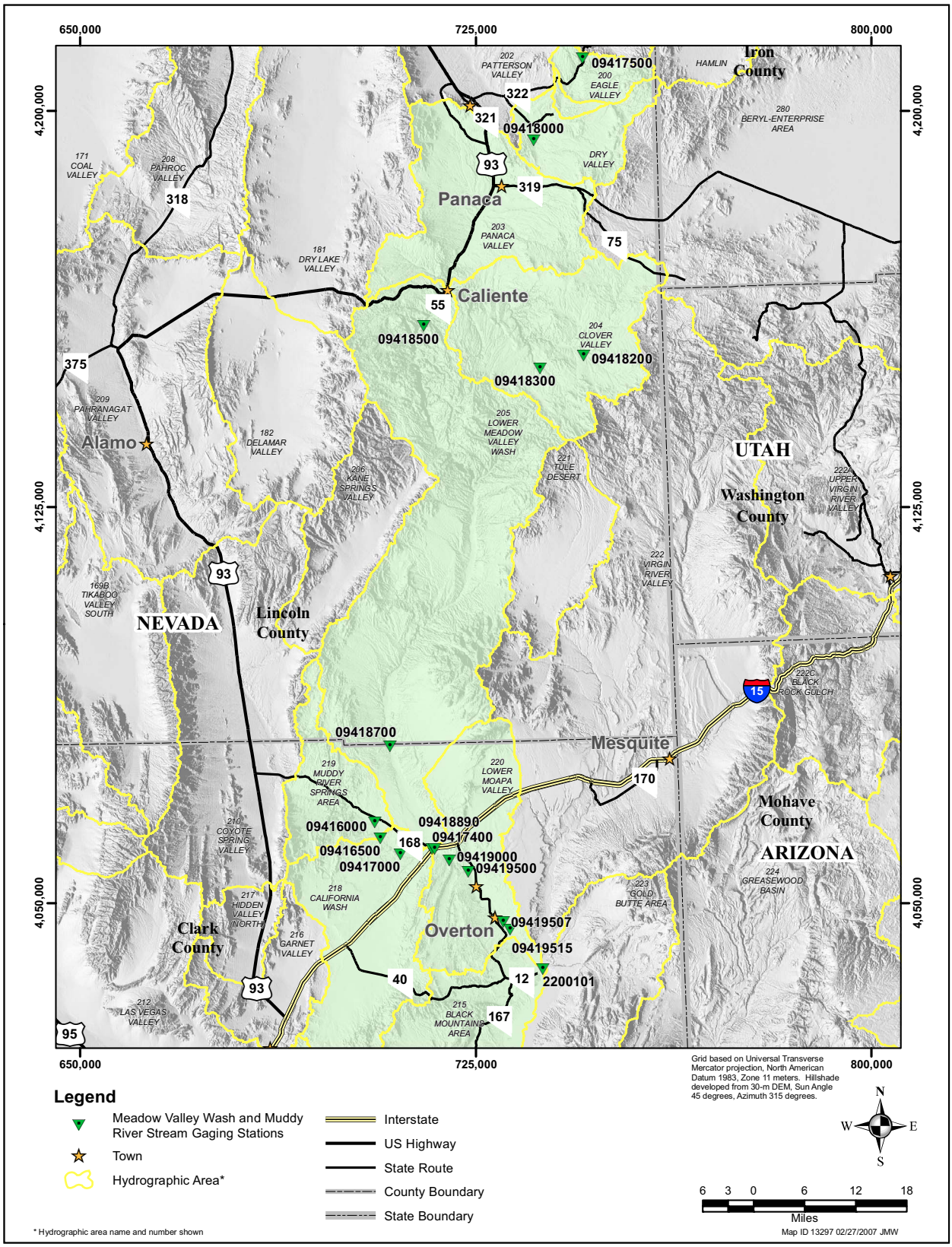

Figure 4-3
Measurement Sites on Muddy River and in Meadow Valley Wash

4.2.1 Classification of Springs

Springs have been classified in many different ways, including discharge, temperature, and the geologic unit from which discharge occurs. In this report, as well as in Volume 3, they are classified by discharge rates, as proposed by Oscar Meinzer in 1923 (Meinzer, 1942), and by temperature.

4.2.1.1 Discharge

Table 4-5 is taken after the system proposed by Oscar Meinzer in 1923 and is used in this report.

