Distribution of the Sagebrush Lizard, *Sceloporus graciosus*, in the Black Hills of South Dakota

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Final Report Submitted to
South Dakota Department of Game, Fish, and Parks
Pierre, South Dakota
December 31, 2005

Suggested citation: Smith, B. E., J. L. Massie, and B. G. Blake. 2005. Distribution of the sagebrush lizard, *Sceloporus graciosus*, in the Black Hills of South Dakota. Unpublished report submitted to the South Dakota Department of Game, Fish, and Parks.

Introduction

The sagebrush lizard, *Sceloporus graciosus*, is a widespread and common inhabitant of the western United States and Baja California (Nussbaum et al. 1983, Baxter and Stone 1985, Censky 1986, Degenhardt et al. 1996, Hammerson 1999, Stebbins 2003). Tinkle et al. (1993) found it to be the most common lizard on their study site in Utah. It is spottily distributed in Montana, North Dakota, and South Dakota (Stebbins 2003). Its range in the Black Hills of South Dakota is poorly known, but Peterson (1974) and D. Backlund (unpublished data) reported populations from the southwestern Black Hills of Wyoming and South Dakota. The sagebrush lizard is considered globally secure (G5) by NatureServe and secure (S5) in Wyoming, but

imperiled (S2) in South Dakota. It receives no regulatory protection within the states of Wyoming or South Dakota.

The sagebrush lizard is a small (4.7 – 8.9 cm snout-vent length) phrynosomatid lizard found in a variety of arid habitats in the United States (Stebbins 2003). It prefers cooler temperatures than some of its congeners (Adolph 1990, Sinervo and Adolph 1994). Many researchers have found that the sagebrush lizard prefers open areas (Rose 1976, Adolph 1990, Green et al. 2001, James and M'Closkey 2002). At a variety of study sites sagebrush lizards have been found to seek out open areas to segregate themselves from other lizards, including congeners (Rose 1976, Adolph 1990, James and M'Closkey 2002). Sagebrush lizards are primarily ground-dwellers (Marcellini and Mackey 1970, Ferguson 1971) but will occasionally climb trees or shrubs (Adolph 1990, Stebbins 2003). Males can frequently be observed performing a stereotyped "push-up" territorial display (Martins et al. 1998).

Working in Utah, Tinkle et al. (1993) found that females first reproduced at 22 – 24 months of age and typically laid 3.7 – 3.8 eggs per clutch once a year, although these workers found that many females laid two clutches a year. Approximately 60% of females reproduced twice per year in the San Gabriel Mountains of California (Goldberg 1975). Sagebrush lizards are relatively long-lived (Deslippe and M'Closkey 1991, Tinkle et al. 1993). Tinkle et al. (1993) found that individuals often lived to six years of age and a few individuals survived for eight years. Tinkle et al. (1993) presented an extensive discussion of the life history and demography of sagebrush lizards in Utah. The natural history of sagebrush lizards has not been studied in the northern part of their range.

The primary purpose of our study was to inventory the distribution of the sagebrush lizard in the Black Hills of South Dakota. We focused our efforts in the southwestern Black

Hills of South Dakota, where Peterson (1974) and D. Backlund (unpublished data) had previously found populations. We also made preliminary observations of the natural history of sagebrush lizards in the Black Hills. We presumed that the species would seek out warm, exposed areas in warmer southwestern-facing canyons of the southwestern Black Hills, and we sought out such sites in our work. Our data are presence/absence data only, and judgments of population sizes are subjective.

Methods

From Peterson (1974) and personal communications with Doug Backlund (South Dakota Department of Game, Fish, and Parks) and Charles Peterson (Idaho State University), we developed several criteria to locate suitable survey sites. We limited our surveys to slopes with a southerly aspect in southwest-facing canyons and draws within the general area where sagebrush lizards had previously been collected. Figure 1 (p. 11) shows a broad outline of the study areas.

In the field we examined slopes in these canyons and draws to determine whether they had suitable habitat, as described by previous studies (Marcellini and Mackey 1970, Peterson 1974, Rose 1976, Nussbaum et al. 1983, Baxter and Stone 1985, Adolph 1990, Tinkle et al. 1993, Hammerson 1999, Green et al. 2001, James and M'Closkey 2002, Stebbins 2003) and personal communications with D. Backlund. We looked for rocky areas of sandstone or limestone with a southerly aspect with relatively little vegetation (Rose 1976, Adolph 1990, Green et al. 2001, James and M'Closkey 2002. We searched during appropriate weather, generally warmer, relatively sunny days. Time of day varied according to temperature. Our search parameters were refined repeatedly as we learned more about the natural history of the species in the Black Hills.

Once suitable survey locations were found, sagebrush lizards were surveyed utilizing visual encounter surveys (Crump and Scott 1994) to determine presence or absence of the species at survey sites. Survey time varied at each site because the size of rock outcroppings at each site varied. At most sites, two people could complete a survey in about fifteen minutes, and many promising sites were revisited multiple times. Due to limited resources, we only surveyed sites that were within a kilometer of roads accessible with a four-wheel drive vehicle.

After surveys of several populations, we came up with a ranking scheme to rank sites to describe their potential for harboring sagebrush lizard populations. We used three ranking factors: aspect, accessibility, and presence of suitable habitat.

Rank 1: A section of canyon with southwest-facing slopes that was easily accessible with suitable habitat such as limestone or sandstone outcroppings with sparse vegetation.

Rank 2: A section of canyon with southwest-facing slopes, sparse vegetation, and rock outcroppings not composed of sandstone or limestone.

Rank 3: A section of canyon that did not face southwest and/or had few rock outcroppings and/or was densely vegetated.

Rank 4: Canyon sections located over a kilometer from the road or that did not meet any of the requirements listed above.

We located 22 canyon sections in the southwestern Black Hills that we searched for sagebrush lizards. These sections were surveyed from one to three times, depending on resources and rankings. Because the study was designed to determine only presence or absence, once sagebrush lizards were found the section was not searched again. The exception was Waterdraw Spring. This location was visited several times because its large lizard population enabled behavioral observations useful in developing a search technique at new sites. If lizards

were not found on the first visit at new sites and the canyon section was ranked 1 or 2, the section was usually visited three times before determining that lizards were absent at this section. We did not revisit canyon sections ranked 3 or 4.

Results

Smith et al., (2005) found two new populations of sagebrush lizards. In 2005, six new sagebrush lizard populations were found. With these eight new populations a total of thirteen populations of sagebrush lizards are now known from the Black Hills (table 1, below; and figures 2 – 15, pp. 16 – 42.

General Locality	Legal Description	Decimal Degrees
Gillette Canyon 1 (survey 25)	T3S, R1E, Sec 26	N 43.7616, W 103.9596
Gillette Canyon 2 (survey 26)	T3S, R1E, Sec 26	N 43.7653, W 103.9548
Hell Canyon (survey 24)	T3S, R3E, Sec. 18	N 43.7860, W 103.8086
Pleasant Valley (survey 28)	T4S, R3E, Sec. 35	N 43.6637, W 103.7358
Redbird Canyon (survey 20)	T3S, R1E, Sec. 9	N 43.8085, W 104.0019
Roby Canyon (survey 4)	T2S, R1E, Sec. 30	N 43.8464, W 104.0425
Water Draw Spring (surveys 6, 17, 29, 30, 31, 32)	T4S, R2E, Sec. 23	N 43.6813, W 103.8400
Survey 2004 (Unnamed Canyon)	T4S, R3E, Sec. 32	N 43.6541, W 103.7902
Historical Site 1 (Jumpoff Spring)	T4S, R2E, Sec. 30	N 43.6716, W 103.9259
Historical Site 2 (Shenk Canyon)	T4S, R2E, Sec. 29	N 43.6781, W 103.8994
Historical Site 3 (Water Draw Canyon)	T4S, R3E, Sec. 30	Not available
Historical Site 4 (Redbird Canyon)	T1S, R2E, Sec. 31	Not available
Historical Site 5 (Lithograph Canyon)	T4S, R2E, Sec. 1	Not available

Table 1: Locations of sagebrush lizard populations in the Black Hills of South Dakota. Survey 2004 was a site we recorded during survey work completed in the area in 2004. Locality data for Historical Sites 3, 4, and 5 are observations from a historical database that were originally recorded using only a legal description. We were not able to assign them coordinates. Table 2 (page 13) lists all localities that we surveyed plus historical data.

Thirty-one lizards were found during 25.5 person-hours of search time, averaging 1.22 lizards per hour searched. Sagebrush lizards were found mostly under sunny conditions and relatively calm winds (≤ 10 km/h), with the exception of a few surveys conducted under overcast

conditions. The lizards were found to be active in full sun temperatures from 28° – 35^oC (mean = 31.1 ± 2.1^oC, n = 11) and ambient temperatures of 25° – 32° C, (mean = 27.18 ± 2.4^oC, n = 8).

Discussion

Sagebrush lizards are predominately found in the southwestern part of the Black Hills, north of the Red Valley physiographic feature in the warmer canyons of the foothills of the Black Hills (figure 1, p. 11). Despite extensive work in the Red Valley of the southwestern Black Hills and in the Elk Mountain area, we have not found them there (Smith et al. 2005). In the Black Hills sagebrush lizards tend to prefer open areas amongst sandstone and limestone outcroppings on hillsides with a southerly or southwesterly aspect. We found them on days with little cloud cover, low wind, and relatively warm temperatures. In these respects, the general natural history of the sagebrush lizard in the Black Hills appears similar to the natural history of this species in the Columbia River basin (Green et al. 2001) and throughout its range as a whole (Stebbins 2003).

More-or-less isolated populations are likely to be spread up and down canyon systems in which we found them, as well as side canyons, as long as suitable habitat exists within reach of lizards migrating from site to site. For example, we found them along Hell Canyon, which connects to Lithograph Canyon, one of the historical sites. We suspect that their distribution is probably determined by the presence and spacing of suitable habitat. A small lizard like the sagebrush lizard probably cannot migrate far, so we also suggest that populations may be isolated to a relatively high degree.

