

Geological Report

APN 588-311-009 (Vacant Lot) Fault Hazard Study

Yucca Valley, California

Prepared for:

Mr. Mark Howard

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Palm Desert, CA 92255



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a DBE/MBE/SBE Company

Prepared by:

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October 2004



October 15, 2004

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Fault Hazard Evaluation
APN 588-311-009 (Vacant Lot)
Yucca Valley, California
LCI Project No. LP04125

Dear Mr. Howard:

Landmark Consultants, Inc. has completed a Fault Hazard Evaluation at the proposed residential development project site in Yucca Valley, California. The project site is proposed for future development of single-family residences on a 9-acre parcel. The project site is located within the Alquist-Priolo (A-P) Earthquake Fault Zone which encompasses the Eureka Peak Fault.

Introduction

The purpose of this fault hazard evaluation was to locate the fault alignment and address the potential for fault related ground rupture within the project site located within the A-P Earthquake Fault Zone. The scope of the work included the following:

- Review of selected geologic maps and reports
- Review of selected aerial photographs
- Site reconnaissance
- Excavation and logging of exploratory trenches
- Geologic analysis of data collected
- Preparation of report detailing field exploration, findings, conclusions, and recommendations.

Site Description

The project site is rectangular in shape, elongated in the north-south direction and consists of approximately 9-acres of vacant desert land (see Plate A-2). The site is covered by moderate vegetation consisting mainly of desert brush, dry grasses, cactus and a few isolated Joshua Trees. A dry stream channel is located near the western portion of the site, traveling north-south. Along the west side of the stream channel is a dirt road created by off-road vehicles. Yucca Trail is located to the north, Emerson Avenue is to the east and Arcadia Trail is located to the south of the site.

Regional Geology

The site is located at the northern base of the Little San Bernardino Mountains within the Mojave Desert region of the California high desert (Plate A-3). The Mojave Desert region is bounded on the southwest by the San Andreas Fault and the Transverse Ranges, on the east by the Colorado River and on the north by the Garlock Fault, the Tehachapi Mountains and the Basin Ranges. The Mojave Desert area contains Paleozoic and lower Mesozoic rocks with Jurassic and Cretaceous granitic rocks of the Nevadan batholith widespread throughout the region's mountain blocks. Valleys between the mountain blocks are in-filled with Quaternary sediments. Faults are typically encountered along the valley – mountain transition.

Local Geology

The project site is located on an alluvial fan complex extending northward from the Little San Bernardino Mountains towards Yucca Valley. The geologic units observed at the project site consist of older Quaternary alluvial deposits (Qao).

Quaternary Alluvial Deposits (Qao): The older alluvial deposits consist of non-bedded granitic cobbles, pebbles and sands. These sediments were deposited by alluvial fan deposition from the Little San Bernardino Mountains.

Fault Hazards

The primary seismic hazard to the project site is the Eureka Peak Fault, which crosses the southwestern corner of the project site. The project site lies between two splays of the Eureka Peak Fault as shown on the A-P Earthquake Fault Zone map (Plate A-4). The Eureka Peak Fault was unknown prior to the June 28, 1992 Landers Earthquake (M_w 7.2). About 10 km of the Eureka Peak Fault ruptured with a maximum surface offset of 21 cm (8 inches) during the Landers Earthquake. It has been suggested that the Eureka Peak

Fault was the source of the April 22, 1992 Joshua Tree Earthquake (M_w 6.1). The Eureka Peak Fault likely handles a significant portion of the slip transferred from the San Andreas Fault Zone to the Eastern California Shear Zone.

The characteristic earthquake is estimated to be a magnitude M_w 5.5 to 6.8 for the Yucca Valley area. The Eureka Peak Fault is a fairly short fault about 20 km in length. The interval between seismic events is unknown and the fault is estimated to have a slip rate of about 0.6mm per year.

We have used the computer program FRISKSP (Blake, 2000) to provide a probabilistic estimate of the site PGA using the attenuation relationship of Boore, Joyner, and Fumal (1997) Soil (310). The PGA estimate for the project site having a 10% probability of occurrence in 50 years (return period of 475 years) is **0.62g**.