Table 4-5
Classification of Spring Size Based on Volume of Discharge

Order of Magnitude	Discharge	
	cfs	gpm
First	>100	> 44,883
Second	10 to 100	4,448 to 44,883
Third	1 to 10	449 to 4,488
Fourth	0.223 to 1	100 to 449
Fifth	0.022 to 0.223	10 to 100
Sixth	0.002 to 0.022	1 to 10
Seventh	0.0003 to 0.002	0.125 to 1
Eighth	< 0.0003	<0.125

after Meinzer, 1942

4.2.1.2 Temperature

Defining what constitutes a “thermal spring” versus warm and cold springs is arbitrary at best. It is a general practice to use the mean annual air temperature (MAT) at the location of the spring as a baseline from which to compare the temperature of spring discharge. If the temperature of the spring discharge is warmer than the MAT, a spring is said to be a warm spring. If it is cooler than the MAT, a spring is considered a cold spring. A more accurate temperature classification depends on several variables, including the initial temperature of the recharge water, heating or cooling during near surface movement, heating while moving to greater depths, cooling while returning to shallower depths, and the cooling or heating while mixing with other groundwater (Garside and Schilling, 1979). Table 4-6 lists the temperature classifications used in this report and their stereotypical occurrences.

4.2.2 Project Basin Springs Inventory

This section provides a brief description of the springs located within each of the project basins. The springs were identified by field investigations, database searches, and from 1:24,000 USGS topographic maps. Data sources for the inventoried springs include published reports, published data

Table 4-6
Classification of Springs Based on Physical Temperature

Description	Temperature (°C)	Stereotypical Occurrences
Hot	>32.2	Thermal springs associated with deep circulation
Warm	21.1 to 32.2	Springs in the central part of valleys
Cold	<21.1	Springs near recharge areas in mountain blocks

from the USGS, and field investigations conducted by SWNA. The selection of springs for field investigation was made through a collaborative effort by a team of professional hydrologists and geologists who have numerous years of experience in the project area. A list of criteria were developed by the team and considered the following:

- Aerial distribution
- Discharge
- Lithologic setting

Springs were chosen to represent each hydrographic basin in both aerial extent and elevation. This was difficult to achieve because spring locations are generally not equally spaced in each valley. Springs of different magnitudes of discharge were considered for inclusion in the data set. The lithologic setting was also considered. Springs in alluvial materials, and different types of consolidated rocks were observed.

Data collection procedures were established to ensure consistent and accurate compilation and collection of data during the field investigations. Key points of the data collection program were as follows:

- Photographic documentation
- Discharge measurement
- Water-chemistry sampling
- Written description of each spring
- Detailed geologic mapping (for selected springs).

4.2.2.1 Spring Valley

The inventory of springs within Spring Valley included a total of 503 springs. Of these, 9 were investigated and documented by SNWA personnel, 11 were found within the USGS NWIS or Desert Research Institute (DRI) database, and 483 were identified from additional location only data sets and topographic maps. A majority of the spring locations in Spring Valley occur along the western side of the northern half of the valley (Figure 4-4).

The 9 springs documented by SNWA in Spring Valley included Willow, North Millick, South Millick, South Bastian, Layton, North, Swallow, and Blind springs as well as The Cedars. Table 4-7 provides a summary of the location, discharge magnitude, and temperature of these springs. The majority of

