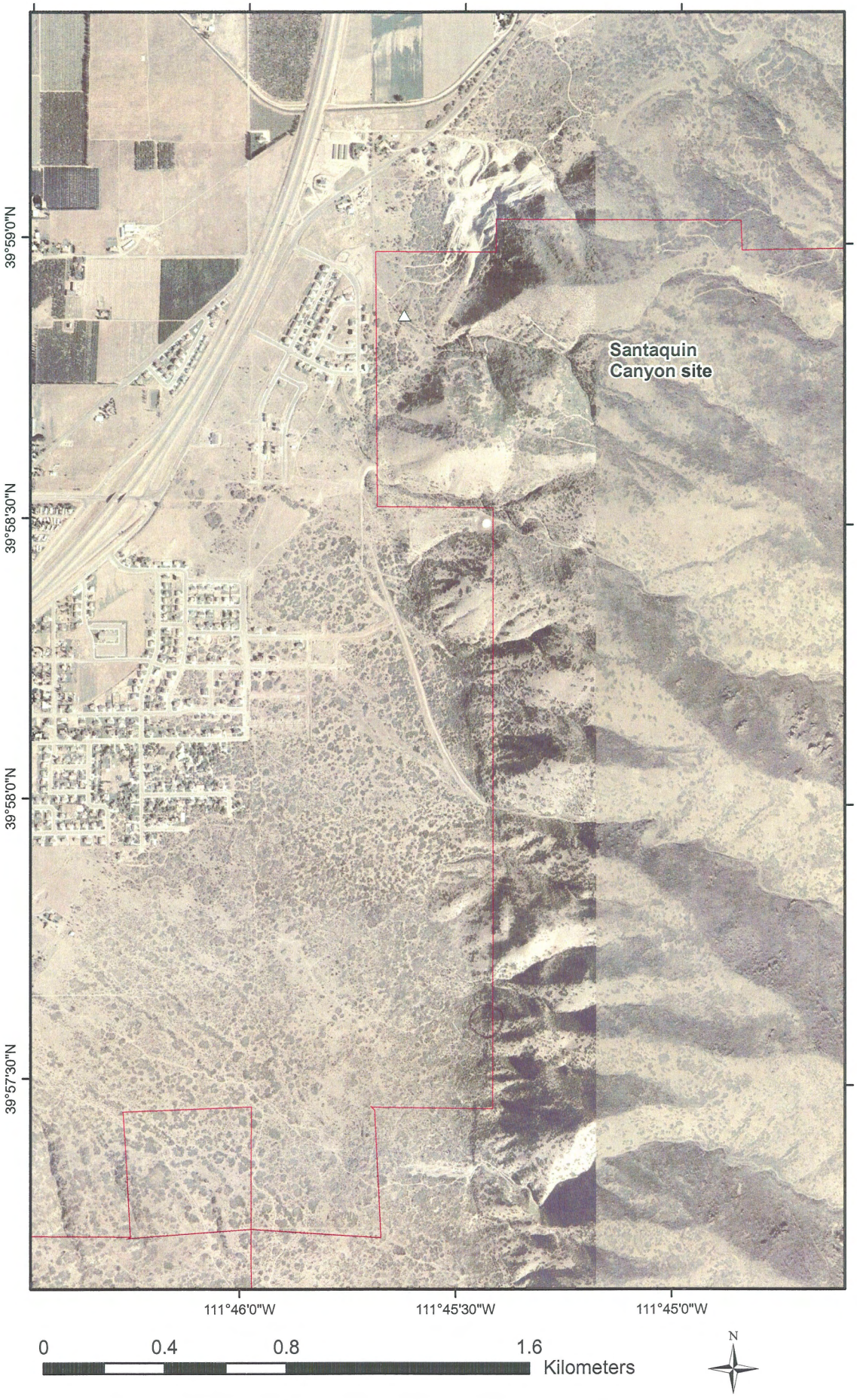
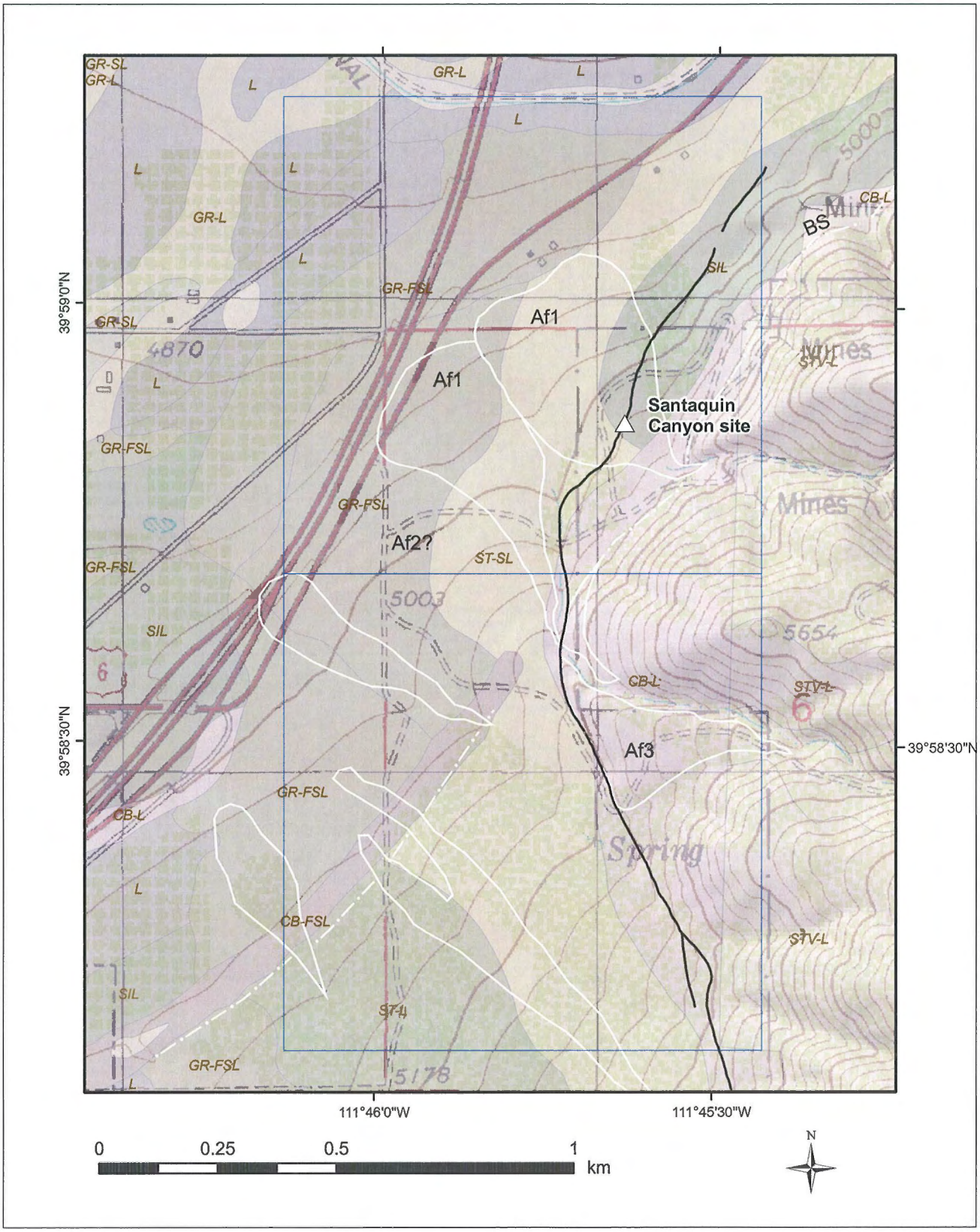

39°59'0"N
39°58'30"N
39°58'0"N
39°57'30"N
Santaquin
Canyon site
111°46'0"W
111°45'30"W
111°45'0"W
0
0.4
0.8
1.6
Kilometers
N