Although the sagebrush lizard is considered globally secure (G5) throughout its range, it is considered imperiled (S2) in South Dakota. We recommend further surveys of this lizard in South Dakota, pending resources, not so much because the species is considered imperiled in the

state but because it is a species at the edge of its range within the Black Hills and because populations may be isolated to a relatively high degree. Populations of any species at the edge of their distribution, including those that are common across the range, may be critical because they can be repositories of unique alleles and are often populations where considerable evolution may be ongoing (Scribner et al. 2006). The status of populations at the edge of the range can also be precarious, since special management of habitat may be necessary to avoid population declines. Habitats in which we found sagebrush lizards are common across the southern Black Hills but are probably isolated from other such habitat to the south and west. We do not see imminent threats to sagebrush lizard habitat in the Black Hills. However, development could threaten this habitat in the future simply because the areal extent of the range of sagebrush lizards in the Black Hills is small, and each population seems to exist in a relatively small patch of suitable habitat within this range.

A logical next step for the study of sagebrush lizards in the Black Hills would be surveys of historical localities. Our study was designed to find only new localities. Some populations, such as that in the Preacher Spring quadrangle, are either very isolated or are part of another extended series of populations. We also suggest surveys up and down canyon systems in which we found lizards and in side canyons based on the assumption that there will be other small, isolated populations in suitable habitat within these canyons and side canyons.

If a monitoring program is considered sagebrush lizards are relatively easy to observe under suitable weather conditions. We think that it would not be hard to devise a monitoring plan in which locations found in this study are periodically visited to assess presence or absence of sagebrush lizards at these sites. One population of note is that at Waterdraw Spring. This

population seems large and we think it would be suitable for more detailed studies of the sagebrush lizard in the Black Hills.

In conclusion, we found that sagebrush lizards were reasonably common in localized populations in the Black Hills. Monitoring of the species in the Black Hills might be considered because (1) the sagebrush lizard is at the edge of its range in the Black Hills, (2) it seems to occur in small, isolated populations in a relatively small part of the Black Hills, (3) Black Hills populations seem to be relatively isolated from suitable habitat to the south and west in Wyoming, and (4) they are at the northern edge of their range in the Black Hills. In addition, a monitoring program in the Black Hills would be easy to design and implement with few resources. Although we more than doubled the amount of known populations, we believe there are still several, perhaps many, populations to be found. We would suggest the best strategy for finding more populations is to go to known sites and work outward in all directions from there, searching suitable habitat along the canyons and side canyons connected to these sites. There is probably some limiting distance beyond which lizards cannot migrate and further populations up and down the canyon would not be expected. This would depend on the spacing of lizard populations and suitable habitat. Knowledge of migration distances, availability of suitable habitat, and general data on geography and topography could probably be used to model the potential distribution of the lizards in the Black Hills. Sagebrush lizards are almost certainly isolated within the Black Hills from the main range of the species and from each other, and we suspect that local populations in the Black Hills have considerable genetic structure.

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Figure 1 (following page): Shaded relief map of the southern Black Hills showing general locations of study areas (circled). White circles are areas where sagebrush lizards were found.

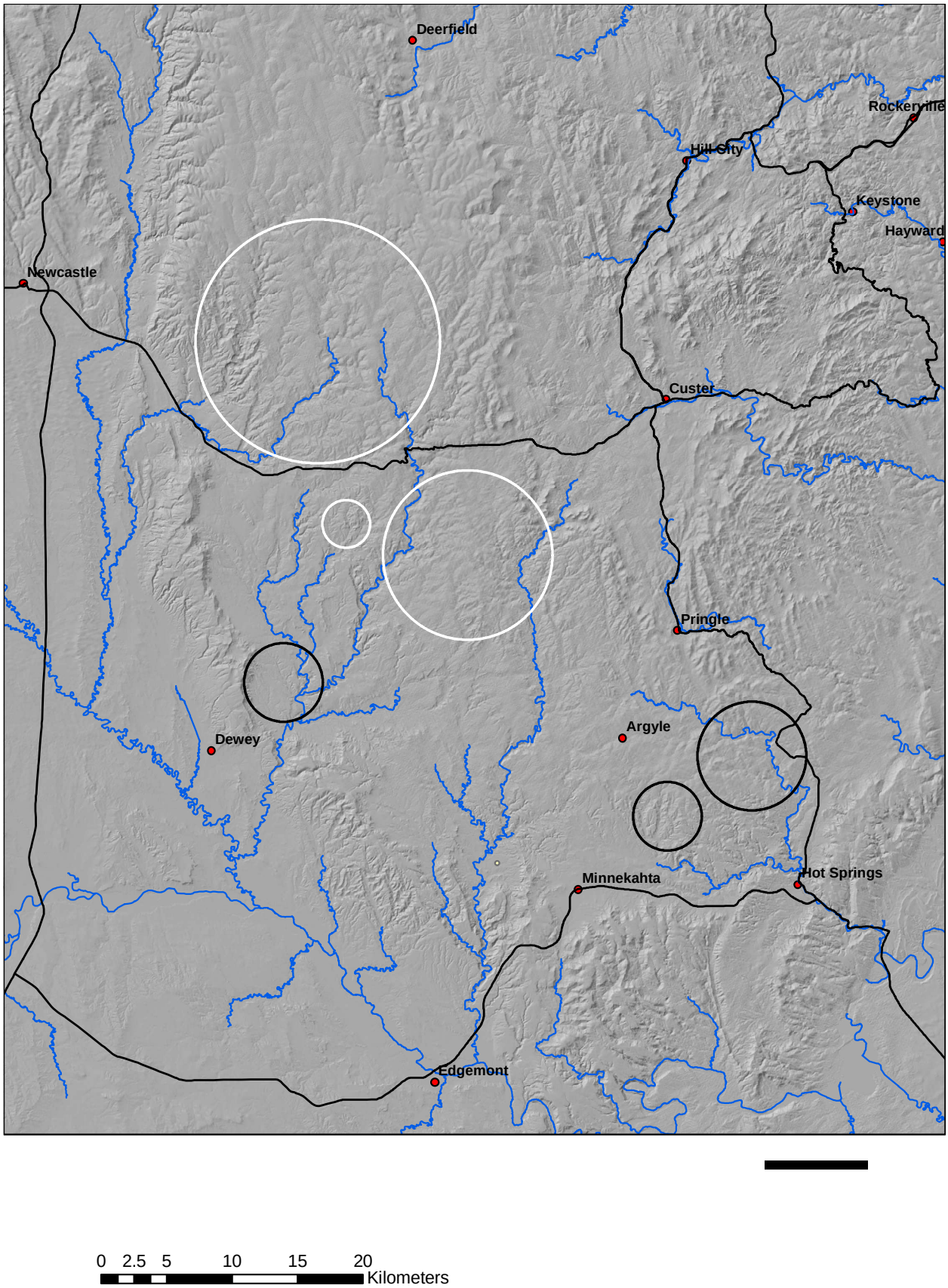

Deerfield
Rockerville
Hill City
Keystone
Hayward
Newcastle
Custer
Pringle
Argyle
Dewey
Minnekahta
Hot Springs
Edgemont
0 2.5 5 10 15 20
Kilometers

Table 2 (following page): Survey numbers, quadrangle names, legal descriptions, decimal degrees, presence/absence (1/0) data, and page numbers on which each survey is mapped.

Survey Number	Quadrangle	Legal Description	Decimal Degrees	Presence	Figure and Page Number
1	Fanny Peak	T3S, R1E, Sec. 18	N 43.7957, W 104.0387	0	2, 17
2	Fanny Peak	T3S, R1E, Sec. 7	N 43.8092, W 104.0362	0	2, 17
3	Fanny Peak	T2S, R1E, Sec. 32	N 43.8282, W 104.0294	0	3, 19
4	Fanny Peak	T2S, R1E, Sec. 30	N 43.8464, W 104.0425	1	3, 19
5	Jewel Cave	T4S, R3E, Sec. 32	N 43.6547, W 103.7891	0	4, 21
6	Jewel Cave	T4S, R2E, Sec. 23	N 43.6813, W 103.8400	0	4, 21
7	Dead Horse Flats	T2S, R2E, Sec. 20	N 43.8620, W 103.9106	0	5, 23
8	Dead Horse Flats	T2S, R2E, Sec. 17	N 43.8706, W 103.8979	0	5, 23
9	Dead Horse Flats	T2S, R2E, Sec. 20	N 43.8583, W 103.9014	0	5, 23
10	Dead Horse Flats	T2S, R2E, Sec. 29	N 43.8490, W 103.9089	0	5, 23
11	Signal Hill	T3S, R2E, Sec. 22	N 43.7787, W 103.8683	0	6, 25
12	Signal Hill	T3S, R2E, Sec. 15	N 43.7871, W 103.8693	0	6, 25
13	Dead Horse Flats	T2S, R2E, Sec. 17	N 43.8706, W 103.8979	0	5, 23
14	Dead Horse Flats	T2S, R2E, Sec. 29	N 43.8490, W 103.9089	0	5, 23
15	Signal Hill	T3S, R2E, Sec. 15	N 43.7871, W 103.8693	0	6, 25
16	Signal Hill	T3S, R2E, Sec. 15	N 43.7871, W 103.8693	0	6, 25
17	Jewel Cave	T4S, R2E, Sec. 23	N 43.6813, W 103.8400	1	4, 21
18	Dead Horse Flats	T2S, R2E, Sec. 19	N 43.8593, W 103.9226	0	5, 23
19	Dead Horse Flats	T2S, R2E, Sec. 17	N 43.8703, W 103.8969	0	5, 23
20	Fanny Peak	T3S, R1E, Sec. 9	N 43.8085, W 104.0019	1	2, 17
21	Dead Horse Flats	T3S, R1E, Sec. 4	N 43.8194, W 103.9985	0	7, 27
22	Signal Hill	T3S, R2E, Sec. 15	N 43.7817, W 103.8690	0	6, 25
23	Signal Hill	T3S, R2E, Sec. 15	N 43.7865, W 103.8685	0	6, 25
24	Signal Hill	T3S, R3E, Sec. 18	N 43.7861, W 103.8086	1	6, 25
25	Dead Horse Flats	T3S, R1E, Sec. 26	N 43.7616, W 103.9596	1	8, 29
26	Dead Horse Flats	T3S, R1E, Sec. 26	N 43.7653, W 103.9548	1	8, 29
27	Fourmile	T5S, R3E, Sec. 1	N 43.6439, W 103.7076	0	9, 31
28	Fourmile	T4S, R3E, Sec. 35	N 43.6637, W 103.7358	1	9, 31
29	Jewel Cave	T4S, R2E, Sec. 23	N 43.6813, W 103.8400	1	4, 21
30	Jewel Cave	T4S, R2E, Sec. 23	N 43.6813, W 103.8400	1	4, 21
31	Jewel Cave	T4S, R2E, Sec. 23	N 43.6813, W 103.8400	1	4, 21
32	Jewel Cave	T4S, R2E, Sec. 23	N 43.6813, W 103.8400	1	4, 21
33	Jewel Cave SW	T5S, R1E, Sec. 26	N 43.5819, W 103.9587	0	10, 33
34	Jewel Cave SW	T5S, R1E, Sec. 26	N 43.5811, W 103.9601	0	10, 33
35	Jewel Cave SW	T5S, R1E, Sec. 35	N 43.5766, W 103.9595	0	10, 33
36	Minnekahta NE	T6S, R4E, Sec. 35	N 43.4870, W 103.6037	0	11, 34
37	Minnekahta NE	T7S, R4E, Sec. 1	N 43.4738, W 103.5983	0	11, 34
38	Minnekahta NE	T7S, R4E, Sec. 1	N 43.4738, W 103.5983	0	11, 34
39	Minnekahta NE	T7S, R4E, Sec. 2	N 43.4733, W 103.6001	0	11, 34
40	Minnekahta NE	T7S, R4E, Sec. 2	N 43.4717, W 103.6021	0	11, 34
41	Pringle	T6S, R5E, Sec. 9	N 43.5430, W 103.5262	0	12, 36
42	Pringle	T6S, R5E, Sec. 9	N 43.5420, W 103.5308	0	12, 36
43	Pringle	T6S, R5E, Sec. 9	N 43.5384, W 103.5334	0	12, 36