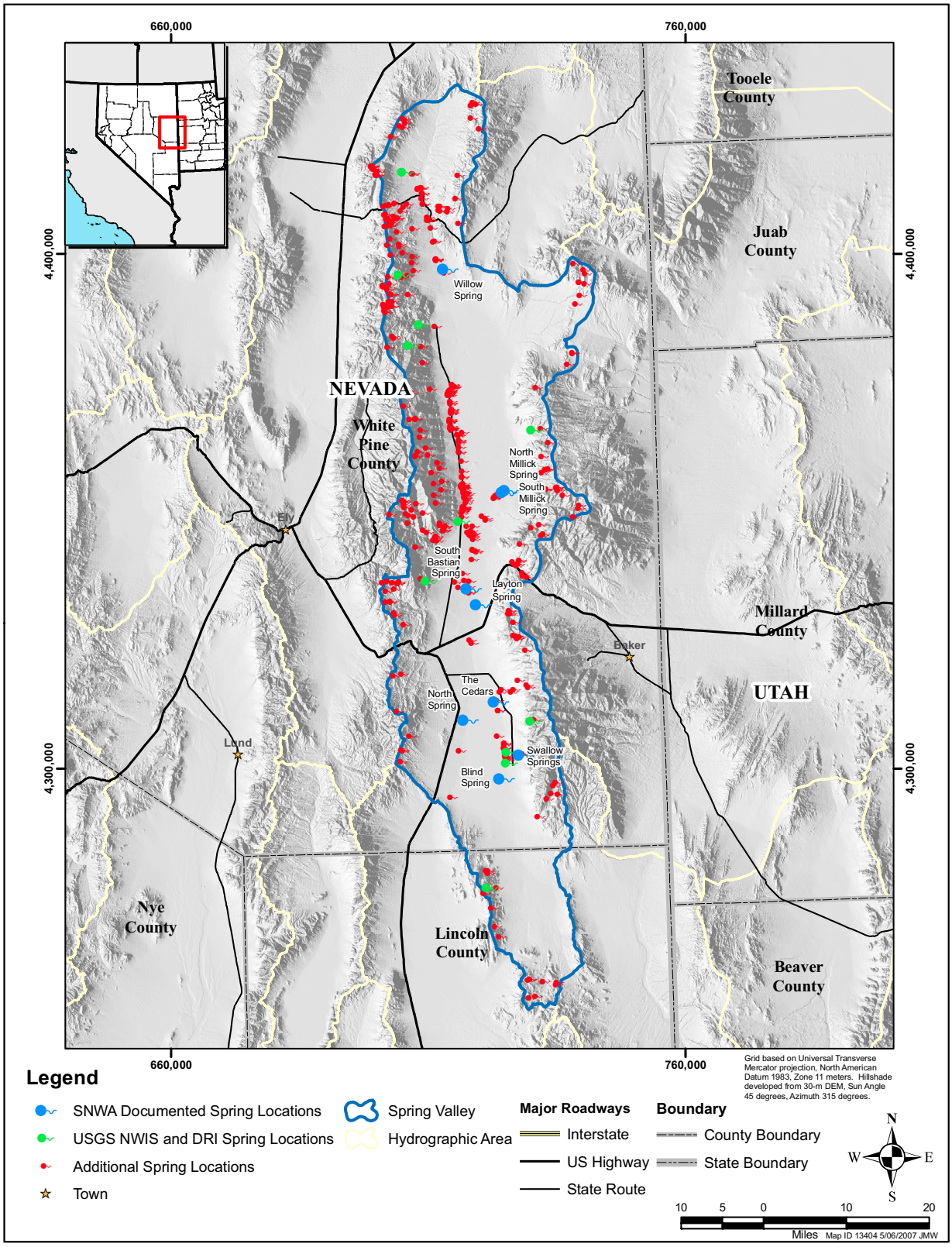

Figure 4-4
Spring Valley Spring Locations

Table 4-7
SNWA Documented Spring Locations in Spring Valley

Spring Name	UTM Easting[a] (m)	UTM Northing[a] (m)	Elevation[b] (ft-amsl)	Discharge Magnitude	Temperature Class.
Willow Spring	713,830	4,397,068	5,982	6	Cold
North Millick Spring	725,523	4,354,156	5,590	4	Cold
South Millick Spring	725,031	4,353,754	5,592	4	Cold
South Bastian Spring	718,388	4,334,865	5,660	6	Cold
Layton Spring	720,204	4,331,794	5,698	7	Cold
North Spring	717,768	4,309,388	5,763	6	Warm
The Cedars	723,712	4,312,911	5,783	5	Warm
Swallow Springs	728,597	4,302,920	6,080	4	Cold
Blind Spring	724,717	4,298,025	5,773	8	Cold

[a]Coordinates are in UTM Zone 11 and North American Datum of 1983
[b]Elevations are in North American Vertical Datum of 1988

the springs documented by SNWA for Spring Valley were valley floor or near valley floor springs in the central portion of the valley. Appendix B of Volume 3 contains 64 discharge measurements for the 9 springs.

4.2.2.2 Snake Valley

The inventory of springs within Snake Valley included a total of 359 springs. Of these, 3 were investigated and documented by SNWA personnel, 32 were found within the USGS NWIS or DRI database, and 324 were identified from additional location only data sets and topographic maps. A majority of the spring locations in Snake Valley occur at higher elevations along the western side of the southern half of the valley (Figure 4-5).

The 3 springs documented by SNWA in Snake Valley included Big Springs, Caine Spring, and Warm Springs. Table 4-8 provides a summary of the location, discharge magnitude, and temperature of these springs. Appendix B of Volume 3 contains 67 discharge measurements for the 3 springs.

4.2.2.3 Cave Valley

The inventory of springs within Cave Valley included a total of 47 springs. Of these, 2 were investigated and documented by SNWA personnel, 5 were found within the USGS NWIS or DRI database, and 40 were identified from additional location only data sets and topographic maps. A majority of the spring locations in Cave Valley occur at higher elevations in the northern half of the valley (Figure 4-6).

The 2 springs documented by SNWA in Cave Valley included Cave Spring and Sidehill Spring. Table 4-9 provides a summary of the location, discharge magnitude, and temperature of these springs. Appendix B of Volume 3 contains 14 discharge measurements for the 2 springs.