Santaquin
Canyon site
Af1
Af1
Af2?
Af3
GR-SL
GR-L
GR-FSL
ST-SL
CB-L
CB-FSL
STV-L
SIL
Mines
Spring
4870
5003
5654
5178
39°59'0"N
39°58'30"N
111°46'0"W
111°45'30"W
0
0.25
0.5
1
km
N


39°59'0"N
39°58'30"N
39°58'30"N
111°46'0"W
111°45'30"W
BS
Af1
Af1
Santaquin
Canyon site
Af2?
Af3
0
0.25
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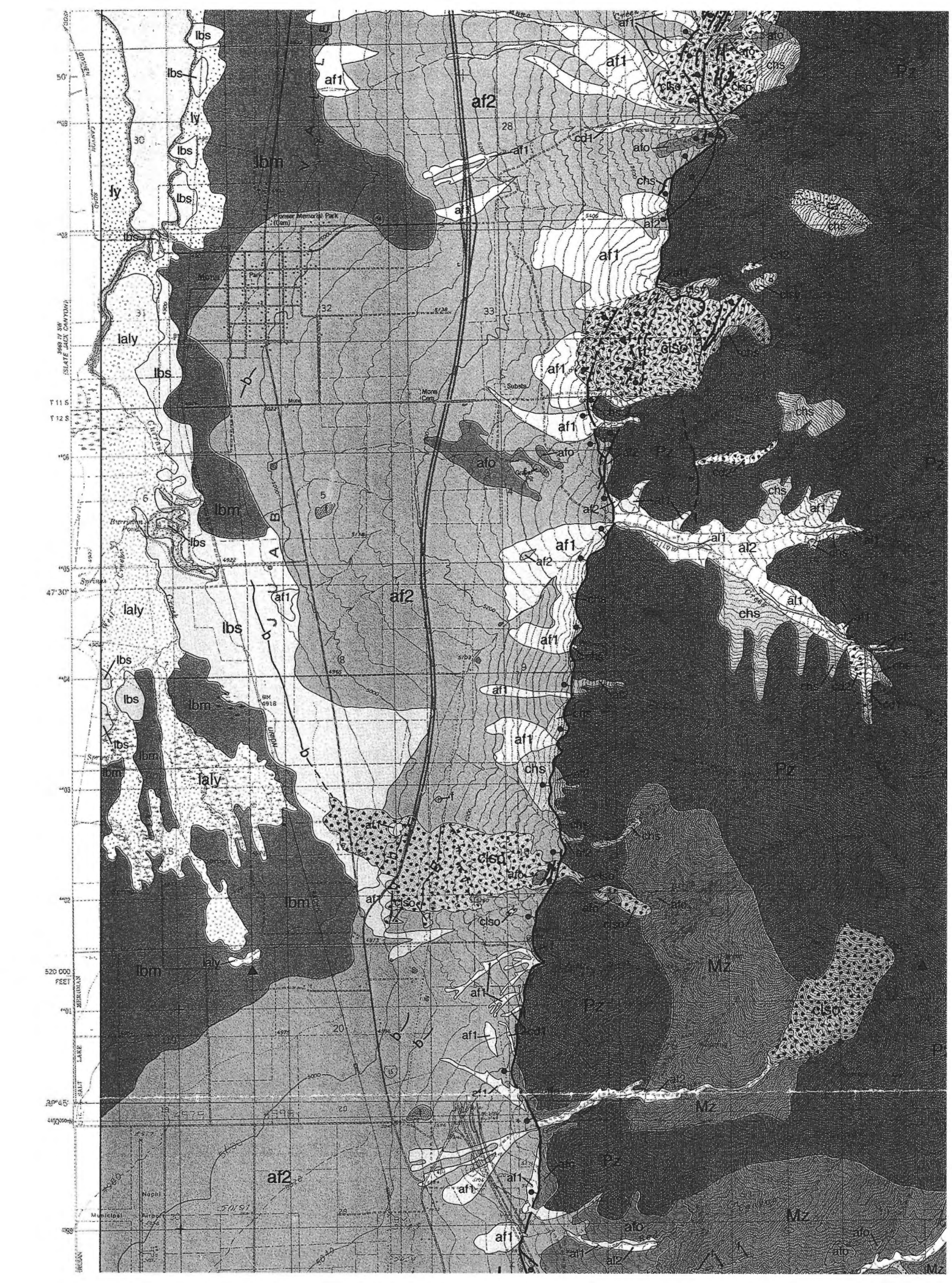
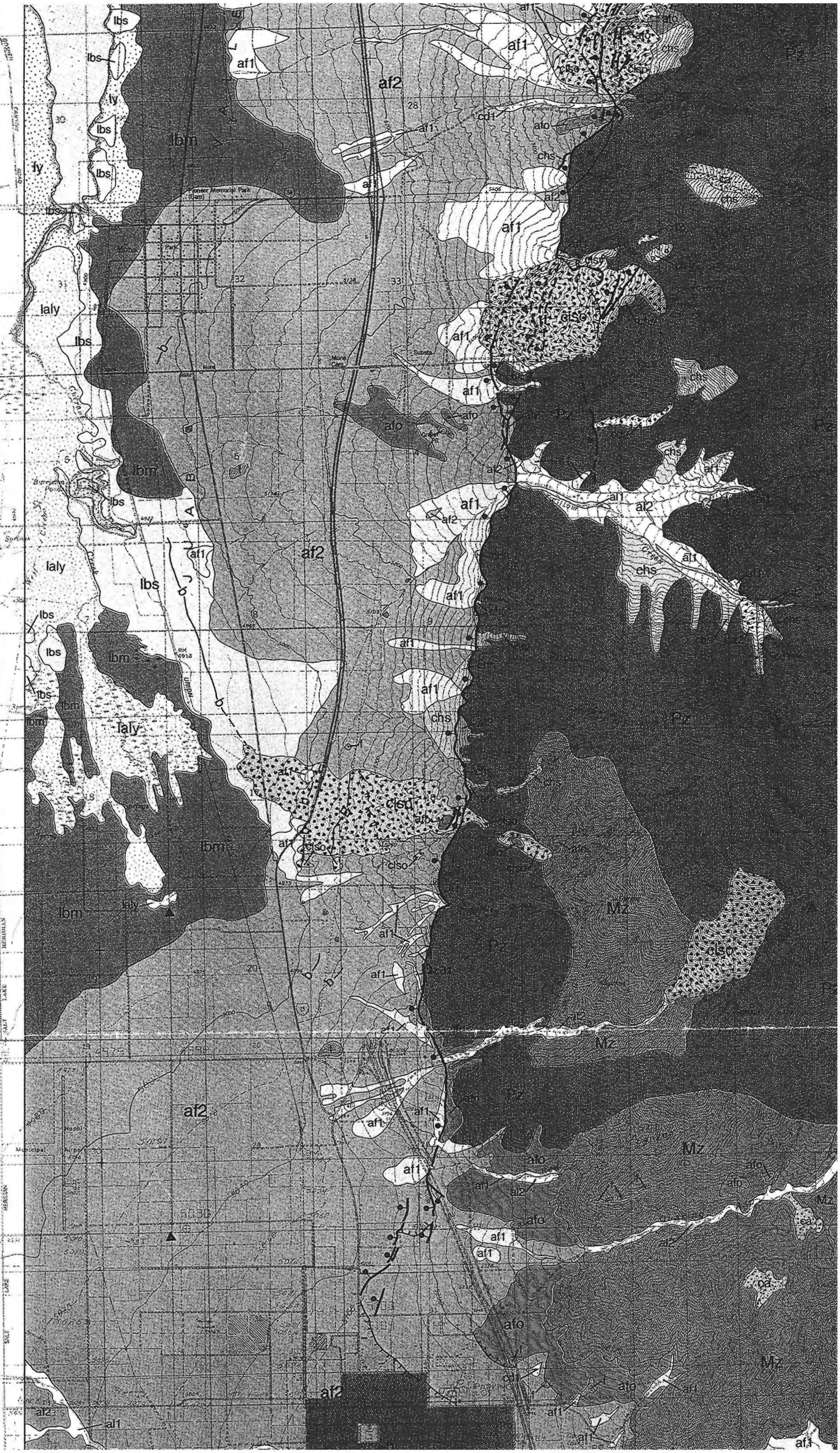
1
km
N


