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MEMORANDUM TO: King Stablein
Program Manager, NNWSI

THROUGH: Paul Prestholt
OR, NNWSI

FROM: Charlotte Abrams
Geology-Geophysics Section, WMGT

Keith McConnell
Geology-Geophysics Section, WMGT

SUBJECT: TRIP REPORT: APPENDIX 7 VISIT TO NNWSI AND SURROUNDING AREA, FEBRUARY 3-7, 1986

On February 3 - 7, 1986, an Appendix 7 visit was made to the Yucca Mountain proposed nuclear waste repository site and surrounding areas. Two of the most important aspects of the Yucca Mountain site (as seen in the Draft Environmental Assessment reviews) are the "potentially adverse conditions" related to the presence of Holocene faulting and (or) Quaternary faulting at or very near the site. Our Appendix 7 visit was designed so that as many faults as possible in the region would be visited in order to become familiar with all aspects of faulting that might relate to the proposed repository. Individual objectives of the visit are listed below:

1) To become familiar with the regional geologic framework of the Nevada test site in order to facilitate discussions of the geology of the area with the U.S.G.S. and DOE and to be able to knowledgeably review pertinent reports on the proposed repository.
2) To view the various classes of faults known to be present in the area of the repository site and region so as to be fully aware of the mechanisms of faulting, the extent of faulting, hardships in determining the extent of recent faulting, and any other aspect that might relate to 10 CFR 60.
3) To view and compare calcite-silica veins associated with the Bow Ridge fault with known hydrothermal or spring vein deposits so as to be fully cognizant of the possibility of Quaternary volcanic activity near the test site.

A listing of specific activities and observations follows. Slides of most major features were taken where access permitted. A listing of slides (attachment 1) and generalized maps of all points visited (attachment 2) are attached.

February 3, 1986

Visit to Paul Prestholt's (NRC-OR) office and to thrust faults southeast and south of the test site. In attendance at the office: Paul Prestholt (NRC),

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Keith McConnell (NRC) and Charlotte Abrams (NRC). In attendence to observe faults: Keith McConnell (NRC) and Charlotte Abrams (NRC).

Activities and Observations

Met with the NRC-OR at the OR's office to pick up the vehicle and maps and to view photographs of the repository site.

The first fault visited was the Keystone thrust. The Keystone thrust can be seen in Red Rocks park west of Las Vegas where grey limestone is thrust over red sandstone. The color contrast between the two lithologies makes the fault easy to see. The sandstone contains excellent cross-bedding. Splays off the Keystone thrust were apparent in exposures along highway 159 south of Blue Diamond just before the intersection of 159 with highway 160.

The Cottonwood fault, a part of the Keystone thrust system, was viewed on Highway 160 just east of Mountain Springs summit near the Potasi turn-off where limestone (brecciated and broken) occurs in the hanging wall and overlies footwall sandstone. The brecciated zone is approximately 20' thick in this area. An abandoned Pb-Zn sulfide mine is located near the fault zone.

The Pahrump fault, a north-northwest-trending normal fault defined by the USGS as being potentially active (Open-File Report 84-792), was crossed on an unpaved road near Pahrump. The fault is defined by a low scarp trending approximately N10W. Where observed the scarp was cut by a wash.

February 4, 1986

Met with Burt Slemmons and Nancy Walker (NRC Contractors) and traveled to Mercury where we met at Lawrence Livermore's Mercury laboratory with William (Bill) McKinnis (LLNL). In the absence of Lawrence McKague (LLNL) Bill McKinnis acted as our guide while on the repository and Nevada test sites.

Activities and Observations

Early in the day we drove to an unnamed wash east of Yucca Mountain and west of Busted Butte. We walked in a north-northwest direction up the wash in an effort to "ground truth" a northwest-trending lineament that Nancy Walker identified from Landsat imagery (Nancy Walker is currently a student at the University of Nevada, Reno, on contract with the NRC through LLNL). No fault scarp was identified; therefore, the presence of a fault in that area is unconfirmed. Offset of vitrophyre on the east side of Yucca Mountain was observed and photographed.