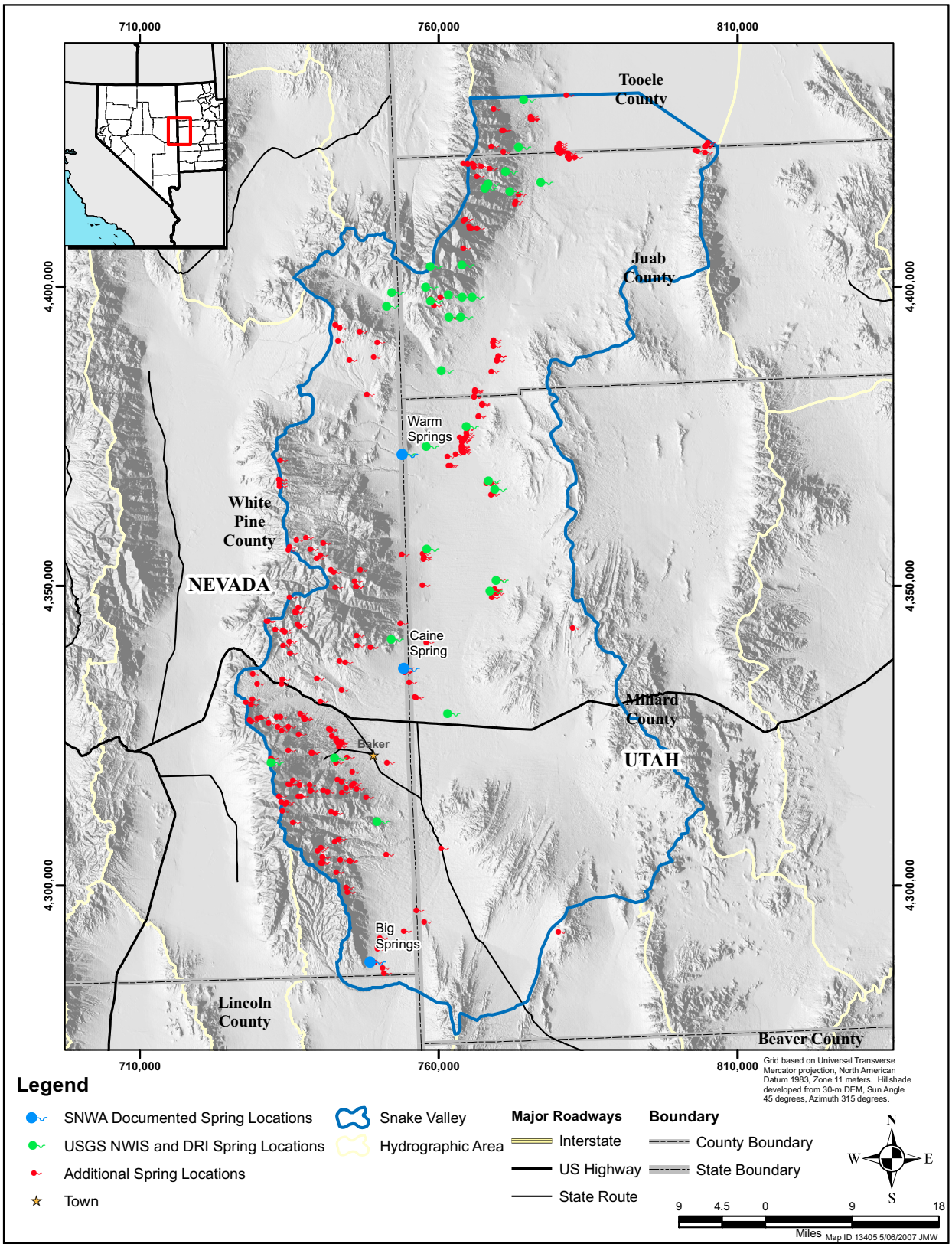

Figure 4-5
Snake Valley Spring Locations

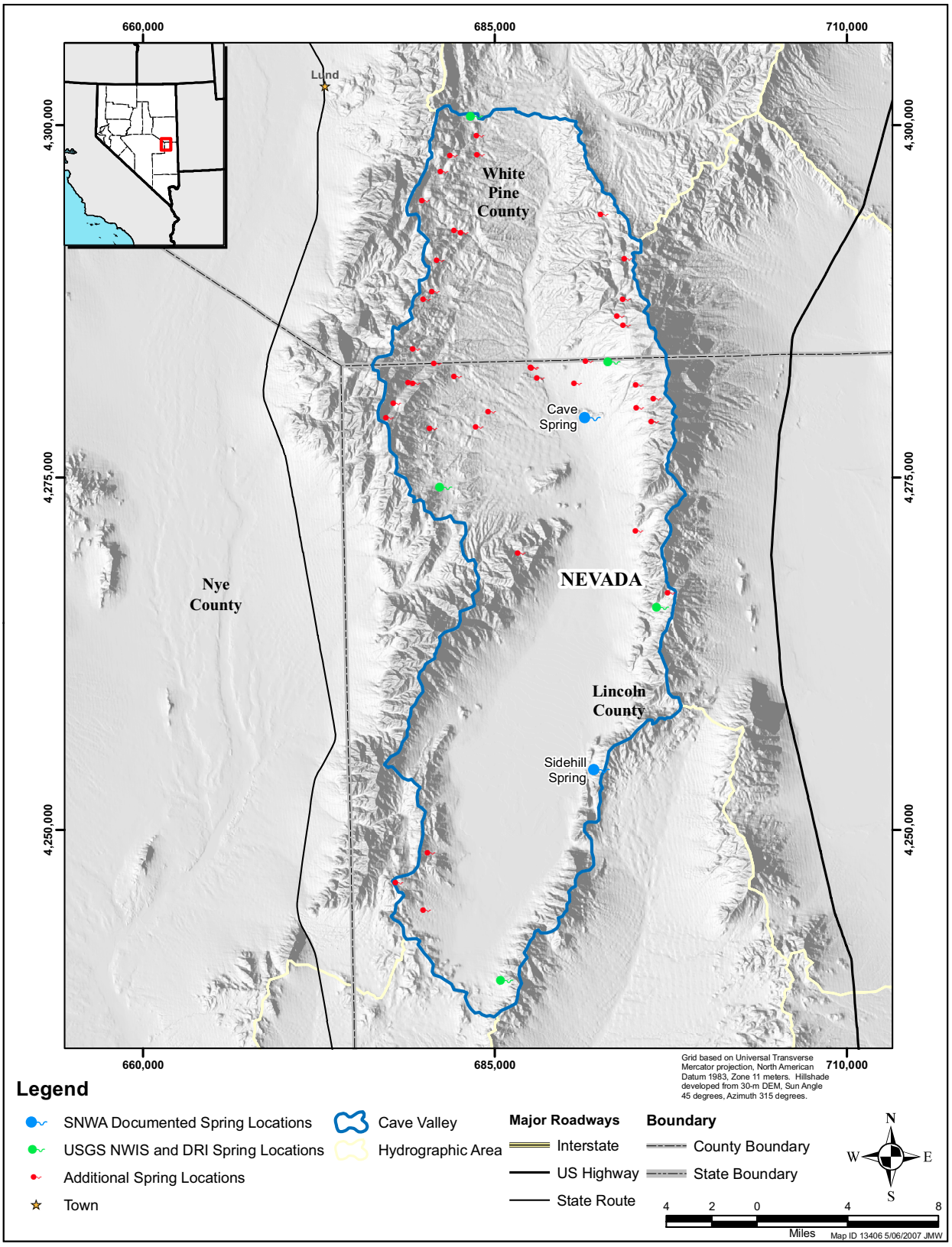

Figure 4-6
Cave Valley Spring Locations

Table 4-8
SNWA Documented Spring Locations in Snake Valley

Spring Name	UTM Easting[a] (m)	UTM Northing[a] (m)	Elevation[b] (ft-amsl)	Discharge Magnitude	Temperature Class.
Big Springs	749,422	4,287,293	5,568	3	Cold
Caine Spring	755,138	4,336,186	5,028	6	Cold
Warm Springs	754,812	4,371,945	5,252	2	Warm

[a]Coordinates are in UTM Zone 11 and North American Datum of 1983
[b]Elevations are in North American Vertical Datum of 1988

Table 4-9
SNWA Documented Spring Locations in Cave Valley

Spring Name	UTM Easting[a] (m)	UTM Northing[a] (m)	Elevation[b] (ft-amsl)	Discharge Magnitude	Temperature Class.
Cave Spring	691,760	4,279,249	6,488	4	Cold
Sidehill Spring	692,407	4,254,280	6,527	6	Cold

[a]Coordinates are in UTM Zone 11 and North American Datum of 1983
[b]Elevations are in North American Vertical Datum of 1988

4.2.2.4 Dry Lake Valley

The inventory of springs within Dry Lake Valley included a total of 98 springs. Of these, 4 were investigated and documented by SNWA personnel, 13 were found within the USGS NWIS or DRI database, and 81 were identified from additional location only data sets and topographic maps. A majority of the spring locations in Dry Lake Valley occur at higher elevations (Figure 4-7).

The 4 springs documented by SNWA in Dry Lake Valley included Meloy, Bailey, Littlefield, and Coyote springs. Table 4-10 provides a summary of the location, discharge magnitude, and temperature of these springs. Appendix B of Volume 3 contains 14 discharge measurements for the 4 springs.