Survey Number	Quadrangle	Legal Description	Decimal Degrees	Figure and Page Number
Historical Site 1	Jewel Cave NW	T4S, R2E, Sec. 30	N 43.6716, W 103.9259	13, 37
Historical Site 2	Jewel Cave NW	T4S, R2E, Sec. 29	N 43.6781, W 103.8994	13, 37
Historical Site 3	Jewel Cave	T4S, R3E, Sec. 30	Not available	4, 21
Historical Site 4	Preacher Spring	T1S, R2E, Sec. 31	Not available	14, 39
Historical Site 5	Jewel Cave	T4S, R2E, Sec. 1	Not available	15, 41
Survey 2004	Jewel Cave	T4S, R3E, Sec. 32	N 43.6541, W 103.7902	4, 21

Table 3: Survey numbers, quadrangle names, legal descriptions, decimal degrees, and page numbers on which each historical locality is mapped.

Figures 2 – 15: Maps of presence (black solid circles from this study; blue solid circles are historical sites) and absence (open circles) of sagebrush lizards in the Black Hills.

Figure 2 (following page): Fanny Peak Quadrangle. Surveys 1 (T3S, R1E, Sec. 18), 2 (T3S, R1E, Sec. 7), and 20 (T3S, R1E, Sec. 9).

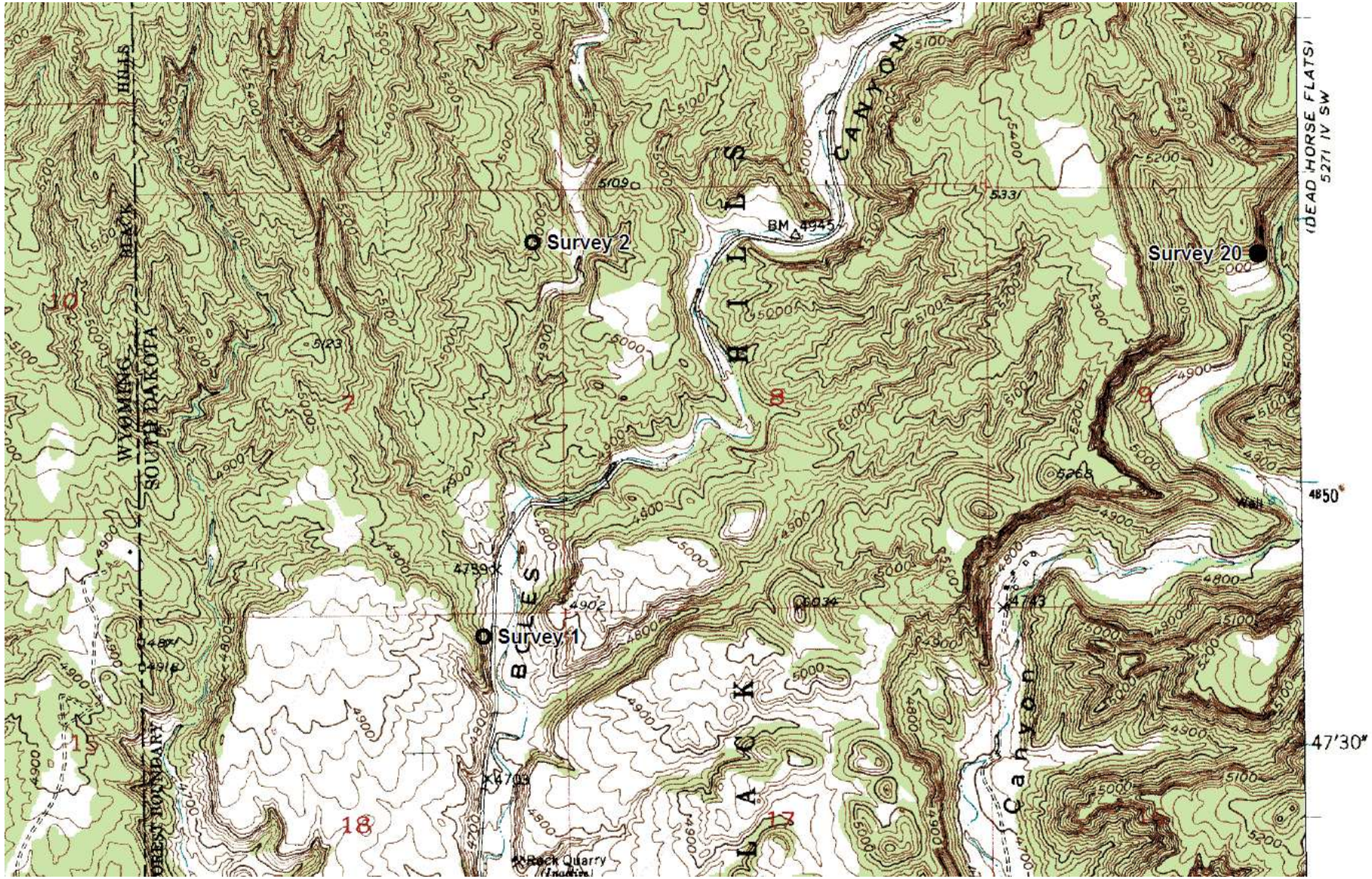
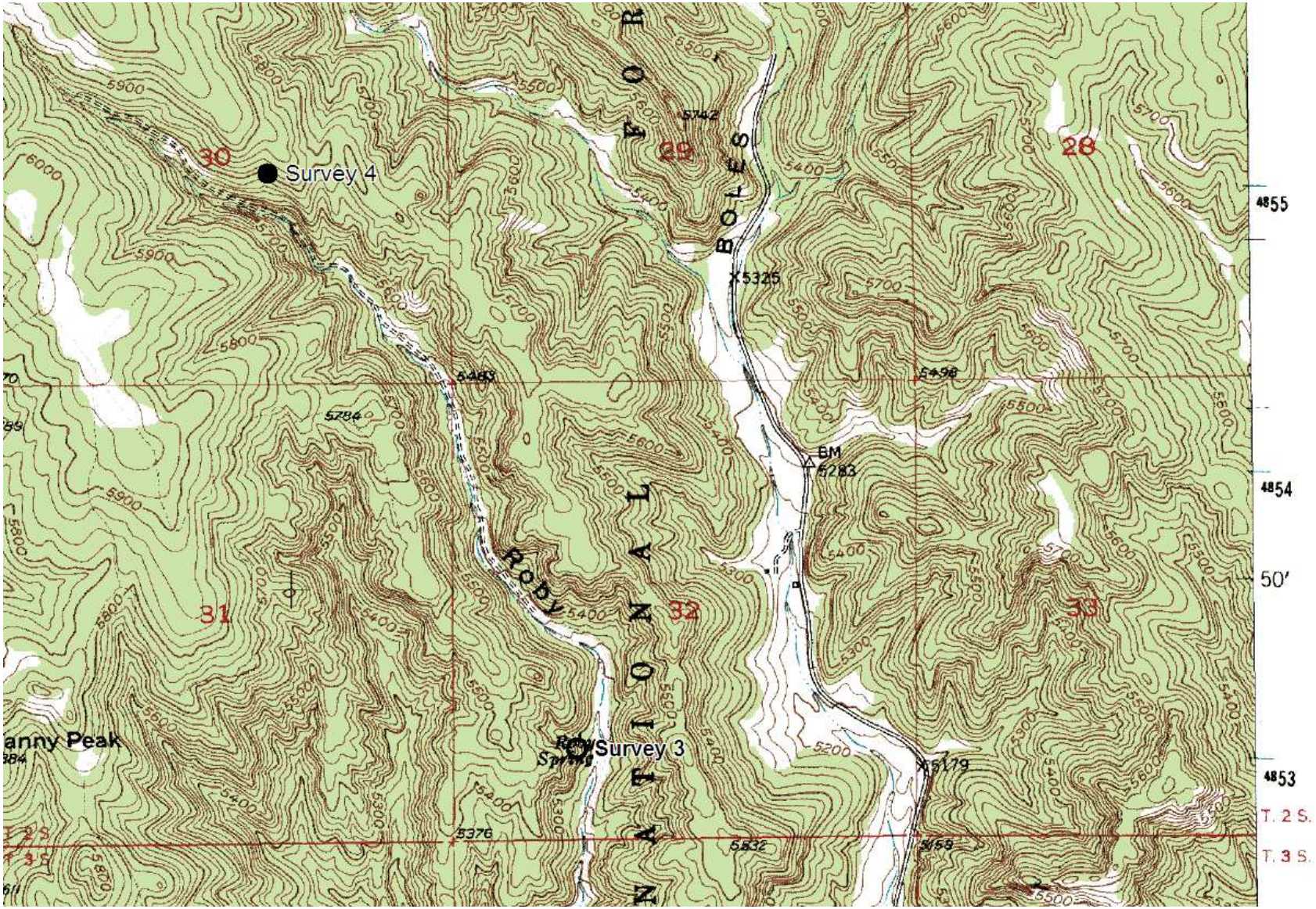

Survey 2
Survey 20
Survey 1
CANYON
HILLS
BLACK
Canyon
WYOMING
SOUTH DAKOTA
BM 4945
Rock Quarry
(DEAD HORSE FLATS)
5271 IV SW
4850'
47'30"

Figure 3 (following page): Fanny Peak Quadrangle. Surveys 3 (T2S, R1E, Sec. 32) and 4 (T2S, R1E, Sec. 30).