The Bow Ridge fault (north-trending normal fault, OFR 84-567) was observed in trench 14 on the east side of Yucca Mountain. The exposed fault zone is characterized by brecciation with rotated blocks of welded tuff. Carbonate-silica veins exposed within the trench appear to be fault controlled. These veins display well-defined margins with some lamination along boundaries. The veins appear to bifurcate upward.

While visiting trench 14 we met with Bob Scott (USGS) and members of the BLM who happened to be in the area on a field trip. Bob Scott will present a paper on some of his fault related work at the Rocky Mountain section of Geological Society of America in Flagstaff, Arizona, in May.

The Rock Valley fault, a northeast-trending seismically active left-lateral strike-slip fault with Holocene movement (USGS Open-File Report 84-792, Metcalf, 1983; Rogers and others, 1977), was observed in trench RV2. The Rock Valley fault in this trench displays a small colluvial wedge which may indicate there may have been minor normal faulting, but the lack of a distinct colluvial wedge may suggest strike-slip movement.

February 5, 1986

McConnell and Abrams (NRC) were escorted by William McKinnis on the NTS on this day.

Activities and Observations

The Cane Spring fault, a northeast trending-seismically active left-lateral strike-slip fault (Knauss, 1981; Rogers and others, 1977; USGS Open File Report 84-792) was visited at Cane Spring. The fault is not well defined. The springs at Cane Spring may be fault controlled and the fault may be defined by a lineament extending into Frenchman Flat.

The Triassic-Jurassic Mine Mountain thrust (Sand 82-2207) was observed at Mine Mountain. Lower Devonian carbonates lie in the hanging wall and are thrust over argillite of the Mississippian-Devonian Eleana Formation. The contact observed was excellent with brecciation and slickensides.

The stop at Mine Mountain included a visit to an abandoned mercury mine and several stopes and shafts. A vertical breccia zone on the mountain defines a small fault, possibly associated with the Mine Mountain fault (USGS OFR 84-792). A stope on the mountain is into barite-rich rock. Rock exposures on the mountain top include jasperiod and silicified carbonate.

Mid Valley, Yucca Mountain, and surrounding areas were observed from the top of Shoshone Mountain. This location offered an excellent view of the traces of the seismic lines run by Livermore Laboratory across Mid Valley.

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The Carpetbag fault, a north-trending normal fault reactivated by a recent atomic test (Knauss, 1981), and the Yucca fault, also a north trending normal fault, were observed in Yucca Flat. The Carpetbag fault displays approximately 3 to 12 feet of displacement along the trace of a well-defined scarp. The Yucca fault is also defined by a distinct scarp, although not as pronounced as the Carpetbag fault scarp. Both scarps are in alluvium.

The Yucca fault intersects the Boundary fault (northeast trending normal fault classified as potentially active by USGS Open-File Report 84-792) to the north, on the north side of Yucca Flat. Trenches across the Boundary fault show broken up Climax Granite in contact with colluvium. Quartz veins in the granite are offset by a scale of inches. Sulfide mineralization is associated with the granite. A grossularite-scheelite-bearing skarn adjacent to the Climax granite was previously mined for scheelite.

February 6, 1986

Death Valley faults were visited on this day of the trip by McConnell and Abrams.

Activities and Observations:

In route to Death Valley a fault scarp in alluvium south of the town of Beatty was observed and is believed to be an expression of the Beatty fault (a north trending fault with Quaternary movement, USGS Open File Reports 84-792 and 84-854). The Montgomery-Shoeshone fault, a northeast trending fault, is mapped to lie north of Beatty and extends into the Rhyolite area. No fault zone was observed, but some relationship between mines in the area and the fault trace may exist.

Folding of sedimentary rocks in Boundary Canyon was observed. The Boundary Canyon fault (an east-west trending Miocene detachment, USGS Open-File Report 84-854) dissects a portion of the Canyon near Death Valley.

In Death Valley folds were observed in what may be hanging wall rock of the Amargosa Valley thrust sheet (State of California, Death Valley sheet). North-trending normal faults were also observed just south of the intersection of Titus Canyon Road and Highway 190 in Death Valley. The Death Valley-Furnace Creek fault scarp, an active, northwest-trending right-lateral strike-slip fault (Rogers and others, 1977, USGS Open-File Report 84-854) (in alluvium) crosses Hwy. 190 in this area.