4.2.2.5 Delamar Valley

The inventory of springs within Delamar Valley included a total of 31 springs. Of these, 1 was investigated and documented by SNWA personnel, 2 were found within the USGS NWIS or DRI database, and 28 were identified from additional location only data sets and topographic maps. A majority of the spring locations in Delamar Valley occur at higher elevations on the eastern side of the valley (Figure 4-8).

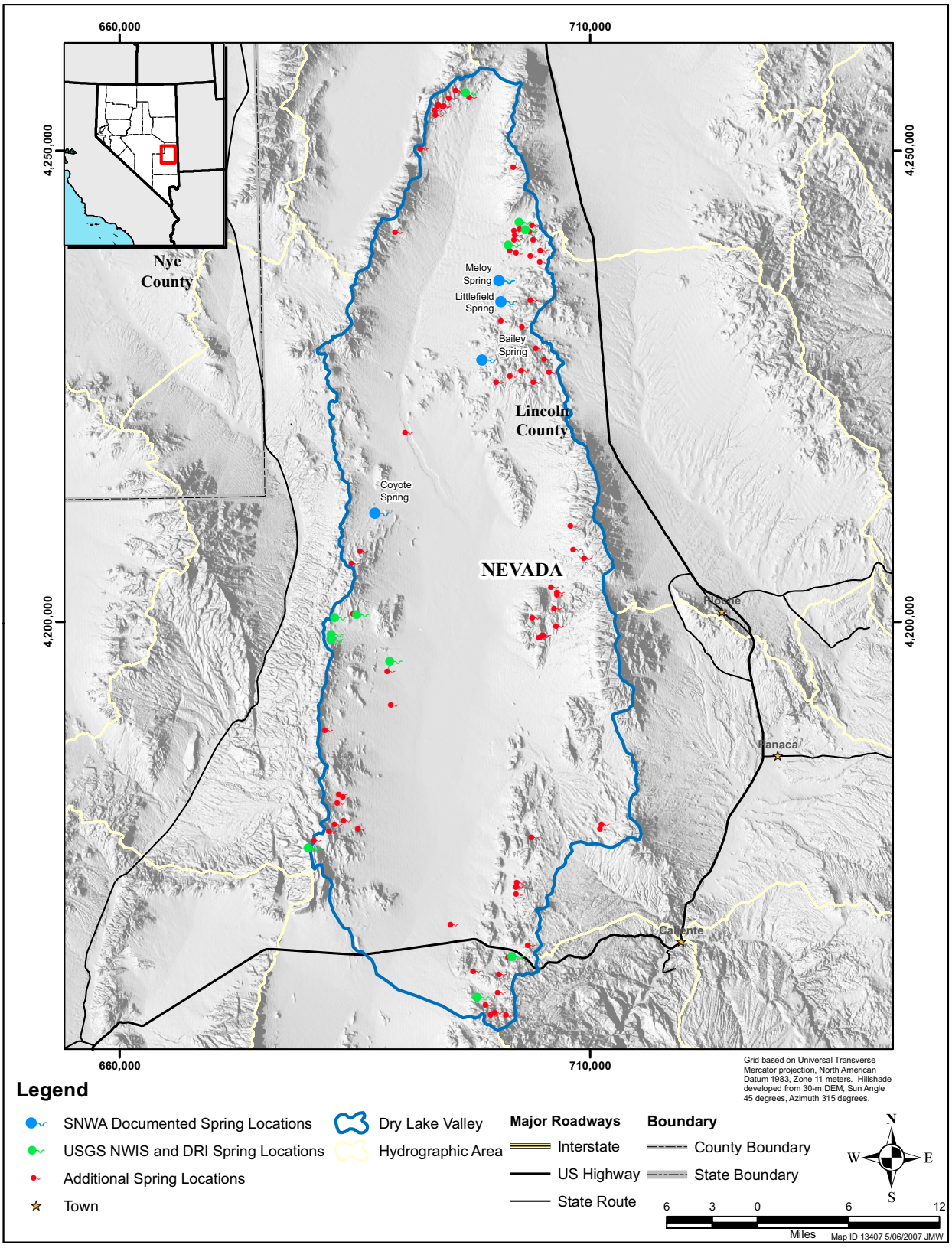

Figure 4-7
Dry Lake Valley Spring Locations

Table 4-10
SNWA Documented Spring Locations in Dry Lake Valley

Spring Name	UTM Easting (m)	UTM Northing (m)	Elevation (ft-amsl)	Discharge Magnitude	Temperature Class.
Meloy Spring	700,888	4,236,201	6,174	5	Cold
Bailey Spring	699,080	4,227,795	6,089	6	Cold
Littlefield Spring	701,112	4,233,949	6,146	5	Cold
Coyote Spring	687,693	4,211,513	5,220	6	Cold

[a]Coordinates are in UTM Zone 11 and North American Datum of 1983
[b]Elevations are in North American Vertical Datum of 1988

Grassy Spring was documented by SNWA in Delamar Valley. Table 4-11 provides a summary of the location, discharge magnitude, and temperature of this spring. Appendix B of Volume 3 contains 4 discharge measurements for Grassy Spring.