Survey 4
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T. 2 S.
T. 3 S.

Figure 4: Jewel Cave Quadrangle. Surveys 6, 17, 29, 30, 31, 32 (T4S, R2E, Sec. 23), historical site 3 (T4S, R3E, Sec. 30; locality approximate), and surveys 5 and 2004 (T4S, R3E, Sec. 32).

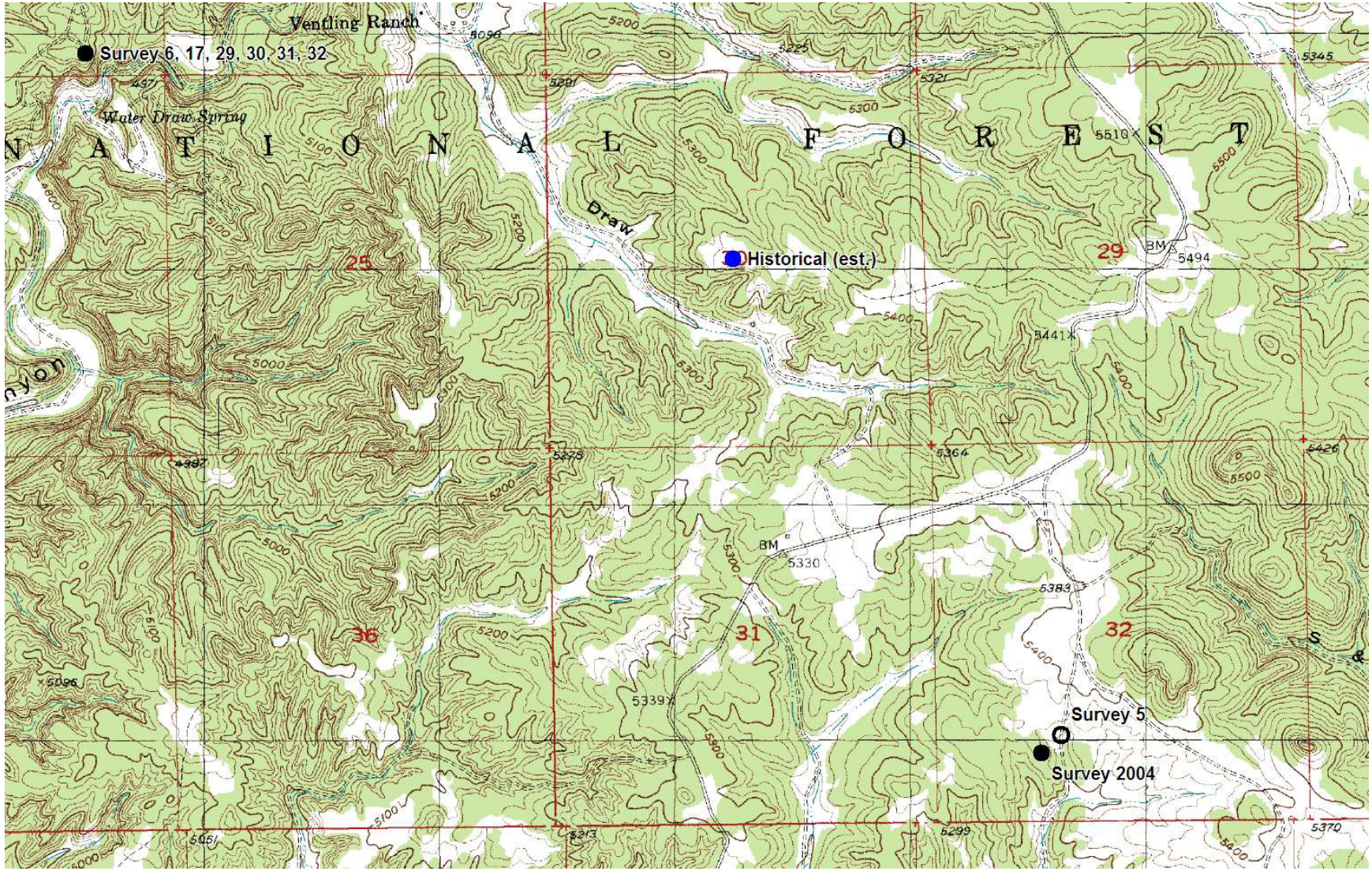

Ventling Ranch
Survey 6, 17, 29, 30, 31, 32
Water Draw Spring
N A T I O N A L F O R E S T
Draw
Historical (est.)
25
29
36
31
32
Survey 5
Survey 2004

Figure 5: Dead Horse Flats Quadrangle. Surveys 7 and 9 (T2S, R2E, Sec. 20); 8 and 13 (T2S, R2E, Sec. 17); 10 and 14 (T2S, R2E, Sec. 29); 18 (T2S, R2E, Sec. 19); and 19 (T2S, R2E, Sec. 17).

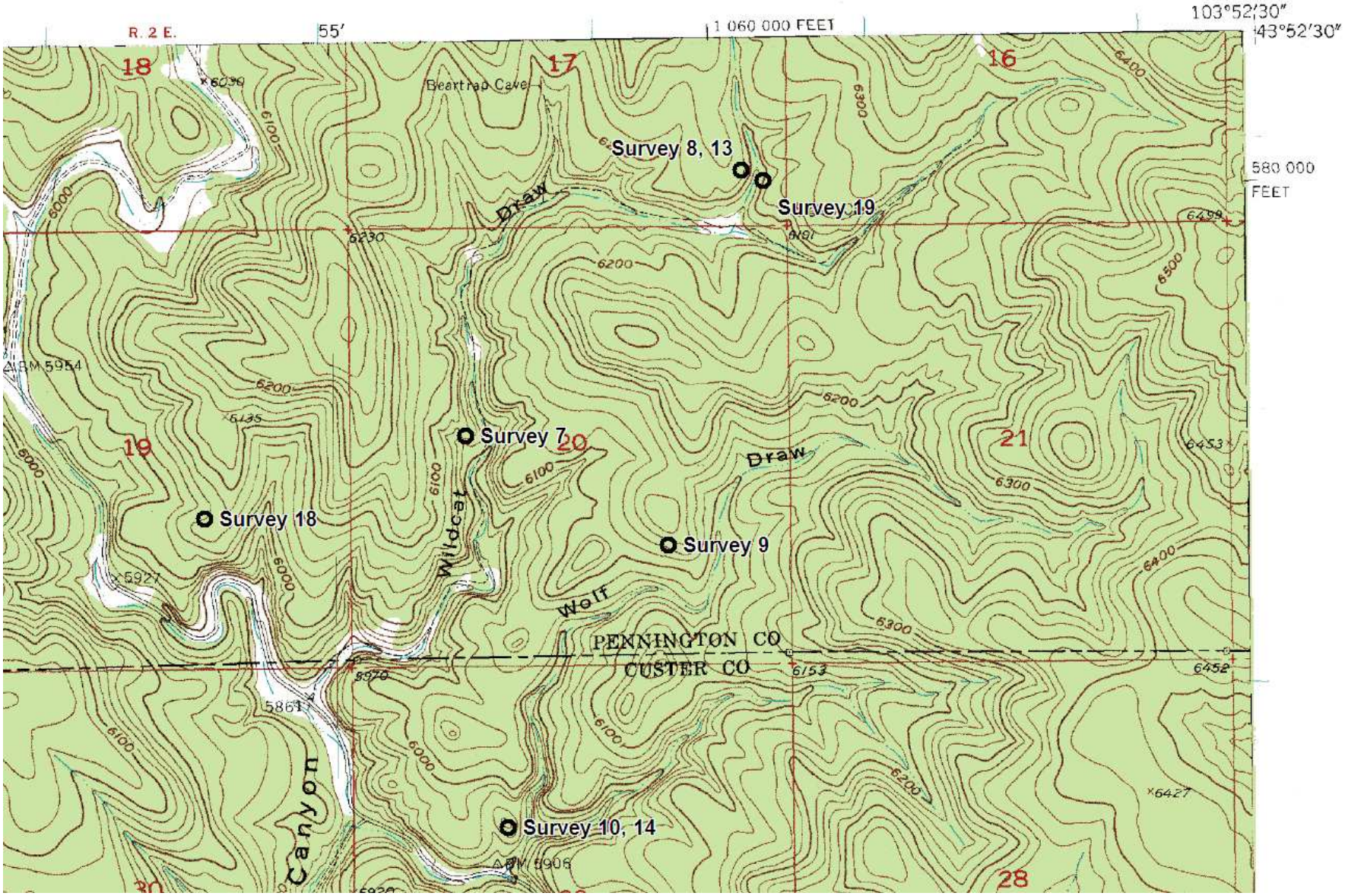

R. 2 E.
55′
1 060 000 FEET
103°52′30″
43°52′30″
580 000 FEET
Beartrap Cave
Survey 8, 13
Survey 19
Survey 7
Survey 18
Survey 9
Survey 10, 14
Draw
Wildcat
Wolf
Canyon
PENNINGTON CO
CUSTER CO
18
17
16
19
20
21
28
30
6000
6100
6200
6300
6400
6500
6453
6452
6427
5927
5861
5970
6135
6230
6191
6153
BM 5954
BM 5906

Figure 6: Signal Hill Quadrangle. Surveys 11 (T3S, R2E, Sec. 22); 12, 15, and 16 (T3S, R2E, Sec. 15); 22 (T3S, R2E, Sec. 15); 23 (T3S, R2E, Sec. 15); and 24 (T3S, R3E, Sec. 18).