We then climbed to vein deposits in Furnace Creek Wash. These veins were observed from Hwy. 190 on a recent field trip lead by Issac Winograd, USGS (see trip report, Appendix 7 visit, November 4-8, 1985). These well-defined veins are composed of laminated and layered calcite and branch upward through unconsolidated sediment. The veins are similar in appearance to paleo-spring

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deposits previously observed in Ash Meadows and in the Glendale area on the recent Appendix 7 visit in November, 1985.

February 7, 1986

On this day faults and trenches in Crater Flat, on the west side of Yucca Mountain, and along Bare Mountain were observed by Abrams and McConnell (NRC).

Activities and Observations

Trenches 10A and 10B on the west side of Yucca Mountain were visited. These trenches are shown on a map accompaning OFR 84-792 as intersecting the Solitario Canyon fault (north trending normal fault), but no fault was observed in the trenches and the trenches appear to cut only alluvium.

Trench 8 on the west side of Yucca Mountain intersects an approximately 3' wide zone of broken up material with a zone of veining. The vein material appears to be caliche with included rock fragments. Possible minor rotation and a small debris wedge are visible along the fault.

The Sterling Mine is located on the east side of Bare Mountain (west side of Crater Flat). The site is currently mined for gold. Several abandoned mines are also located in carbonate along the east side of Bare Mountain parallel to the trace of the Bare Mountain fault as drawn by workers in the area. Rock exposed along the east face of Bare Mountain is folded.

At the intersection of Flourspar Canyon and the road paralleling the east slope of Bare Mountain broken up rock was observed. The canyon forms a distinct curvilinear lineament. At one location within the Canyon broken up crystal tuff was observed indicating a possible fault zone.

Charlotte Abrams
Geology-Geophysics Section, WMGT

Keith McConnell
Geology-Geophysics Section, WMGT

*Record note:
Prestholt's concurrence
by phone

Enclosures

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NAME	:KMcConnell	:CAbrams	:PPrestholt*	:PJustus	:KStablein	:	:
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ATTACHMENT 1 - LIST OF SLIDES
(Slides are on file in room 494, Willste Building)

1. Carbonate (grey) overlying red sandstone west of Las Vegas on Charleston Blvd. extension near Red Rocks Park.

2. Splays off the Keystone thrust in limestone. On Highway 159 near intersection with Highway 160; south of Blue Diamond.

3. Cottonwood fault-sandstone dips beneath limestone. Highway 160 just west of Potasi Mountain.

4. Cottonwood fault gouge, westward from scene in slide 3, on Highway 160.

5. Fault scarp of the Pahrump fault on dirt road northwest of Pahrump, NV.

6. View of Busted Butte (west side).

7. East side of Yucca Mountain.

8. Offset in vitrophre, east side of Yucca Mountain.

9. Closer view of scene in slide 8.

10. Looking northward up wash, east side of Yucca Mountain, west side of Busted Butte.

11. Zone of jointing in welded tuff, east side of Yucca Mountain.

12. Rock Valley fault in trench.

13. Cane Spring with abandoned stagecoach station in center of slide.

14. Cane Spring and possible trace of Cane Spring fault.

15. Yucca Mountain in background. View from Shoshone Mountain.

16. View of Mid Valley showing seismic line traces and drill pads.

17. Mine Mountain thrust-carbonate (lower Devonian) is thrust over argillite of the Eleana Formation.

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18. Slickensides associated with the Mine Mountain thrust.

19. Mine Mountain thrust in background. Grey limestone thrust over red argillite.

20. Vertical breccia zone on Mine Mountain.

21. Workings of mercury mine on Mine Mountain.

22. Stope into Mine Mountain.

23. Weathered barite-bearing rock, Mine Mountain.

24. Exposure in trench cutting the Carpetbag fault.

25. Carpetbag fault scarp in Yucca flat.

26. Trench cutting the Yucca fault.

27. Yucca fault scarp.

28. Offset of quartz veins in trench 2 cutting the Boundary fault. Weathered Climax Granite surrounds vien.

29. Broken-up Climax Granite, trench 2 cutting the Boundary fault.

30. View from scheelite-bearing skarn. Tuff (white) in background, Climax Granite in center of slide and scheelite-bearing skarn in foreground.