lbs
lbm
ly
laly
af1
af2
afo
clso
chs
Pz
Mz
Pioneer Memorial Park
Mona
Nephi
Municipal Airport
Salt Lake Meridian
T 11 S
T 12 S
47°30'
520 000 FEET



lbs
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SALT LAKE MERIDIAN
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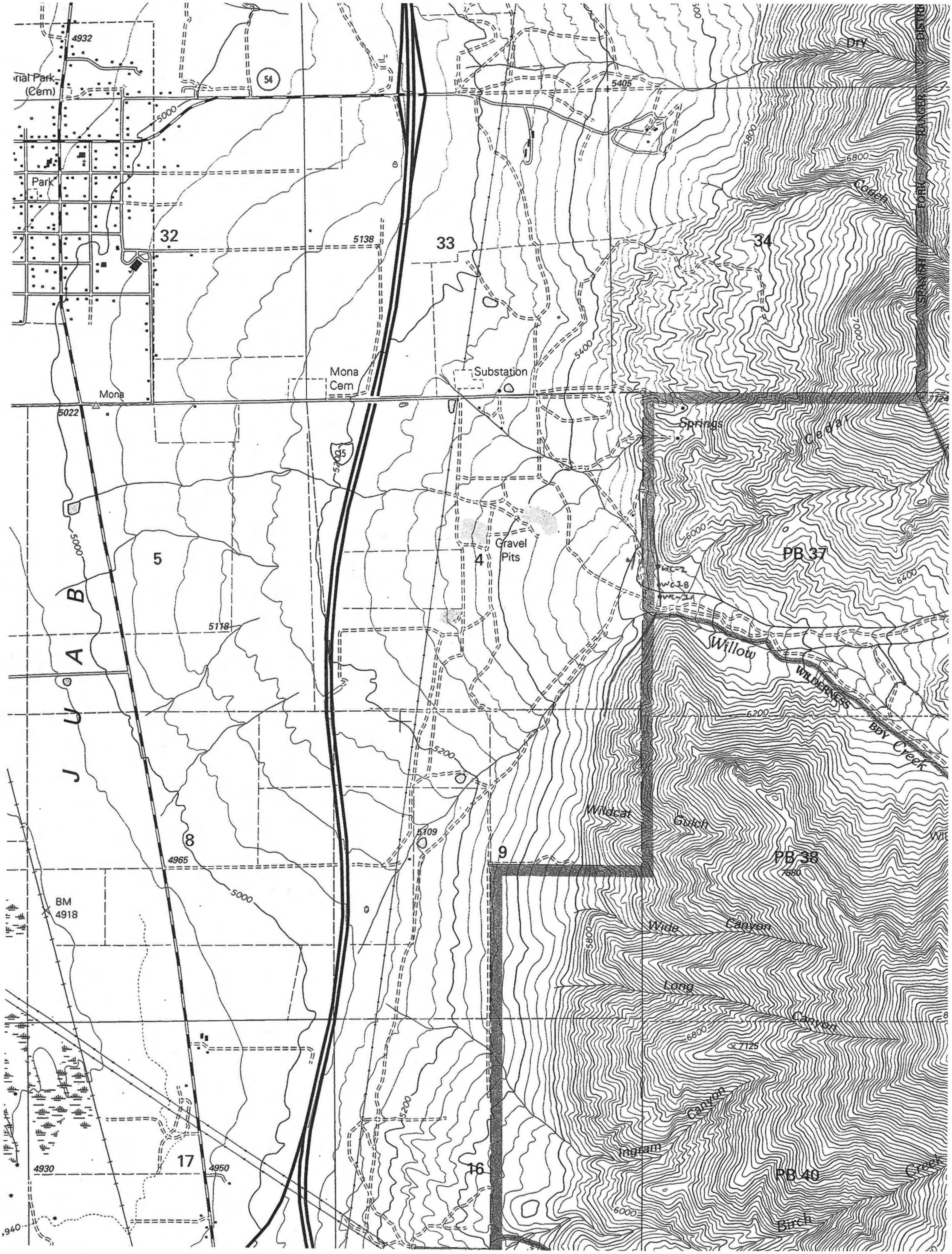
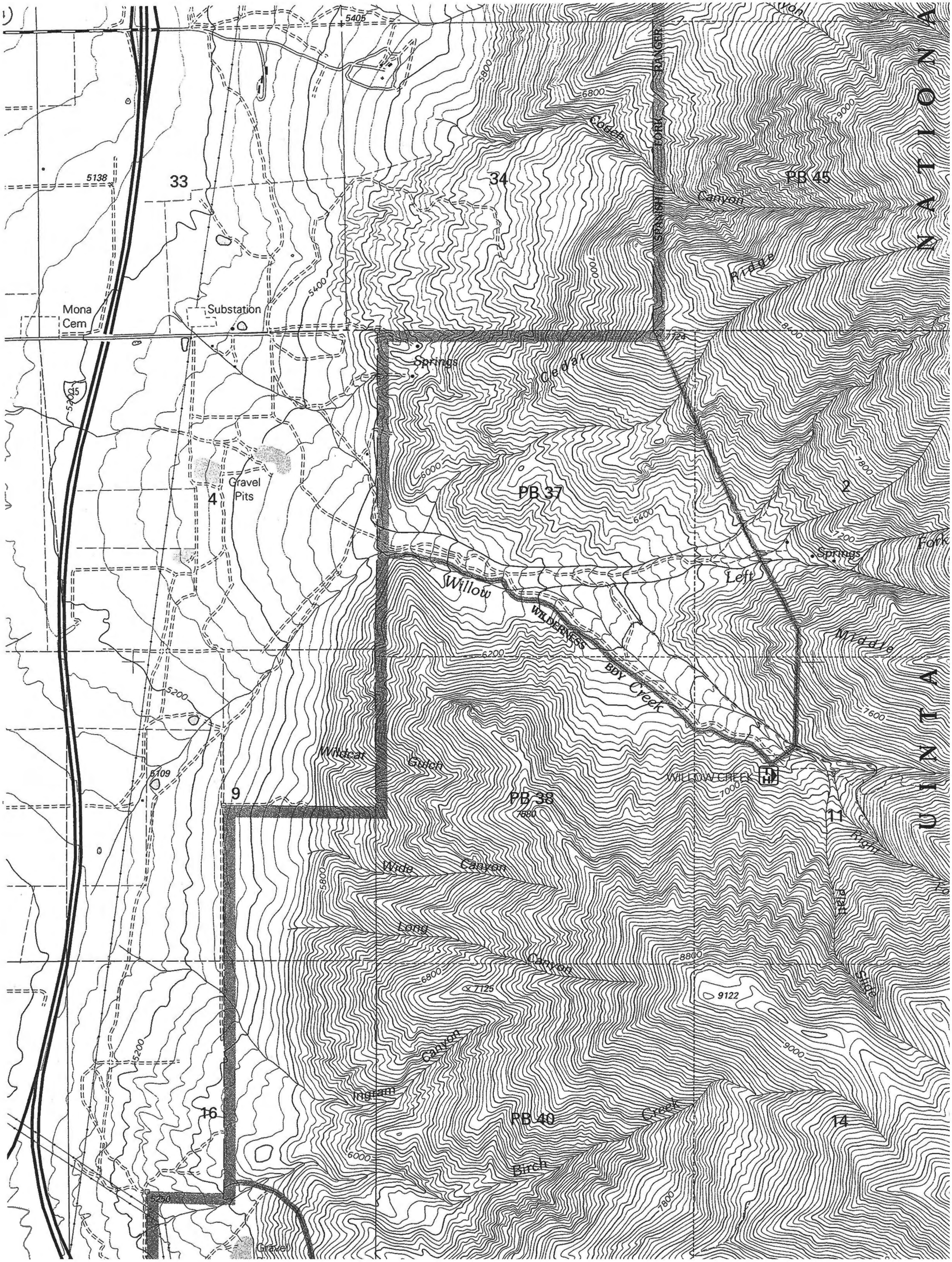