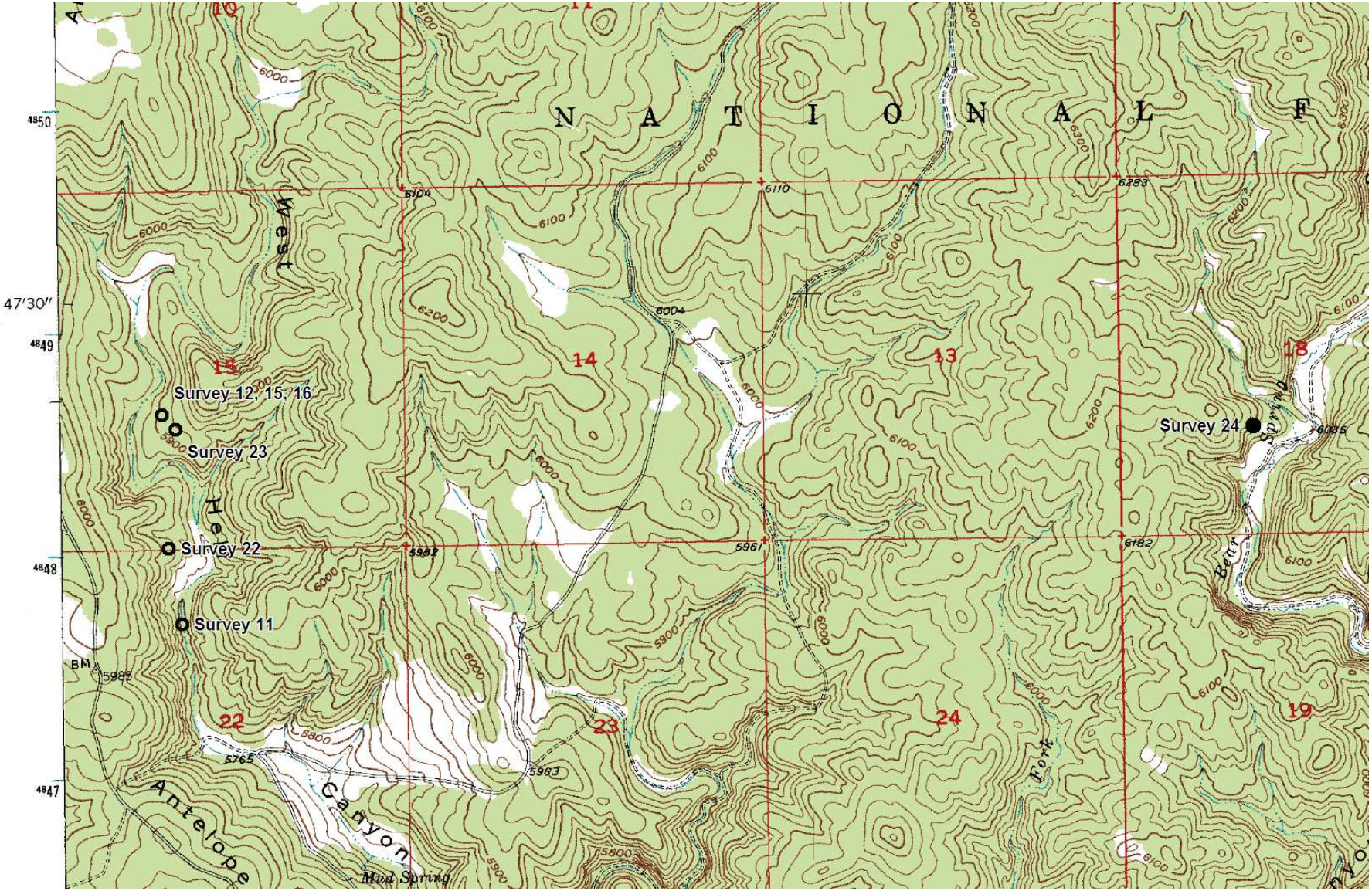

N A T I O N A L F
West
Hel
Antelope
Canyon
Mud Spring
Fork
Bear
Spring
Survey 12, 15, 16
Survey 23
Survey 22
Survey 11
Survey 24
47'30"
10
11
14
13
18
15
22
23
24
19
6104
6110
6283
6004
5982
5961
6182
5985
5765
5963
6035

Figure 7. Dead Horse Flats Quadrangle. Survey 21 (T3S, R1E, Sec. 4). Lizards were found at survey site 20, about 1 km west of survey 21 (fig. 2, p. 18).

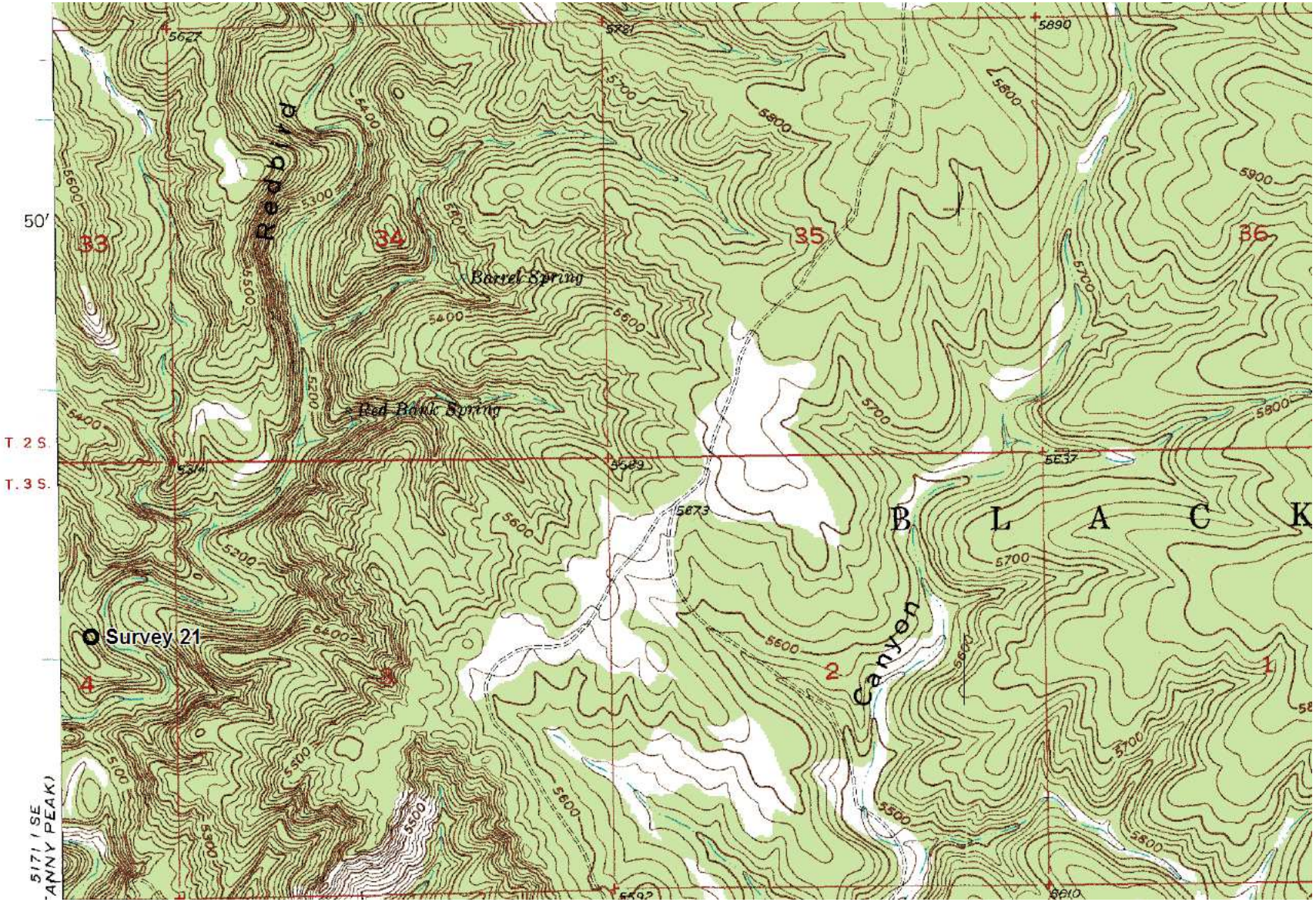

Redbird
Barrel Spring
Red Rock Spring
BLACK
Canyon
Survey 21
33
34
35
36
4
3
2
1
T. 2 S.
T. 3 S.
50'

Figure 8. Dead Horse Flats Quadrangle. Surveys 25 and 26 (T3S, R1E, Sec. 26).