31. View of Yucca Flat from scheelite-bearing skarn near Boundary fault.

32. Ghost town of Rhyolite.

33. Folds in exposure in Boundary Canyon.

34. Death Valley-Furnace Creek fault scarp.

35. Amargosa Valley thrust-folds are in hanging wall, east side of Death Valley.

36. Normal faults, looking east in Death Valley.

37. View of veins in Furnace Creek Wash, Death Valley.

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38. Vein, Furnace Creek Wash.

39. Vein, Furnace Creek Wash.

40. Close up of vein, Furnace Creek Wash.

41. View of the Death Valley fault trace from Dantes overview.

42. Solitario Canyon fault looking north from trench 10A.

43. View of Yucca Mountain (west side) from Bare Mountain.

44. View of Yucca Mountain (west side) and Crater Flat from Bare Mountain.

45. Bare Mountain (east side) from trench 8 on west slope of Yucca Mountain.

46. Fault scarp in Crater Flat.

47. Broken-up carbonate, Bare Mountain. Possible Bare Mountain fault Zone.

48. South end of Yucca Mountain from U.S. 95.

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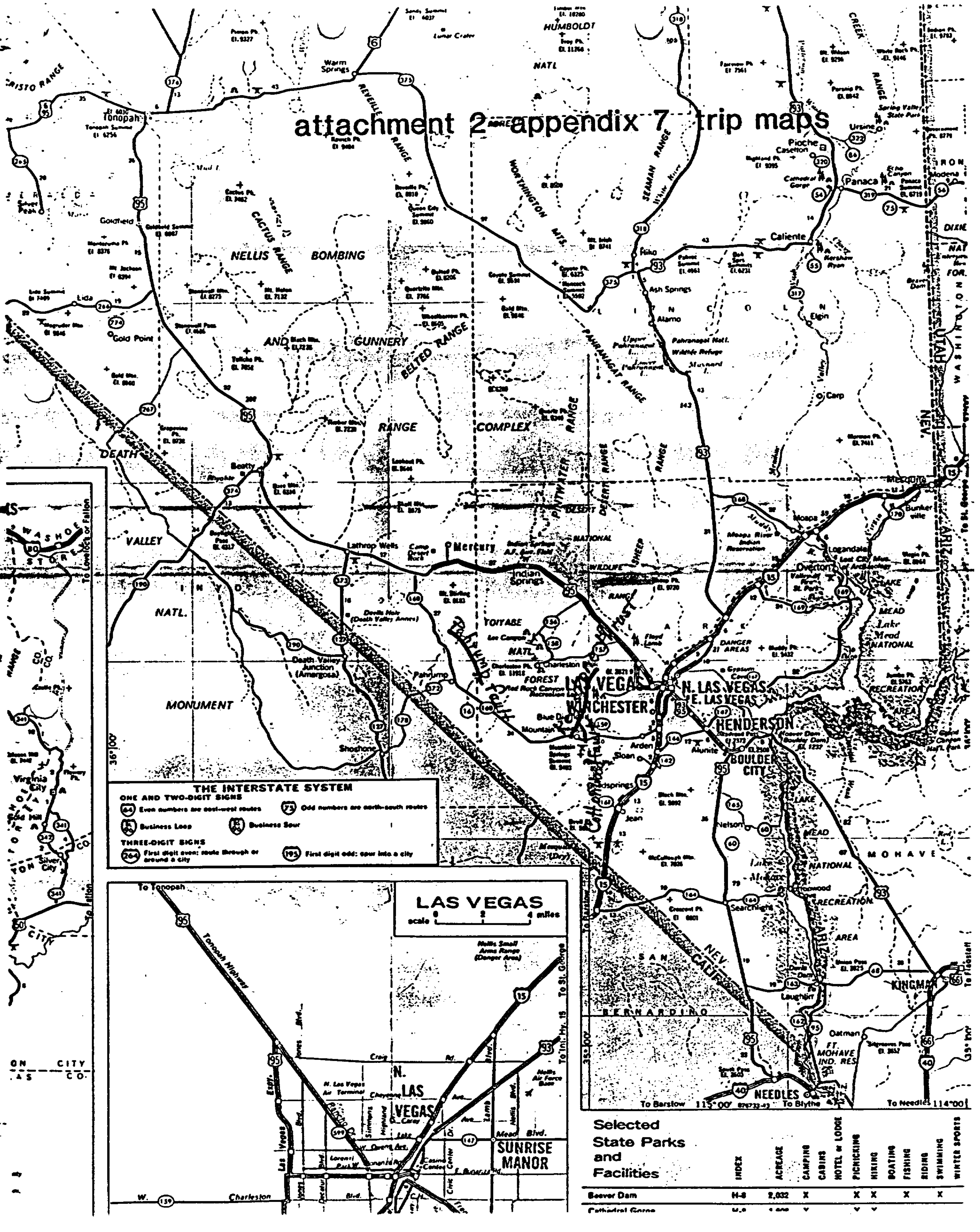
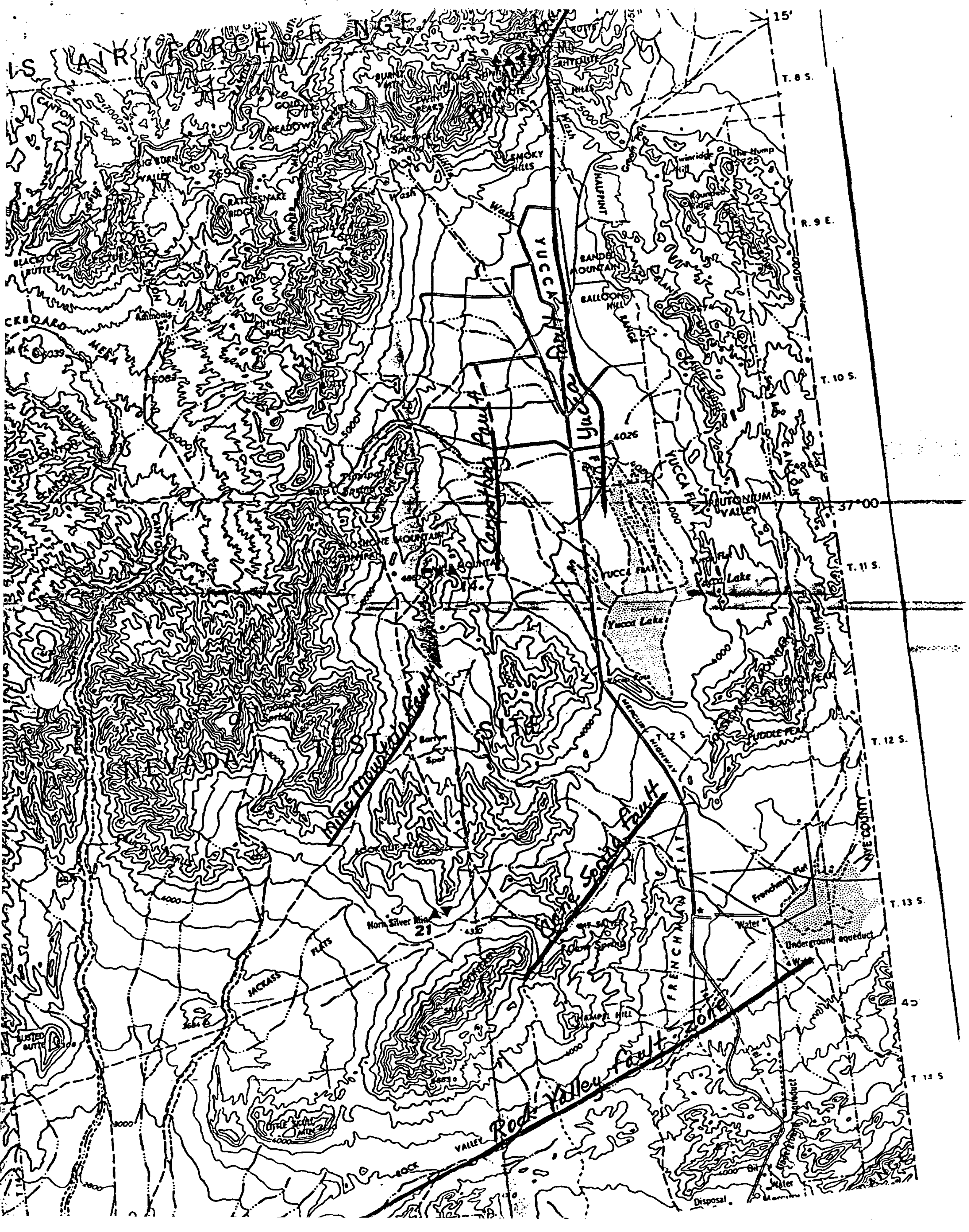
attachment 2--appendix 7 trip maps