4932
Cem
Park
54
5405
Dry
5000
5800
6800
Coach
SPANISH FORK RANGER DISTRICT
32
5138
33
34
5400
7000
Mona Cem
Substation
Mona
5022
7724
Springs
Cedar
15
5000
5
4
Gravel Pits
6000
PB 37
6400
B
5118
A
Willow
WILDERNESS BDY
Creek
U
6200
5200
J
Wildcat
Gulch
5109
8
9
4965
PB 38
7680
BM 4918
5000
5800
Wide
Canyon
Long
Canyon
6800
7125
5200
Canyon
Ingram
17
4950
4930
16
PB 40
Creek
6000
Birch
4940



5405
33
34
PB 45
5138
Coach
Canyon
SPANISH FORK RANGER
Ridge
6800
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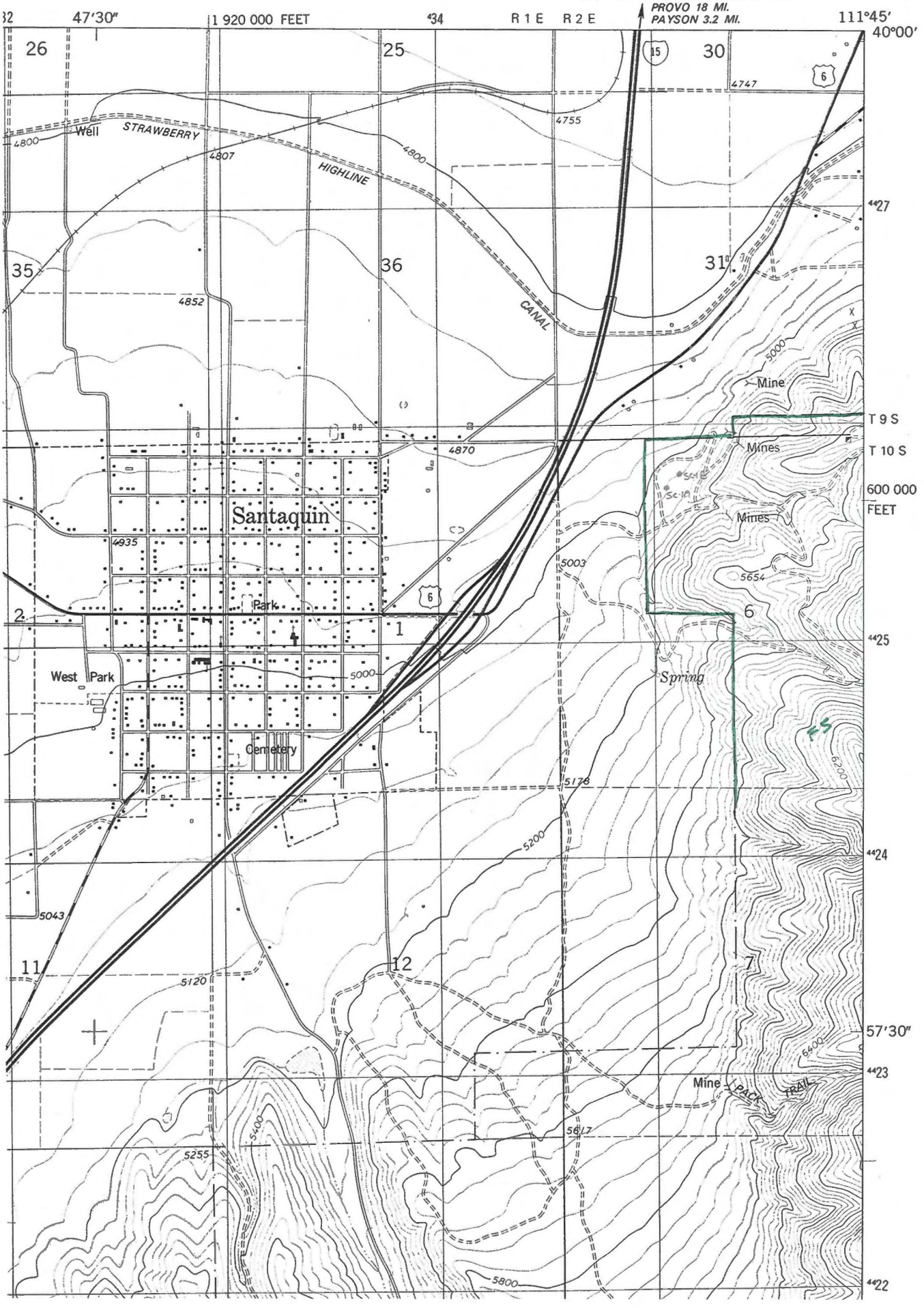
Mona Cem
Substation
7724
8600
Springs
Cedar
15
Gravel Pits
4
PB 37
6000
6400
2
7800
7200
Springs
Left Fork
Willow
WILDERNESS BDY
Creek
Middle
6200
7600
5200
Wildcat
Gulch
WILLOW CREEK
5109
9
PB 38
7580
11
Right
Wide
Canyon
Long
Canyon
8800
7125
9122
Side
Platt
Canyon
Ingram
16
PB 40
Creek
14
Birch
5250
Gravel
UINTA NATIONA

SANTAQUIN QUADRANGLE
UTAH
7.5 MINUTE SERIES (TOPOGRAPHIC)

NE/4 SANTAQUIN 15' QUADRANGLE

PROVO 18 MI.
PAYSON 3.2 MI.

3684 II SW
(SPANISH FORK)



UQFPWG Evaluation

The UQFPWG recognized the uncertainty associated with the timing of surface faulting on the NS, but in the absence of updated information had no alternative but to accept the earthquake chronologies as reported by the original investigators at North Creek and Red Canyon. However, UQFPWG acknowledged a high degree of uncertainty regarding the timing of surface faulting on the NS, as reflected in their recurrence-interval and slip-rate distributions for the NS of 1200-2500-4800 years and 0.5-1.1-3.0 mm/yr, respectively. They also noted the lack of detailed paleoseismic information for the Santaquin trace of the NS, and the resulting uncertainty there regarding the affect on the NS of possible rupture overlap from the PS, and likewise, the possible affect of NS earthquakes on the southern part of the PS. The UQFPWG gave the NS a high priority for future paleoseismic work in Utah (Lund, in prep.)

Reducing Losses from Earthquakes in Utah

The results of this paleoseismic investigation will help reduce losses from future earthquakes in Utah by permitting more accurate earthquake-hazard evaluations for hazard mitigation in the urbanized Wasatch Front region. Specifically, results expected from this collaborative study include: (1) slip rates, timing, and recurrence intervals between the past 2 to 3 earthquakes at the Santaquin Canyon site on the Santaquin strand; and (2) slip rates, timing, and recurrence intervals between the past 3 to 4 earthquakes at the Willow Creek site on the Nephi strand. These data will better define rates of activity for the NS, the most poorly understood of the five central most active segments of the WFZ. Furthermore, comparison of these results with results from previous and ongoing studies of the PS to the north (Machette, 1988; Ostenaa, 1990; Lund and others, 1991; Machette and others, 1992; Lund and Black, 1998; Olig and others, 2004) will help resolve segmentation issues for the Nephi and Provo segments (Ostenaa, 1990; DuRoss and Bruhn, 2003). These data are critical for improving seismic-source characterization and probabilistic earthquake hazard analyses, including the next update of the National Seismic Hazard Maps.

PROJECT PLAN
(Santaquin Canyon Site)

Note that as the USGS and URS Corporation will be responsible for conducting work at the Willow Creek site, the description of that site and work plan are included in the URS collaborative proposal.

The Utah Geological Survey (UGS) will manage and be responsible for the paleoseismic-trenching investigation on the Santaquin strand; URS Corporation will collaborate in the fieldwork at the Santaquin Canyon site and provide coordination with the work performed on the Nephi strand at Willow Creek. The primary goal of the proposed investigation is to identify, determine the timing, and measure the slip of the past two or three surface-faulting earthquakes, compare the resulting paleoearthquake history to the Nephi strand and PS to the north, and develop more accurate fault parameters for seismic-hazard assessment of the entire NS. To accomplish these objectives, we propose to excavate two trenches at our preferred site on the Santaquin strand near Santaquin Canyon (figures 2 and 3).