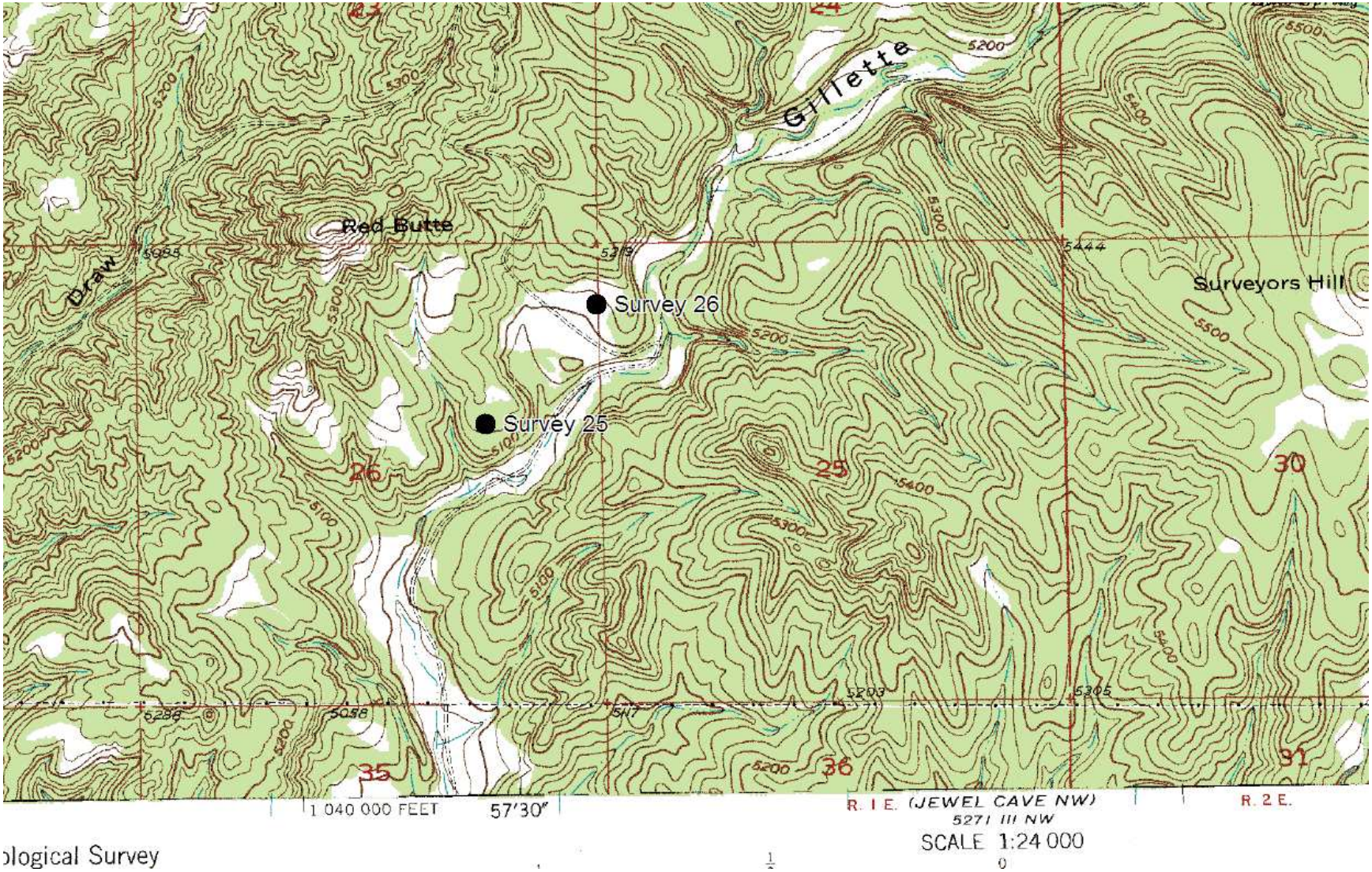

Gillette
Red Butte
Draw
Survey 26
Survey 25
Surveyors Hill
1 040 000 FEET
57'30"
R. 1 E. (JEWEL CAVE NW)
5271 III NW
SCALE 1:24 000
R. 2 E.
ological Survey

Figure 9. Fourmile Quadrangle. Surveys 27 (T5S, R3E, Sec. 1) and 28 (T4S, R3E, Sec. 35).

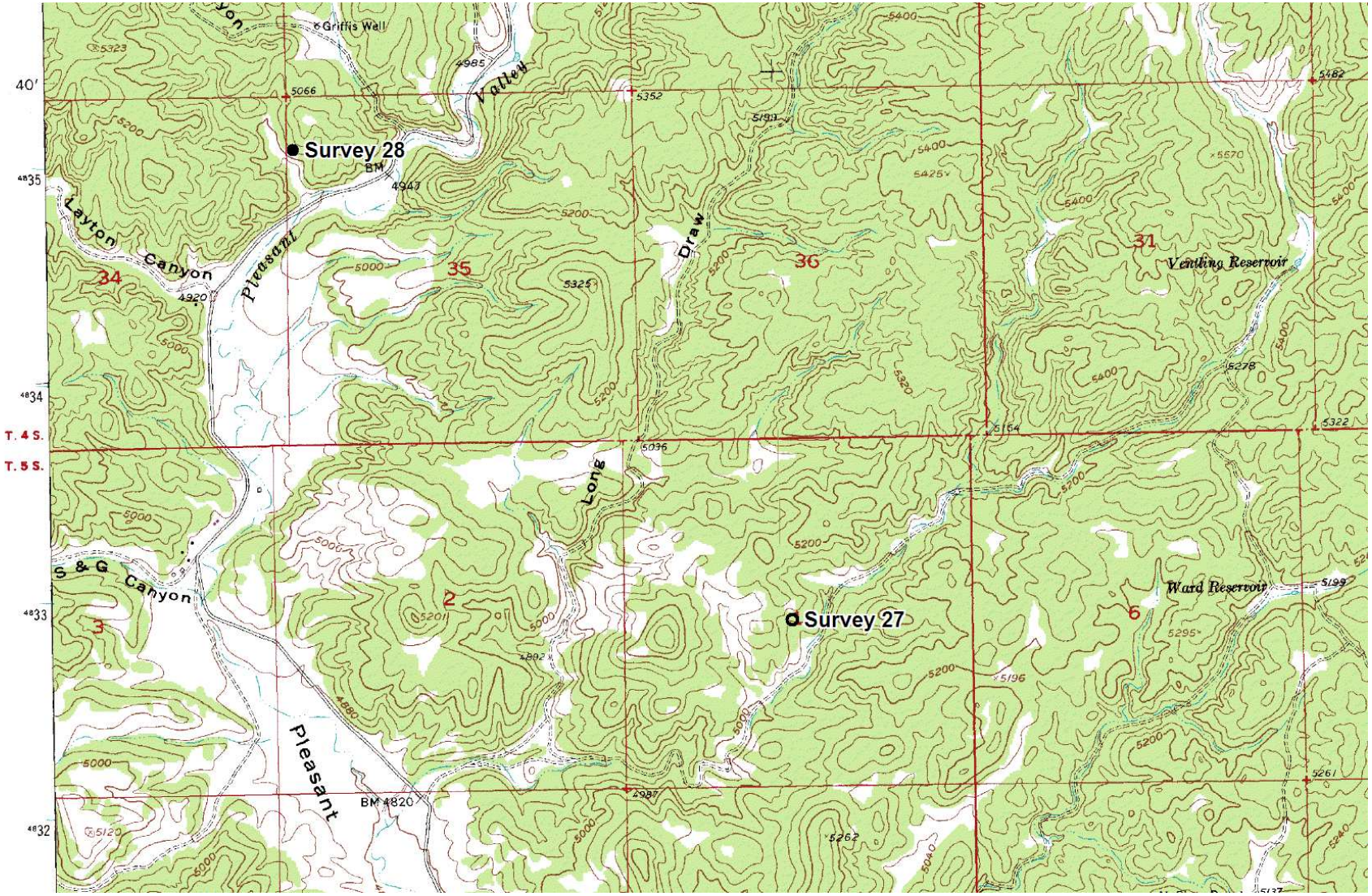

Survey 28
Survey 27
Layton Canyon
Pleasant Valley
Long Draw
S & G Canyon
Pleasant
Griffis Wall
Ventling Reservoir
Ward Reservoir
T. 4 S.
T. 5 S.
34
35
36
31
3
2
6
BM 4820

Figure 10. Jewel Cave SW Quadrangle. Surveys 33 and 34 (T5S, R1E, Sec. 26); and 35 (T5S, R1E, Sec. 35).

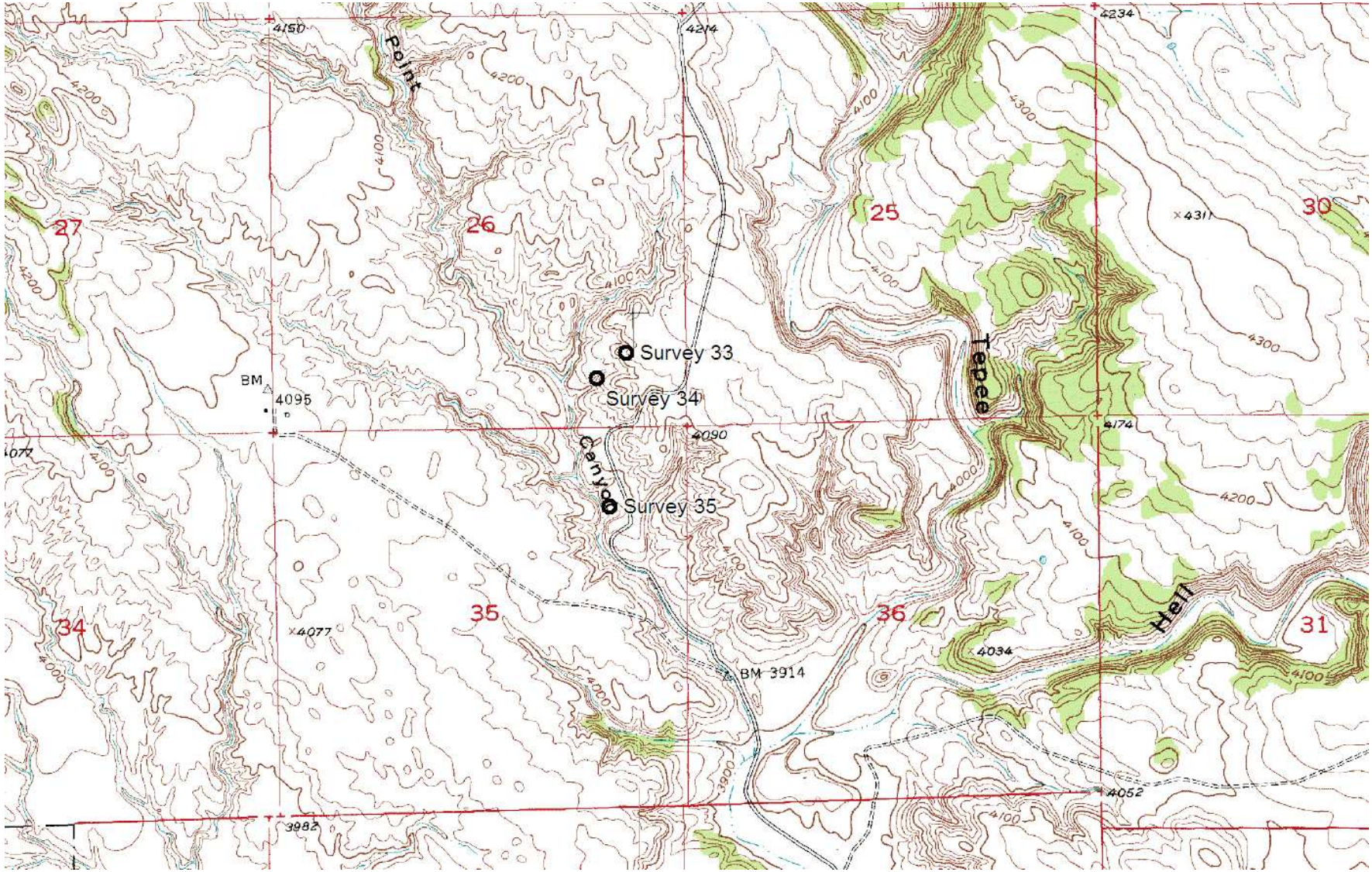

Point
Canyon
Ledge
Hell
Survey 33
Survey 34
Survey 35
BM
4095
BM 3914
4150
4214
4234
4311
4174
4090
4077
4034
4052
3982
27
26
25
30
34
35
36
31

Figure 11. Minnekahta NE Quadrangle. Surveys 36 (T6S, R4E, Sec. 35); 37 and 38 (T7S, R4E, Sec. 1); 39 and 40 (T7S, R4E, Sec.2).