4.2.2.6 Coyote Springs Valley

The inventory of springs within Coyote Springs Valley included a total of 13 springs. Of these, 3 were found within the USGS NWIS or DRI database, and 10 were identified from additional location only data sets and topographic maps (Figure 4-9).

4.3 Summary of Surface Water Resources

This section has provided a brief summary of the detailed descriptions of streams and springs provided in Volumes 2 and 3 found on the CD-ROM accompanying this report. Additional site descriptions, discharge measurements, and site characteristics are found within the data volumes.

Table 4-11
SNWA Documented Spring Locations in Delamar Valley

Spring Name	UTM Easting[a] (m)	UTM Northing[a] (m)	Elevation[b] (ft-amsl)	Discharge Magnitude	Temperature Class.
Grassy Spring	695,124	4,157,193	5,783	6	Warm

[a]Coordinates are in UTM Zone 11 and North American Datum of 1983
[b]Elevations are in North American Vertical Datum of 1988

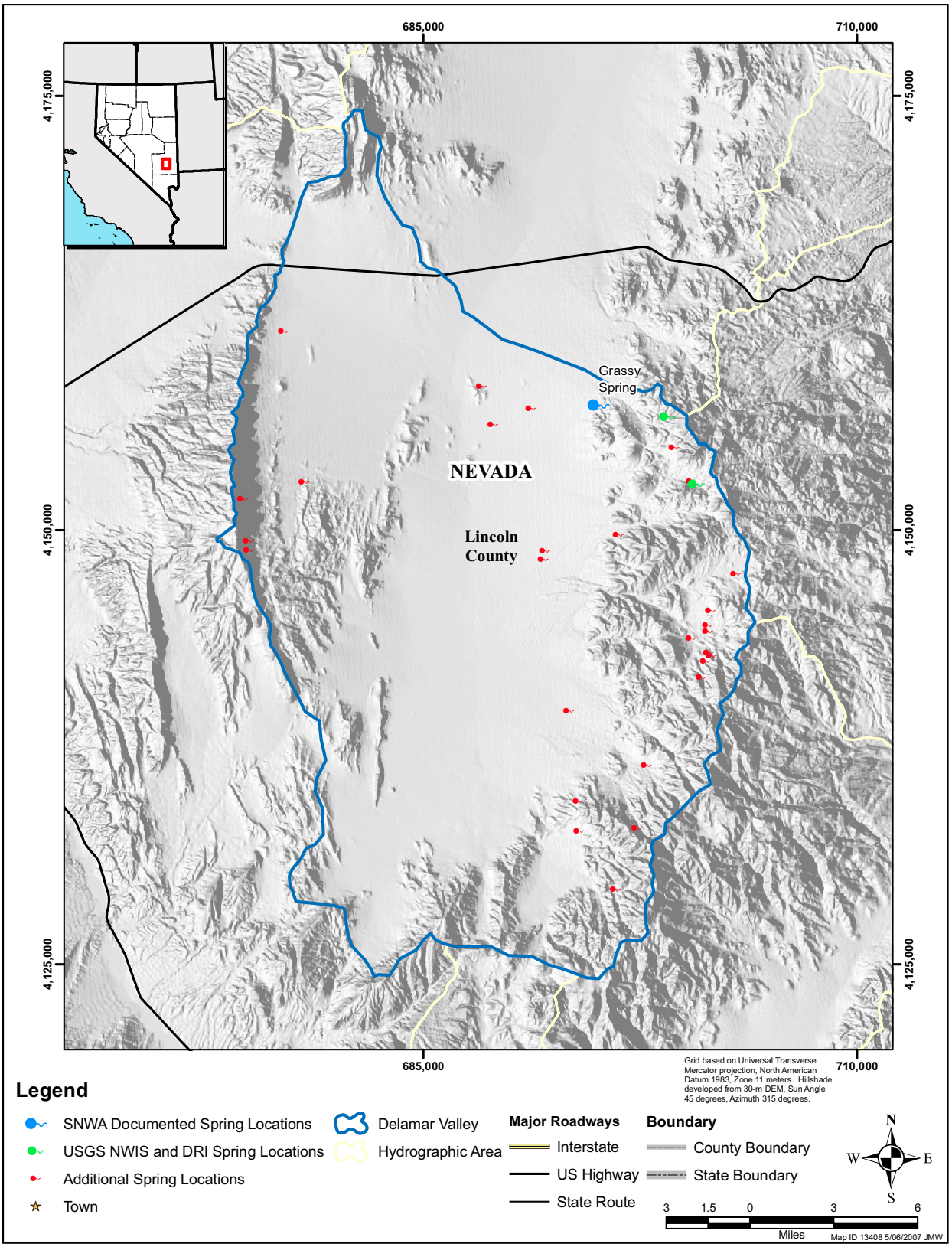

Figure 4-8
Delamar Valley Spring Locations

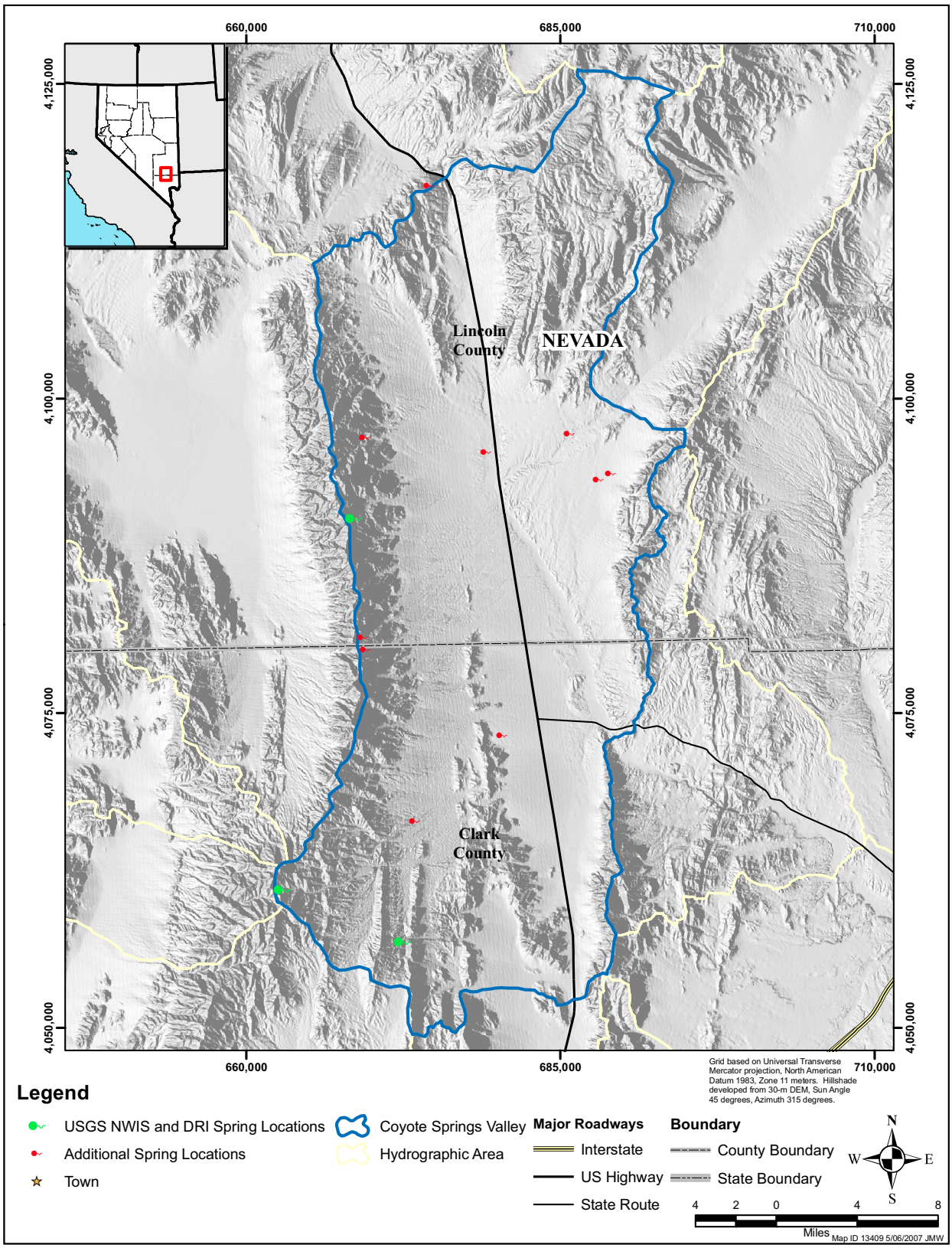

Figure 4-9
Coyote Springs Valley Spring Locations