Santaquin Canyon Trench Site Description

Selection of the Santaquin Canyon location (figure 3) as our preferred trench site is based on geologic mapping by Machette (1992) and Harty and others (1997), a scarp investigation by DuRoss and Bruhn (2003), interpretation of 1:12,000 low-sun angle stereo photographs and 1-meter digital orthophotos, and

both a field and low altitude aerial reconnaissance. The Santaquin Canyon site represents the best opportunity to investigate Holocene surface ruptures on the Santaquin strand of the NS. The site has the stratigraphic and geomorphic conditions necessary to preserve evidence of surface faulting, is easily accessible to excavation equipment, and is one of the few locations along the Santaquin strand without prohibitive landowner restrictions.

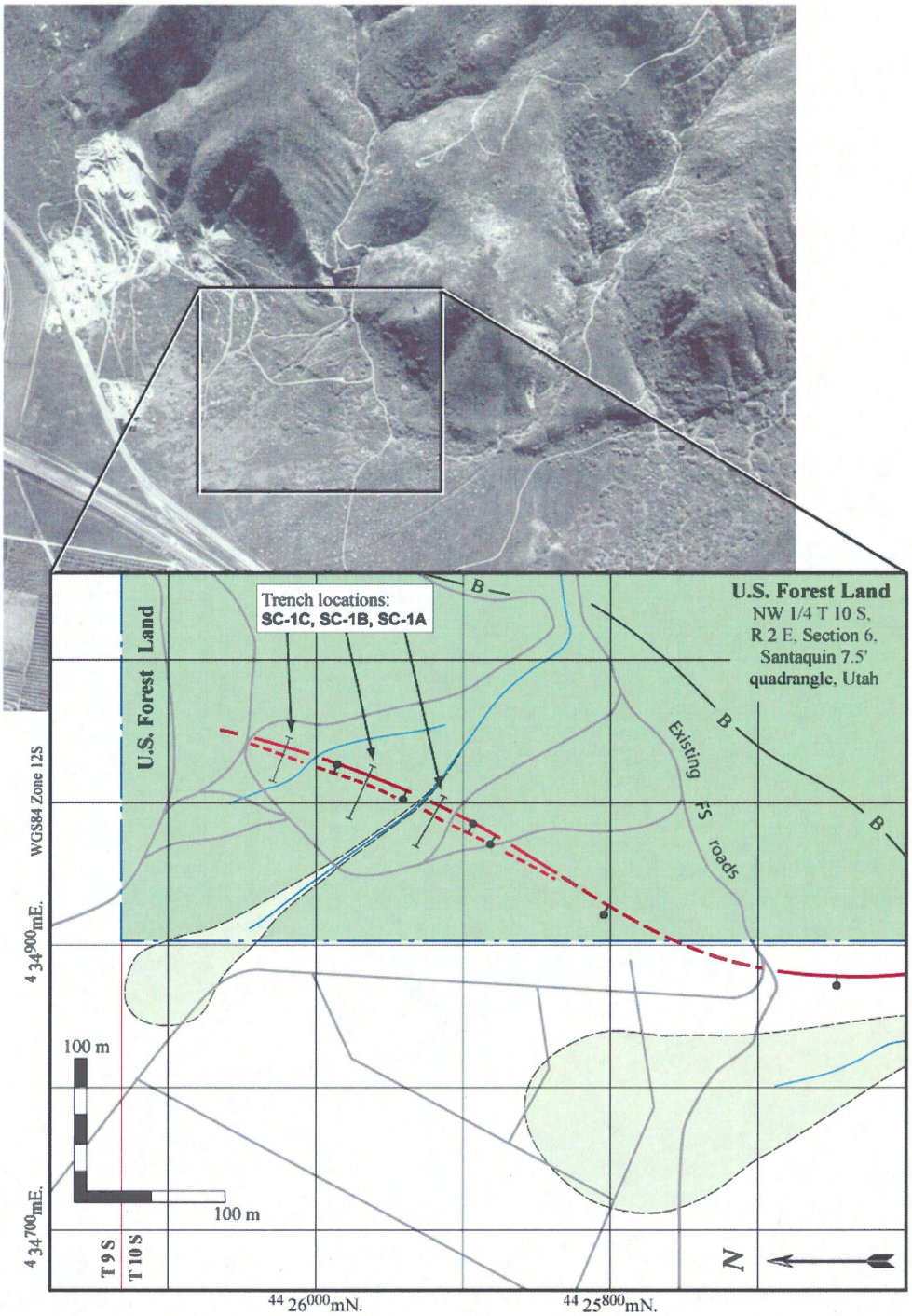


Figure 3. Proposed Santaquin Canyon trench site, low-sun angle aerial photograph scale is approximately 1:12,000. Trench locations in order of preference are SC-1A, SC-1B, SC-1C.

Based on our field reconnaissance, we prefer the Santaquin Canyon site (figure 3) for the following reasons:

1. the fault geometry is simple, scarps are well preserved, with a single main scarp and antithetic scarps together producing 2-3 m of cumulative vertical displacement;
2. Holocene fan deposits are displaced by both the main and antithetic faults, and provide the opportunity to investigate post-Bonneville surface ruptures;
3. a narrow 5-10-m-wide graben serves as a sediment trap for fault scarp colluvium, loess, and debris-flow deposits potentially rich in organic material;
4. the trench site is near the center of the fault strand, and includes the youngest surface ruptures on the strand;
5. the site is on U.S. Forest Service (USFS) land for which a trenching permit can be obtained, and is easily accessible by existing roads;
6. the scarps at the site displace two different age fan surfaces with greater net vertical tectonic displacement on the older surface, indicating multiple earthquakes have occurred there (minimum two and possibly three).

The Santaquin Canyon site lies below the Bonneville shoreline (15,500 to 14,500 ^{14}C yr BP; Currey, written communication to the UGS, 1996), the highest Lake Bonneville shoreline (B on figure 3). We have identified three potential trench locations for USFS permitting (SC-1A, SC-1B, and SC-1C; figure 3), and we propose to excavate trenches at two of them (1A and 1B) to investigate the number, timing, and amount of displacement of past surface-faulting earthquakes. Each trench will cross the main scarp, and extend 30-40 m onto the hanging wall alluvial-fan surface to intercept displacement across the antithetic faults. The trenches will be 3-5 m deep, with a vertical south wall, and a laid-back or stepped north wall. We will excavate two "T" shaped 4-m-long by 1.2-m-wide by 3-m-deep soil pits on the hanging-wall and footwall fan surfaces to expose soil profiles that are unaffected by faulting, and to better correlate alluvial-fan stratigraphy across the fault scarps. The project will be broken into three principal tasks, which include site geologic mapping (Task 1), trench and soil pit excavation, interpretation and logging (Task 2), and data analysis and report preparation (Task 3).

Task 1 - Geologic Mapping

This task will include mapping the Quaternary geology and fault scarps in a 0.5 to 1 km square area centered on the trench site. Following geologic interpretation of aerial photographs, the locations of key geologic contacts and geomorphic features will be precisely mapped in the field using a total station.

As part of this task we will also measure at least one long (200 to 400 m) topographic profile across the fault zone at the trench site. The profile will help constrain net vertical tectonic displacements and slip rates.

Task 2 - Trenching

This task includes: (1) excavation, cleaning, interpreting, and logging trench exposures, (2) describing stratigraphic and pedologic units, (3) collecting samples for ^{14}C dating and, (4) conducting field reviews of our interpretation of the exposure for geologists, students, and public officials. Scarps will be excavated with a track-mounted excavator. Logistical difficulties are not expected due to the size of the scarps, maximum scarp angles (~26° to 30°), or the configuration of the trenches (laid back on one side). The UGS has hydraulic shoring available should it become necessary to shore any part of the trenches.