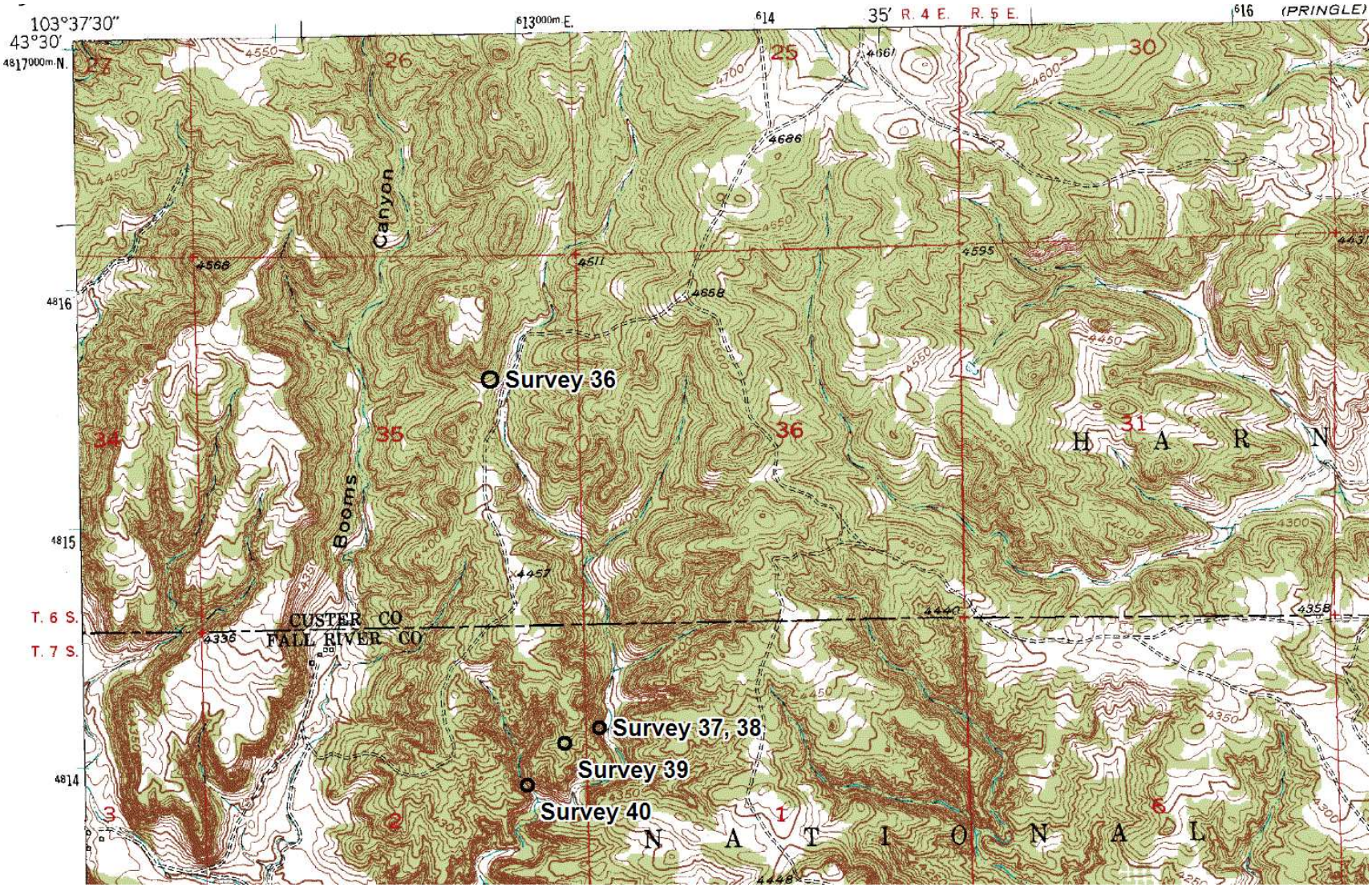


Figure 12: Pringle Quadrangle. Surveys 41, 42, and 43 (T6S, R5E, Sec.9).

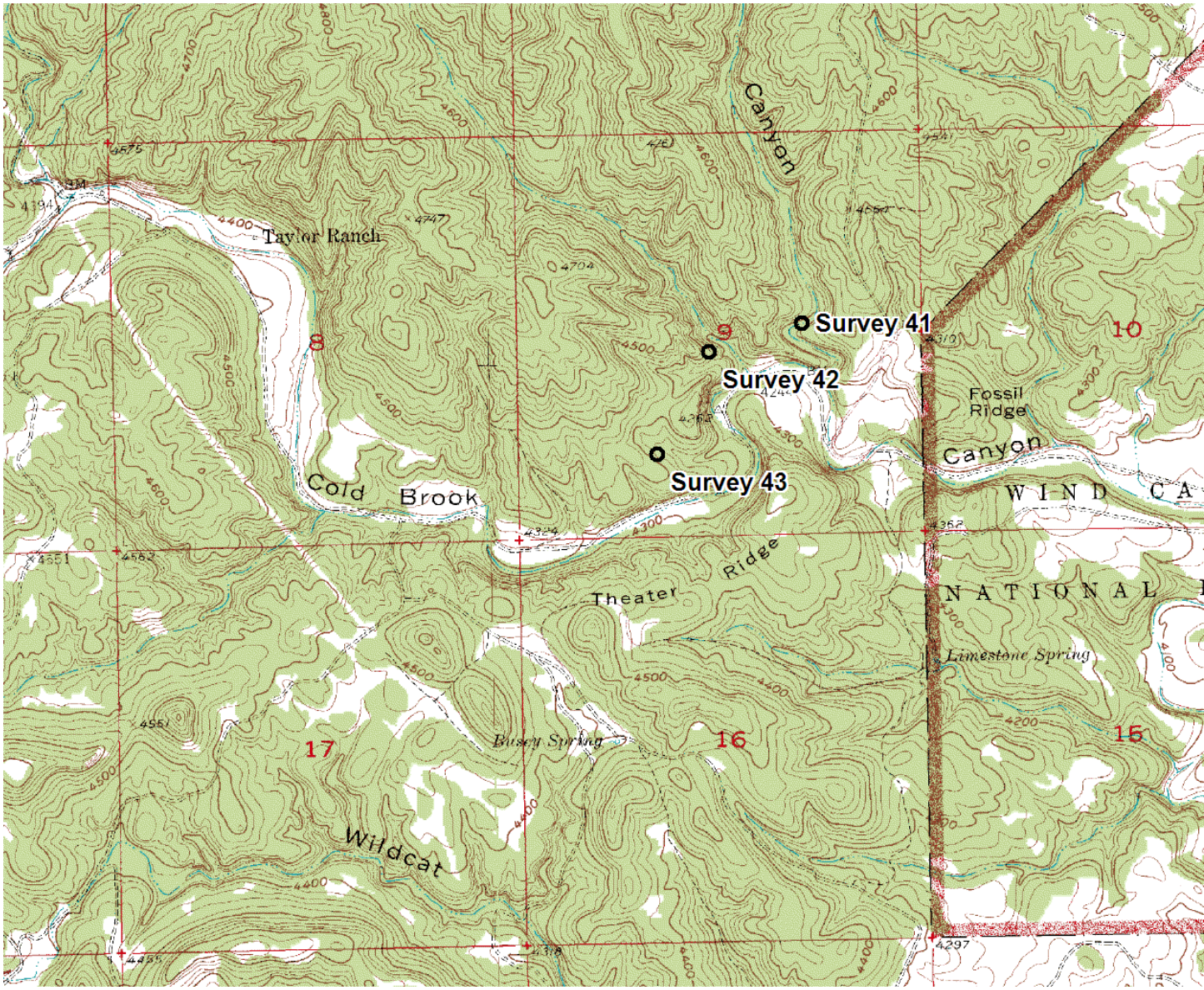


Figure 13. Jewel Cave NW Quadrangle. Historical sites 1 (T4S, R2E, Sec. 30) and 2 (T4S, R2E, Sec. 29).