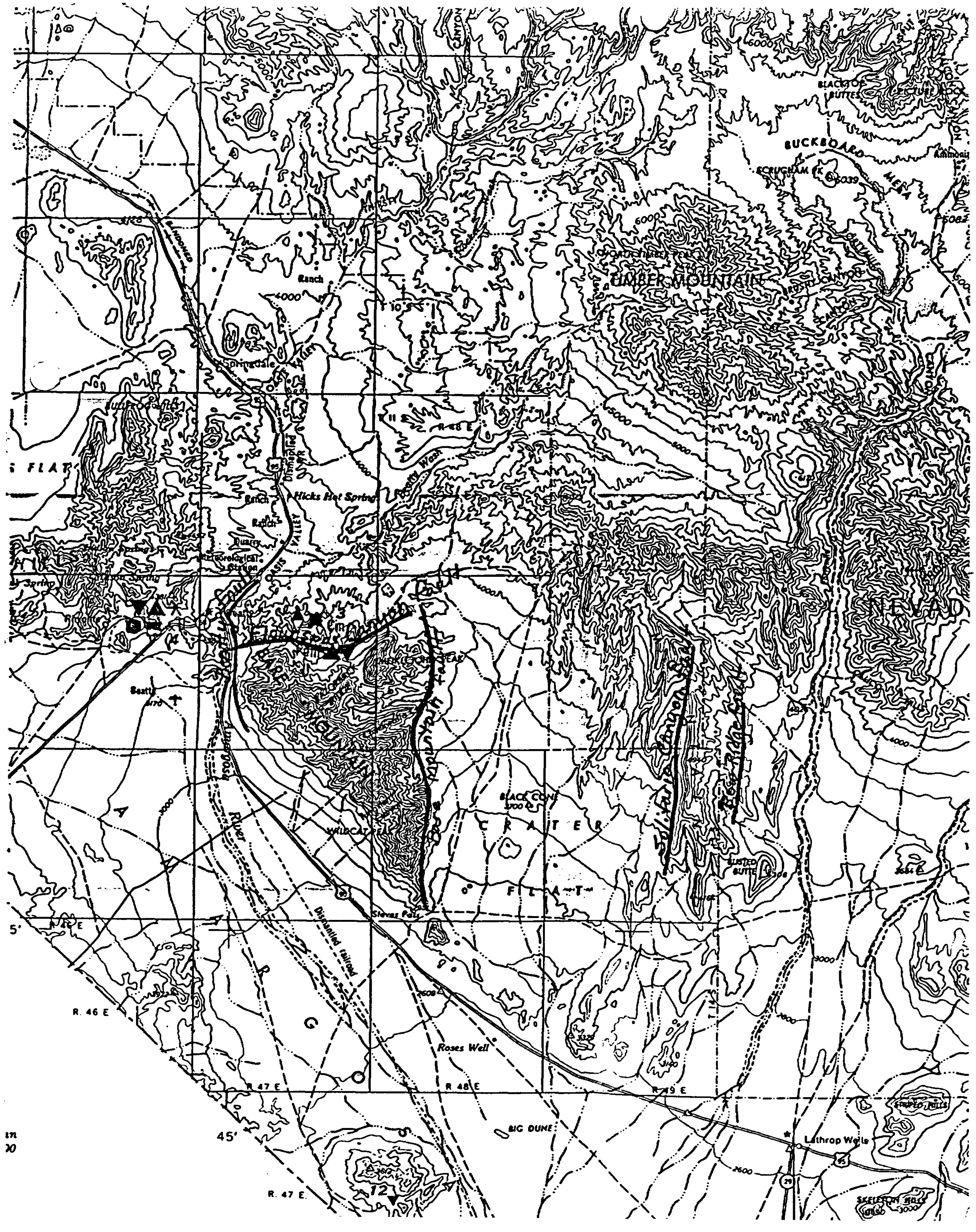


Selected State Parks and Facilities

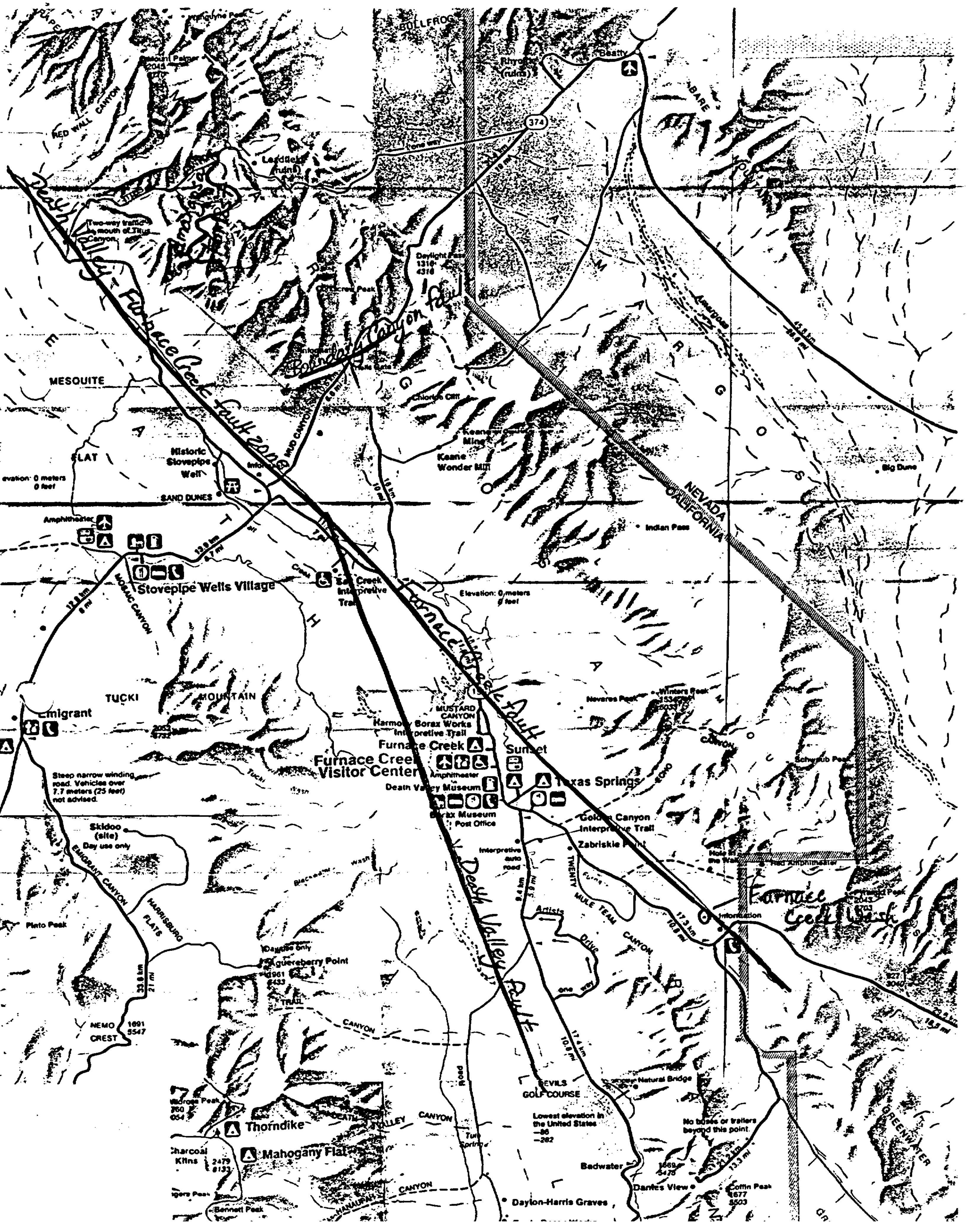
	INDEX	ACREAGE	CAMPING	CABINS	HOTEL or LODGE	PICNICKING	HIKING	BOATING	FISHING	RIDING	SWIMMING	WINTER SPORTS
Beaver Dam	H-8	2,032	X			X	X		X		X	
Cathedral Gorge	[illegible]	[illegible]	X			X	X					