We anticipate encountering abundant organic material for ^{14}C analyses and have budgeted accordingly, assuming 2-3 samples per event horizon, and two events in each of the two Santaquin trenches for a total of

for work at the Willow Creek site. URS will also provide coordination and support to the UGS for the work performed on the Santaquin strand at Santaquin Canyon. The primary goal of the proposed investigation is to identify, determine the timing, and measure the slip of the past three or four surface-faulting earthquakes on the Nephi strand, compare the resulting paleoearthquake history to the Santaquin strand and PS to the north, and develop more accurate fault parameters for seismic-hazard assessment of the entire NS. To accomplish these objectives, we propose to excavate one or two trenches at our preferred site on the Nephi strand near Willow Creek (Figures 2, 3, and 4).

Willow Creek Trench Site Description

We selected the Willow Creek location (Figure 3) as our preferred trench site on the Nephi strand based on geologic mapping by Machette (1992) and Harty and others (1997); a scarp investigation by DuRoss and Bruhn (2003); interpretation of 1:12,000 low-sun angle stereo photographs and 1-meter digital orthophotos; and both a field and low altitude aerial reconnaissance. The Willow Creek site represents the best opportunity to investigate multiple Holocene surface ruptures on the Nephi strand of the NS. The site has the stratigraphic and geomorphic conditions necessary to preserve evidence of surface faulting, is easily accessible to excavation equipment, and is one of the few locations along the Nephi strand without prohibitive landowner restrictions (i.e., it is not in the Nebo Wilderness Study Area).

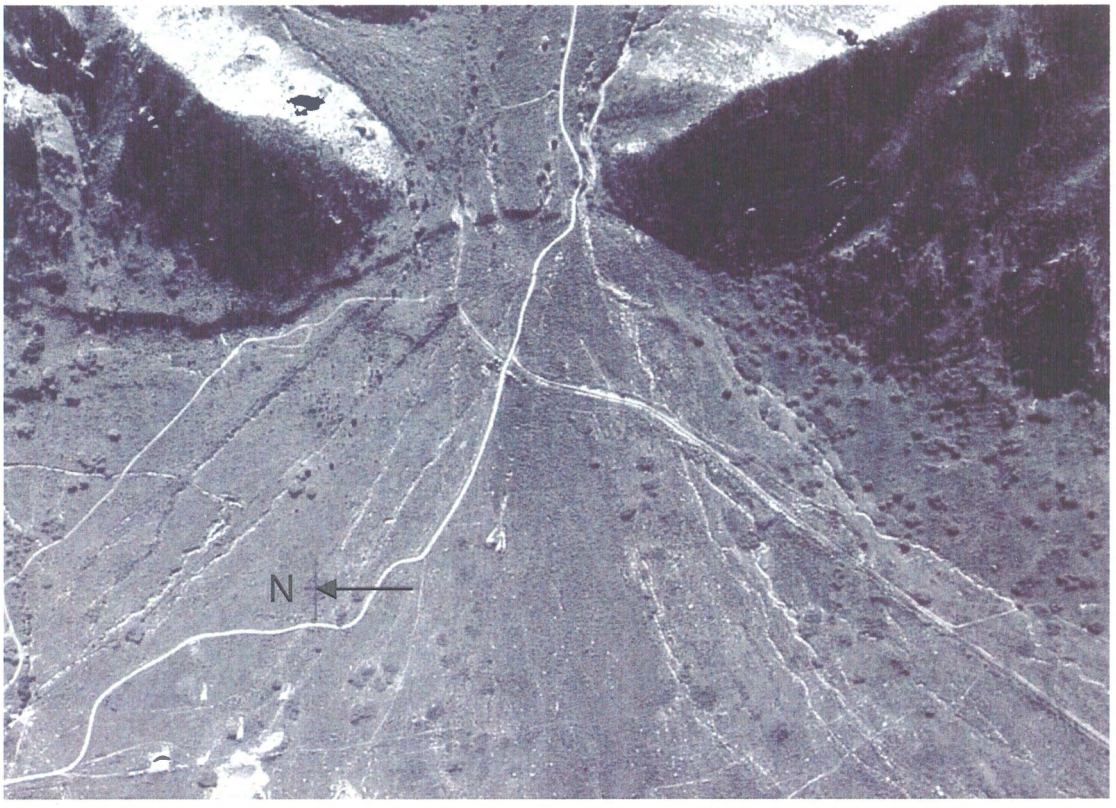


Figure 3. Low-sun-angle photograph showing the main fault scarp (in shadow) at the Willow Creek site on the Nephi strand of the Nephi segment.

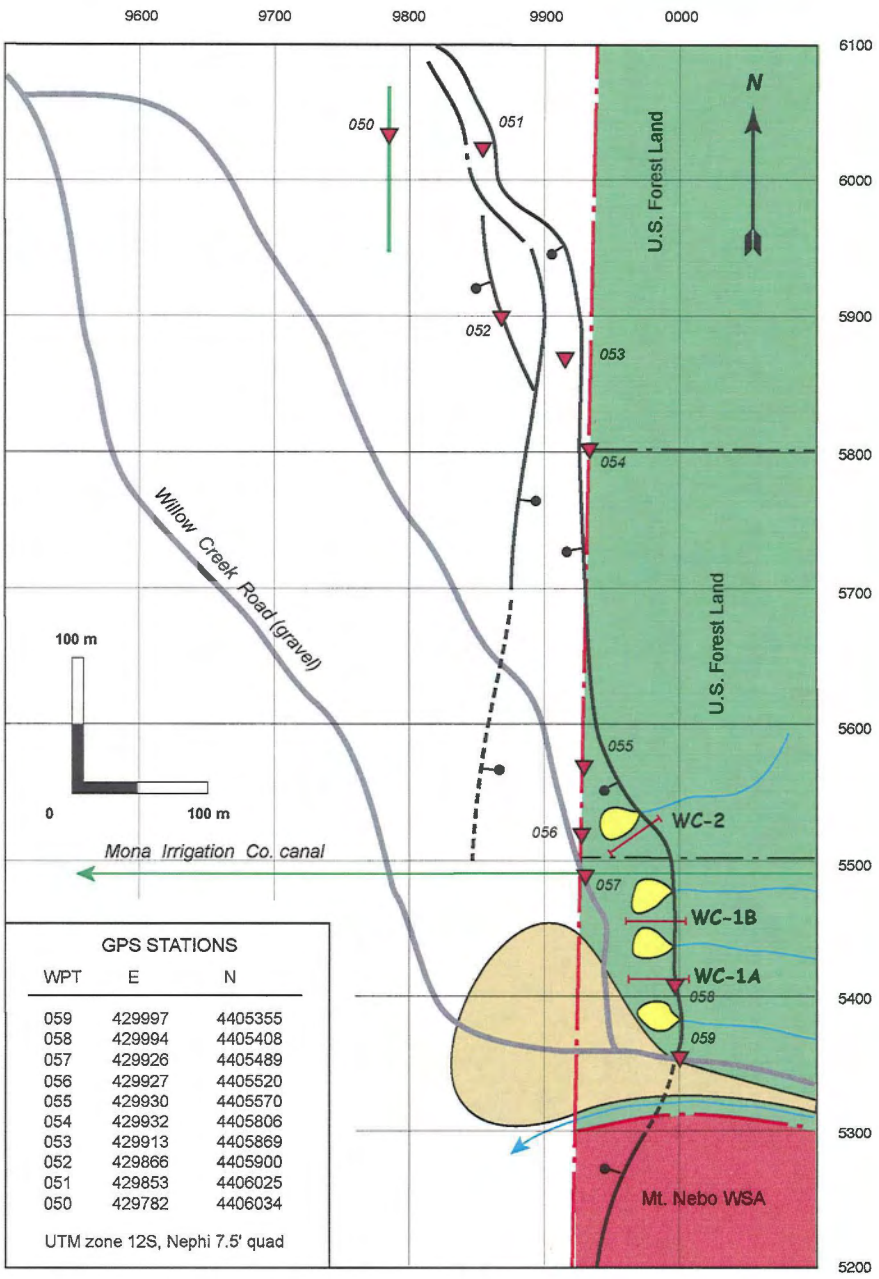


Figure 4. Proposed trench locations at the Willow Creek site.