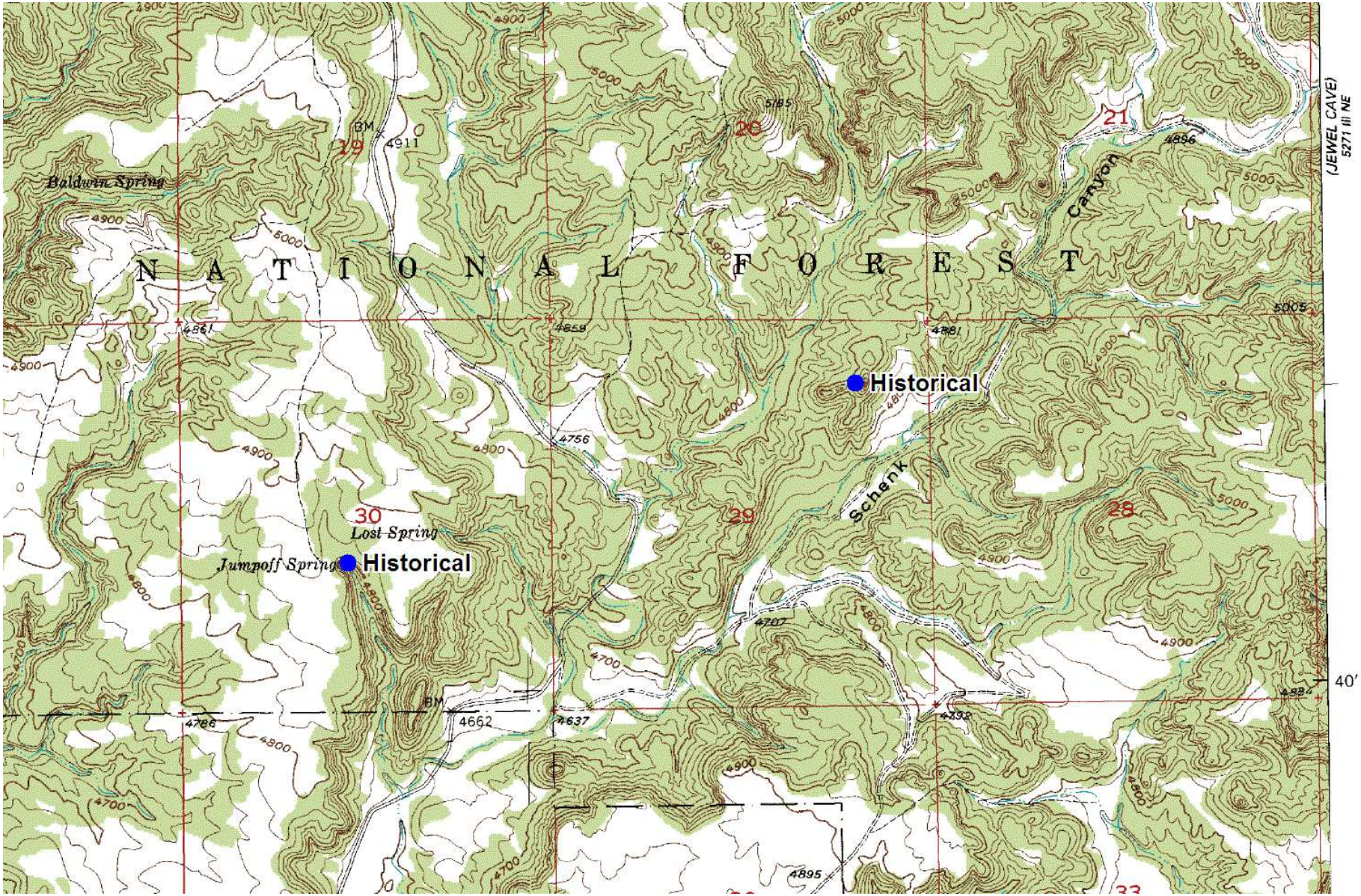

Baldwin Spring
N A T I O N A L F O R E S T
Historical
Lost Spring
Jumpoff Spring
Historical
Schenk
Canyon
(JEWEL CAVE)
5271 III NE
40'

Figure 14. Preacher Spring Quadrangle. Historical Site 4 (T1S, R2E, Sec. 31). Locality approximate.

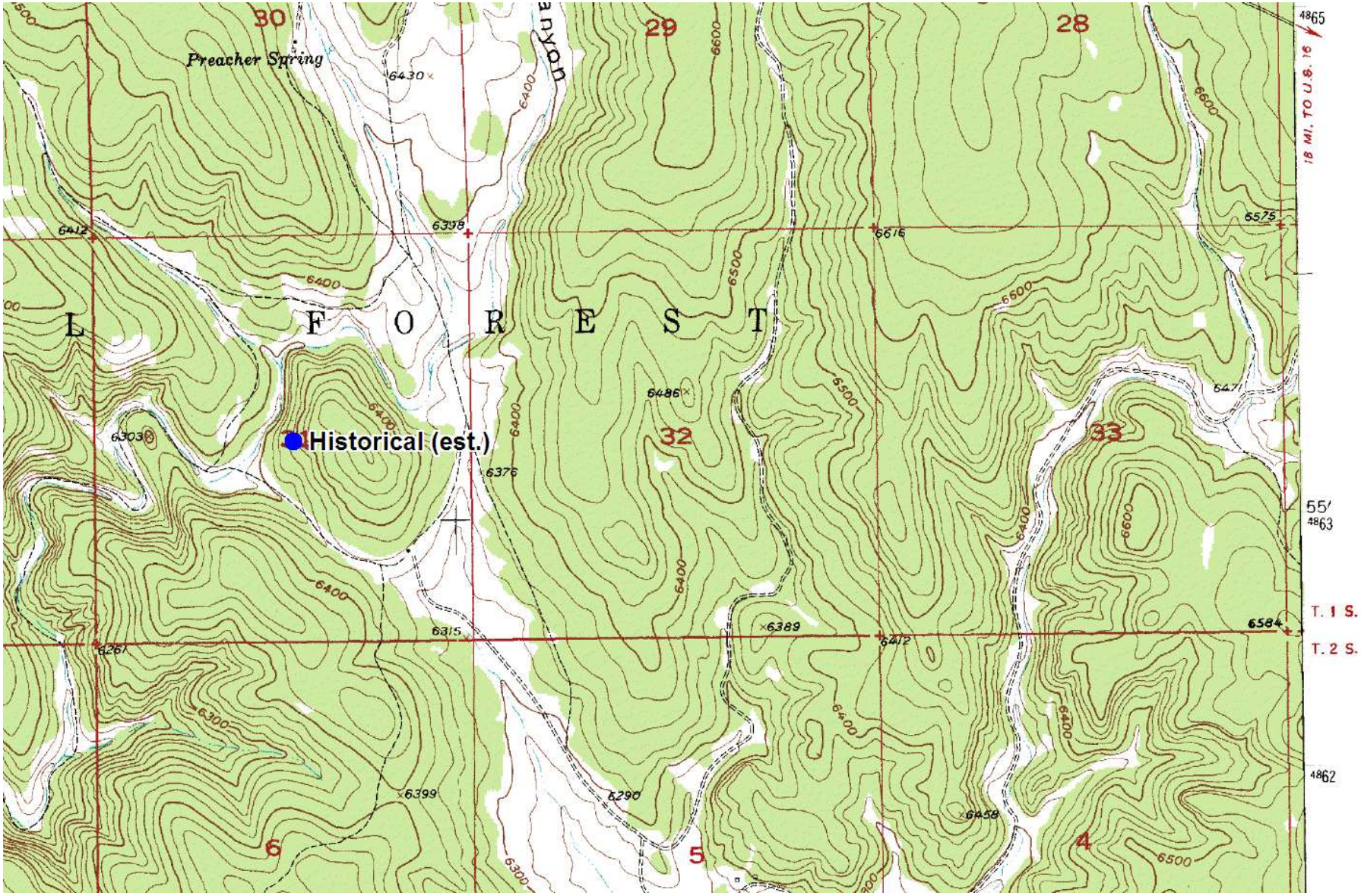
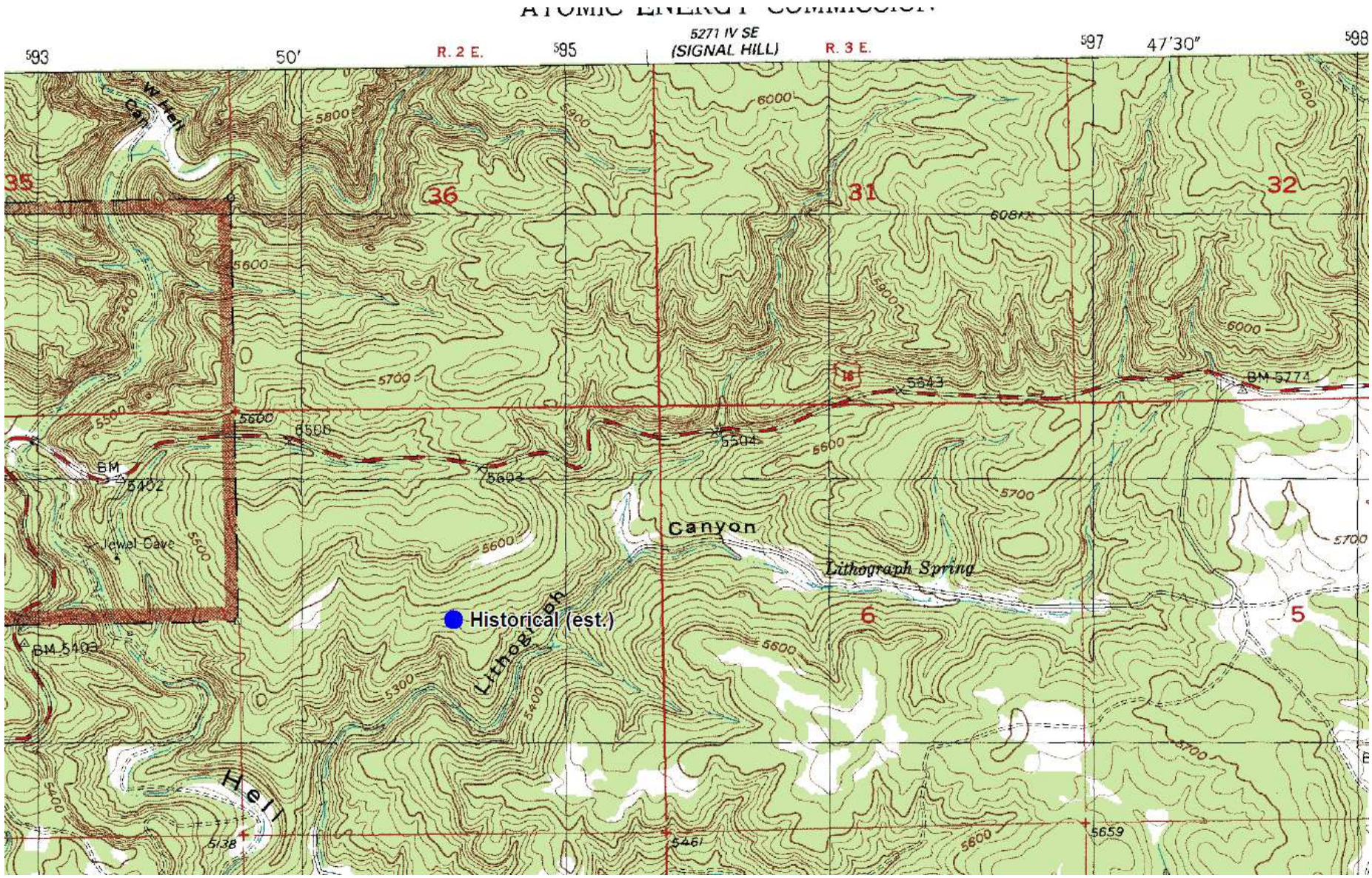

Preacher Spring
Historical (est.)
L F O R E S T
30
29
28
32
33
6
5
4
6430
6398
6412
6616
6575
6486
6303
6376
6315
6389
6412
6584
6261
6399
6290
6458
6471
6400
6500
6600
6300
18 MI. TO U.S. 16
T. 1 S.
T. 2 S.
4865
4863
4862

Figure 15. Jewel Cave Quadrangle. Historical site 5 (T4S, R2E, Sec. 1). Locality approximate.


5271 IV SE
(SIGNAL HILL)
R. 2 E.
R. 3 E.
50′
47′30″
35
36
31
32
6
5
Canyon
Lithograph Spring
Historical (est.)
Lithograph
Hell
Jewel Cave
BM 5402
BM 5403
BM 5774
5643
5504
5603
5600
5700
5800
5900
6000
5400
5500
5300
5138
5461
5659