NEVADA TEST SITE
YUCCA FLAT
Yucca Lake
YUCCA FLAT
Carpetbag Fault
Yucca Fault
Mine Mountain Fault
Cane Spring Fault
Rock Valley Fault Zone
MERCURY HIGHWAY
FRENCHMAN FLAT
Frenchman Flat
Underground aqueduct
Water
Horn Silver Mine
SHOSHONE MOUNTAIN
JACKASS FLATS
ROCK VALLEY
BANDED MOUNTAIN
BALLOON HILL
HALFPINT
PLUTONIUM VALLEY
CANE SPRING
BUSTED BUTTE
Disposal
NYE COUNTY
15'
37°00'
T. 8 S.
R. 9 E.
T. 10 S.
T. 11 S.
T. 12 S.
T. 13 S.
T. 14 S



BUCKBOARD
MESA
SCRUGHAM PK
BLACKTOP BUTTES
Ranch
Springdale
OASIS VALLEY
Beatty Wash
Hicks Hot Spring
Quarry
Meteorological Station
Beatty
Dismantled railroad
River
BLACK CONE
C R A T E R
F L A T
WILDCAT
BUSTED BUTTE
Roses Well
BIG DUNE
Lathrop Wells
STRIPED HILLS
SKELETON HILLS
R. 46 E
R. 47 E
R. 48 E
R. 49 E
45'
NEVAD


BULLFROG
Beatty
Rhyolite (ruins)
374
Leadfield (ruins)
Mount Palmer
RED WALL CANYON
Two-way traffic to mouth of Titus Canyon
Daylight Pass
Death Valley - Furnace Creek fault zone
Boundary Canyon fault
Chloride Cliff
MUD CANYON
Keane Wonder Mine
Keane Wonder Mill
MESQUITE
FLAT
Historic Stovepipe Well
SAND DUNES
Amphitheater
Stovepipe Wells Village
MOSAIC CANYON
Salt Creek Interpretive Trail
Elevation: 0 meters 0 feet
NEVADA
CALIFORNIA
AMARGOSA
RANGE
Indian Pass
Big Dune
Furnace Creek fault
TUCKI
MOUNTAIN
Emigrant
MUSTARD CANYON
Harmony Borax Works Interpretive Trail
Furnace Creek
Furnace Creek Visitor Center
Amphitheater
Death Valley Museum
Borax Museum
Post Office
Sunset
Texas Springs
Nevares Peak
Winters Peak
Schwaub Peak
Steep narrow winding road. Vehicles over 7.7 meters (25 feet) not advised.
Skidoo (site)
Day use only
EMIGRANT CANYON
HARRISBURG FLATS
Golden Canyon Interpretive Trail
Zabriskie Point
Interpretive auto road
TWENTY MULE TEAM CANYON
Artists Drive
Death Valley fault
Furnace Creek Wash
Information
Aguereberry Point
NEMO CREST
DEVILS GOLF COURSE
Natural Bridge
Lowest elevation in the United States
Thorndike
Mahogany Flat
Charcoal Kilns
Badwater
Dantes View
Coffin Peak
No buses or trailers beyond this point.
Dayton-Harris Graves
Bennett Peak
GREENWATER