Based on available data and our field and aerial reconnaissance, we selected the Willow Creek site (Figures 3 and 4) for the following specific reasons:

1. the fault geometry is simple with a single, well-preserved scarp producing 5 to 7 m of net vertical tectonic displacement of different age surfaces near the mouth of the Willow Creek fan (Figure 3);
2. the trench site is easily accessible on existing roads (Figures 3 and 4);
3. the site is near the center of the fault strand (Figure 2), includes the youngest surface ruptures on the strand, and is just southwest of Mt. Nebo, the highest peak in the footwall of the Nephi segment at an elevation of 3,637 m;

4. the site is on U.S. Forest Service (USFS) land for which a trenching permit can be obtained (indeed, we already initiated the permit application process and foresee no obstacles in obtaining a permit);
5. the scarps at the site displace two different age fan surfaces with greater net vertical tectonic displacement on the older surface (5.2 to 6.4 m on Af2y, a mid to early Holocene fan, versus 6.8 to 7.2 m on Af2o, an early Holocene to latest Pleistocene fan; DuRoss, in preparation), indicating multiple earthquakes have occurred (likely 3 to 4 events).

At an elevation of roughly 1,732 m (5,680 ft), the Willow Creek site lies well above the Bonneville shoreline in Juab Valley, the highestand of Lake Bonneville. We have identified three potential trench locations at the Willow Creek site for USFS permitting (WC-1A, WC-1B, and WC-2; Figure 4). All of these locations are on Af2y deposits and the scarps are similar to the scarp at North Creek (Harty et al., 1997), where evidence for 3 events was found (Hanson et al., 1981). We propose to excavate trenches at one or two locations (WC-2 and/or WC-1A, depending on funding levels to M. Machette and the nature of the WC-1A exposure, which will be excavated first), to investigate the number, timing, and amount of displacement of past surface-faulting earthquakes. Site WC-1B is being permitted as a back-up location. Each trench will cross the main scarp, and extend 30-40 m onto the hanging wall alluvial-fan surface to intercept displacement across any buried antithetic faults. The trenches will be 3-5 m deep, with a vertical south wall, and a laid-back or stepped north wall. We will excavate two "T" shaped 4-m-long by 1.2-m-wide by 3-m-deep soil pits on the hanging-wall and footwall fan surfaces to expose soil profiles that are unaffected by faulting, and to better correlate alluvial-fan stratigraphy across the fault scarps. The project will be broken into three principal tasks, which include site geologic mapping (Task 1), trench and soil pit excavation, interpretation and logging (Task 2), and data analysis and report preparation (Task 3). Note that our budget does not include vehicle rental as transportation will be coordinated as needed with UGS and USGS personnel, as will the use of large field equipment (such as a Total Station, ladders, etc.). Fencing materials will be provided from UGS reserves from previous projects. We do not anticipate needing shoring, but the UGS can provide a few pieces if needed. Additionally, costs for excavation and half of the age analyses will be covered by Machette's budget. We have included funding for preparation of bulk soil samples for radiocarbon dating and 5 AMS radiocarbon analyses.

Task 1 - Geologic Mapping

This task will include mapping the Quaternary geology and fault scarps in a 0.5 to 1 km square area centered on the trench site. Following geologic interpretation of aerial photographs, the locations of key geologic contacts and geomorphic features will be precisely mapped in the field using a total station.

As part of this task we will also measure at least one long (~200 m) topographic profile across the fault zone at the trench site. The profile will help constrain net vertical tectonic displacements and slip rates.

United States Department of Agriculture | Forest Service | Spanish Fork Ranger District | 44 West 400 North
Spanish Fork, Utah 84660
801 342-5260

File Code: 1950/2720
Date: January 31, 2005

Dear Interested Party,

The Spanish Fork Ranger District of the Uinta National Forest is proposing to issue a special use permit for an earthquake research project to be conducted cooperatively by the United States Geological Survey (USGS) and the Utah Geological Survey (UGS) in Township 12 South, Range 1 East, section 3 (SW ¼) and Township 10 South, Range 2 East, section 6 (NW ¼), SLM, during the summer of 2005. Exploratory trenches would be excavated at the Wasatch fault zone in two locations to investigate the timing, amount of displacement, and recurrence of major earthquakes in the Nephi and Santaquin area. The work would be funded by the National Earthquake Hazards Reduction Program.

Up to three trenches crossing the fault scarp would be excavated at both sites, which are shown on the attached map. The two proposed sites are located just inside Forest Service lands on alluvial fans. These sites are the best remaining sites along this segment of the Wasatch fault zone. Other sites have been disturbed, are not ideal, are on inaccessible private property, or have been investigated previously. The UGS has determined that further research on this segment of the Wasatch fault zone is their highest priority.

Excavated trenches would be approximately 30 meters in length and 5 meters in depth. Excavation equipment would be thoroughly washed before entering onto Forest Service lands to prevent introducing noxious weeds. Excavated material would be placed adjacent to the trenches, and would be used to back-fill the trenches upon completion of the study. Trench configuration and shoring would be to OSHA specifications and the sites would be temporarily fenced for safety. Excavation of the trenches would begin in late spring of 2005, research would be performed during the summer, and the trenches would be back-filled in the fall of 2005. After back-filling, disturbed areas would be seeded with native grass seed and monitored for noxious weeds for three years following completion of the project. There are no alternatives to trenching that would provide the desired information.

Research results are expected to help reduce hazards to the public from earthquakes. The timing and displacement information generated from the study would feed directly into the national, state and local seismic hazard assessments, and become the basis for making changes to the local application of national building codes. At the current time there is ambiguity over the timing of the last major earthquake on the Nephi segment of the Wasatch fault zone, and no clear consensus about the recurrent interval of major earthquakes. If the return interval is about 1500 years and the last major earthquake was 1200 years ago, then the fault may have a high likelihood of future movement. Conversely, if the last major earthquake was only 300-400 years ago, then the fault may have a lower likelihood of future movement.

The Utah Geological Survey and U.S. Geological Survey have previously conducted approximately 20 similar studies. They have received no complaints from federal, state, or

private landowners with respect to construction, operation, or completion of previous exploratory trenching investigations for seismic hazard analyses.

Excavation and back-filling of the trenches would generate noise and dust for a short period of time in the immediate study areas. Excavated trenches and spoil material would be visible from the near distance, including Interstate 15, throughout the summer. The sites would be posted with signs to indicate the nature of the work and to restrict access. The project is expected to have no effect on surface or ground water quality or quantity, heritage resources, proposed, endangered, threatened, or sensitive species, or the population trends of management indicator species. The sites are located outside of the Mount Nebo Wilderness and the project would not affect the wilderness area.

In the absence of extraordinary circumstances this proposal will be categorically excluded from documentation in an environmental impact statement or an environmental assessment under Section 31.11(a), item 3, of Forest Service Handbook (FSH) 1909.15 on Environmental Policies and Procedures. This category pertains to research activities and studies of limited context and intensity, and requires no project file or decision memo.

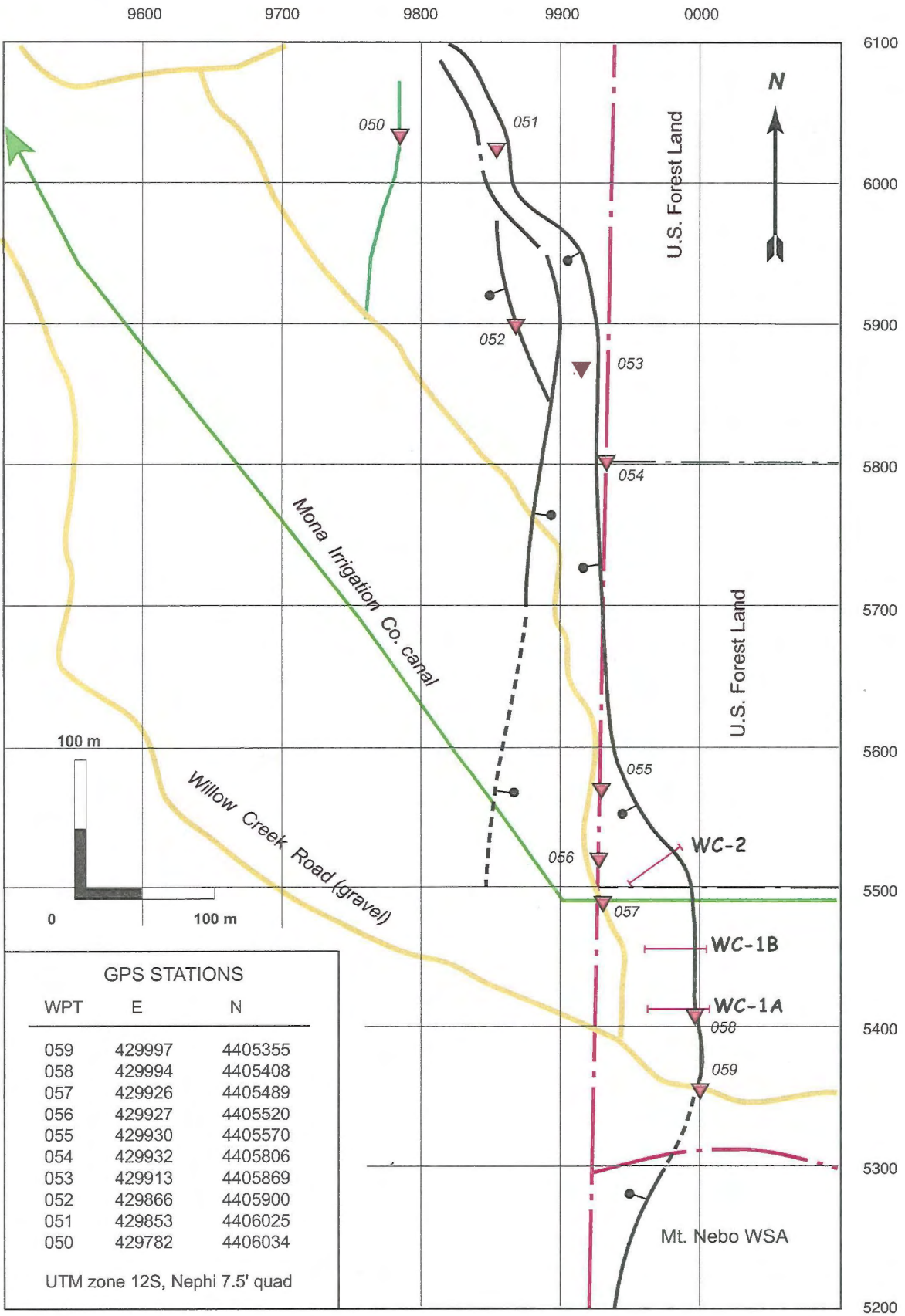
Pursuant to 40 CFR 1500-1508, the public is invited to provide comments on this proposal. Comments should be as specific as possible and have a direct relationship to the proposal. Comments received or postmarked within 14 days of the date of publication of a legal notice in the *Provo Herald* will be considered.

Please send written comments to: William A. R. Ott, District Ranger, Spanish Fork Ranger District, 44 West, 400 North, Spanish Fork, UT 84631; phone: (801) 798-3571, fax: (801) 798-3050; or e-mail: comments-intermtn-uinta-spanishfork@fs.fed.us. Comments may also be delivered to the above address during regular business hours of 8:00 a.m. to 5:00 p.m, Monday-Friday, excluding federal holidays.

If you have any questions regarding this matter please contact Matt Keyes at (435) 623-0952, extension 461.

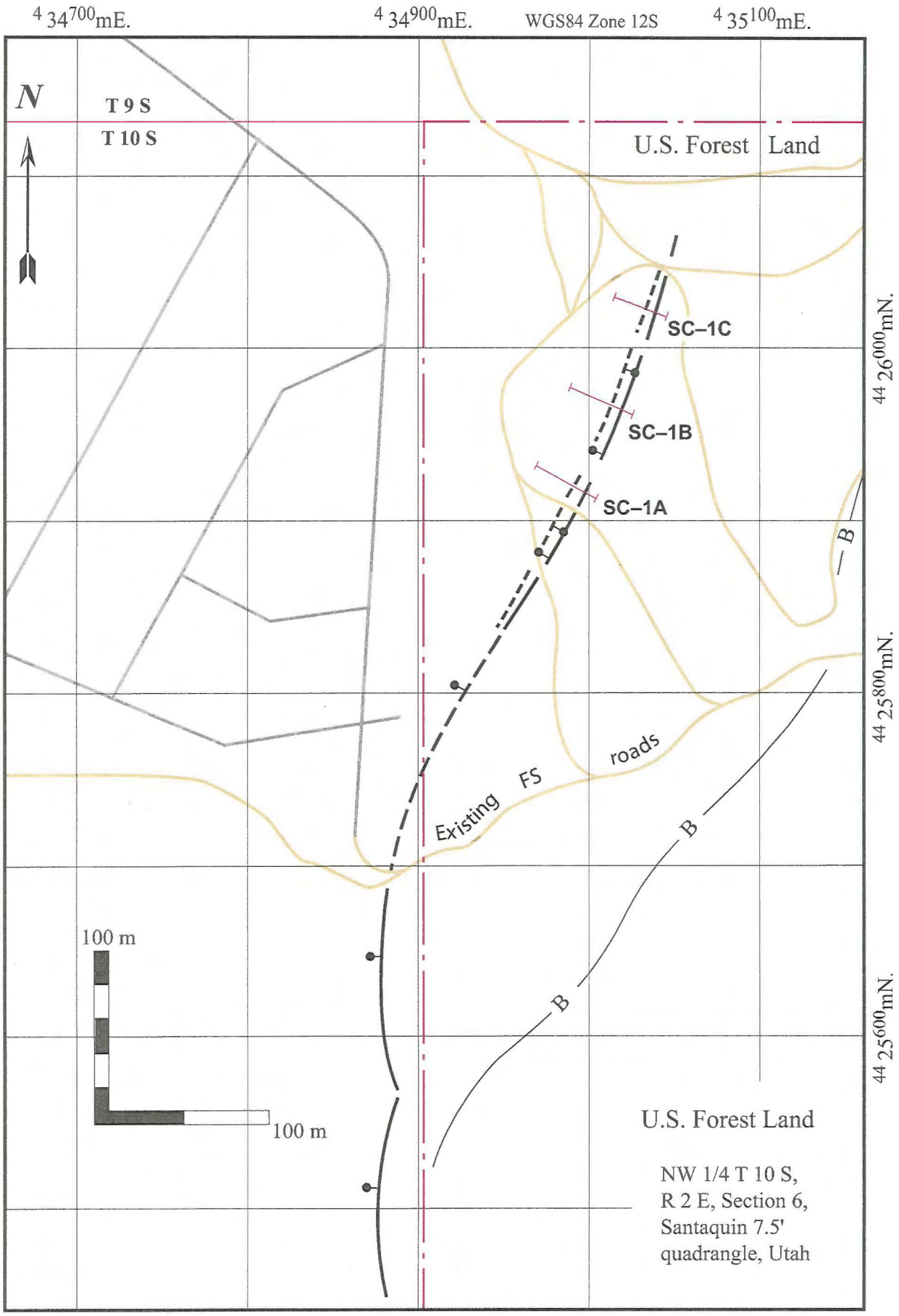
Sincerely,

WILLIAM A.R. OTT
Spanish Fork District Ranger



Index map to proposed Wasatch fault trenching sites, Unita National Forest, Utah

(Proposed Trench Sites WC-1A, WC-1B, WC-2)



Index map to proposed trenching of the Wasatch fault at Santaquin Canyon, Uinta National Forest, Utah

(Proposed Trench Sites SC-1A, SC-1B, SC-1C)