Review of Aerial Photographs

Stereoscopic aerial photographs dated 1964, 1977, 1989, and 1993 were reviewed as part of this investigation. A faint lineament was noted in the 1977, 1989, and 1993 aerial photographs (Plate A-7 through A-9) that likely corresponds to the delineated trace of the Eureka Peak Fault. The lineament was most readily noted along the west side of a stream channel near Palomar Avenue southeast of the project site. No lineaments were noted within the project site area on the aerial photographs reviewed.

Field Exploration

The field exploration was conducted on September 21 through 30, 2004 using an excavator to excavate four (4) trenches to an approximate depth of eight to twelve (8 to 12) feet below the ground surface (Plate A-2). Three trenches were located at the mapped trace of the Eureka Peak Fault near the southwest corner of the site. **The largest continuous trench (Trench 2) crossed the site which is located within the A-P zone and encompassed the mapped trace of the Eureka Peak Fault.** Subsurface soils within the trenches consisted mainly of gravelly silty sand. Some cobbles were noted in the sediment. The soils were consolidated and massive with no bedding features readily visible.

Trench 1 was located near the southwest corner of the property, approximately 60 feet in length and traveling in an east-west direction. No fault traces were encountered in the trench.

Trench 2 was approximately 565 feet in length, crossing the site diagonally from the east to the west and traveling in a northeast-southwest direction. The western portion of the trench was sited perpendicular to the mapped trace of the Eureka Peak Fault on the project site. A fault trace was located approximately 85 feet east of the western property boundary and 160 feet north of the southern property boundary. The trace was marked by carbonate precipitates along the rupture zone on the north and south trench walls.

Trench 3 was located near the southwest corner of the property, approximately 65 feet in length and traveling in a northwest-southeast direction. The trench was sited perpendicular to the mapped northeast-southwest trace of the Eureka Peak Fault. No fault traces were encountered in the trench.

Trench 4 was located approximately 10 feet north of the southwest portion of Trench 2 and was 15 feet in length. This trench was made to determine if the suspected fault trace encountered in Trench 2 was continuous.

Findings and Conclusions

- Fault traces were encountered in two of the exploratory trenches excavated at the project site. The fault trace strikes approximately N22W and dips 75 degrees west to near vertical, which is consistent with the mapped trend of the Eureka Peak Fault in this area.
- Strong to moderate ground shaking is expected to occur at the project site during an earthquake on the Eureka Peak Fault. Peak ground accelerations of approximately 0.62g may be expected at the site during a strong seismic event on the Eureka Peak Fault.
- The potential for fault related ground rupture during the lifetime of the planned development is considered high along the trace of the Eureka Peak Fault. Ground rupture may also occur on fault splays proximal to the main fault trace. The fault trace was observed within one to two feet of the surface fading out in the near surface soils indicating recent ground rupture at the project site. *A minimum setback of 50 feet from the mapped main fault trace is recommended to incorporate potential undocumented fault splays.*

Closure

We have based our findings and conclusions in this report on selected points of field exploration, review of geologic literature, site reconnaissance, and our understanding of the proposed project. Our analysis of data and recommendations presented herein are based on the assumption that soil conditions do not vary significantly from those found at specific exploratory locations. Variations in soil conditions can exist between and beyond the exploration points. If detected, these conditions may require additional studies, consultation, and possible design revisions.

This report was prepared according to the generally accepted *geological standards of practice* that existed in San Bernardino County at the time the report was prepared. No express or implied warranties are made in connection with our services.

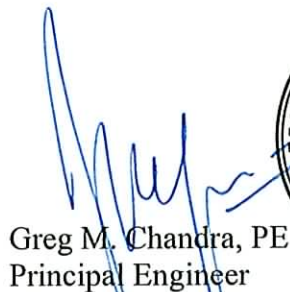
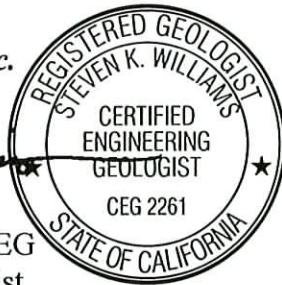
The client has responsibility to see that all parties to the project including project designers and engineers are made aware of this entire report. It is understood that the client or his representative is responsible for submittal of this report to the appropriate governing agencies.

If you should have any questions or comments, please feel free to contact our office at (760) 360-0665.


Respectfully,
Landmark Consultants, Inc.



Steven K. Williams, RG, CEG
Senior Engineering Geologist



Greg M. Chandra, PE
Principal Engineer

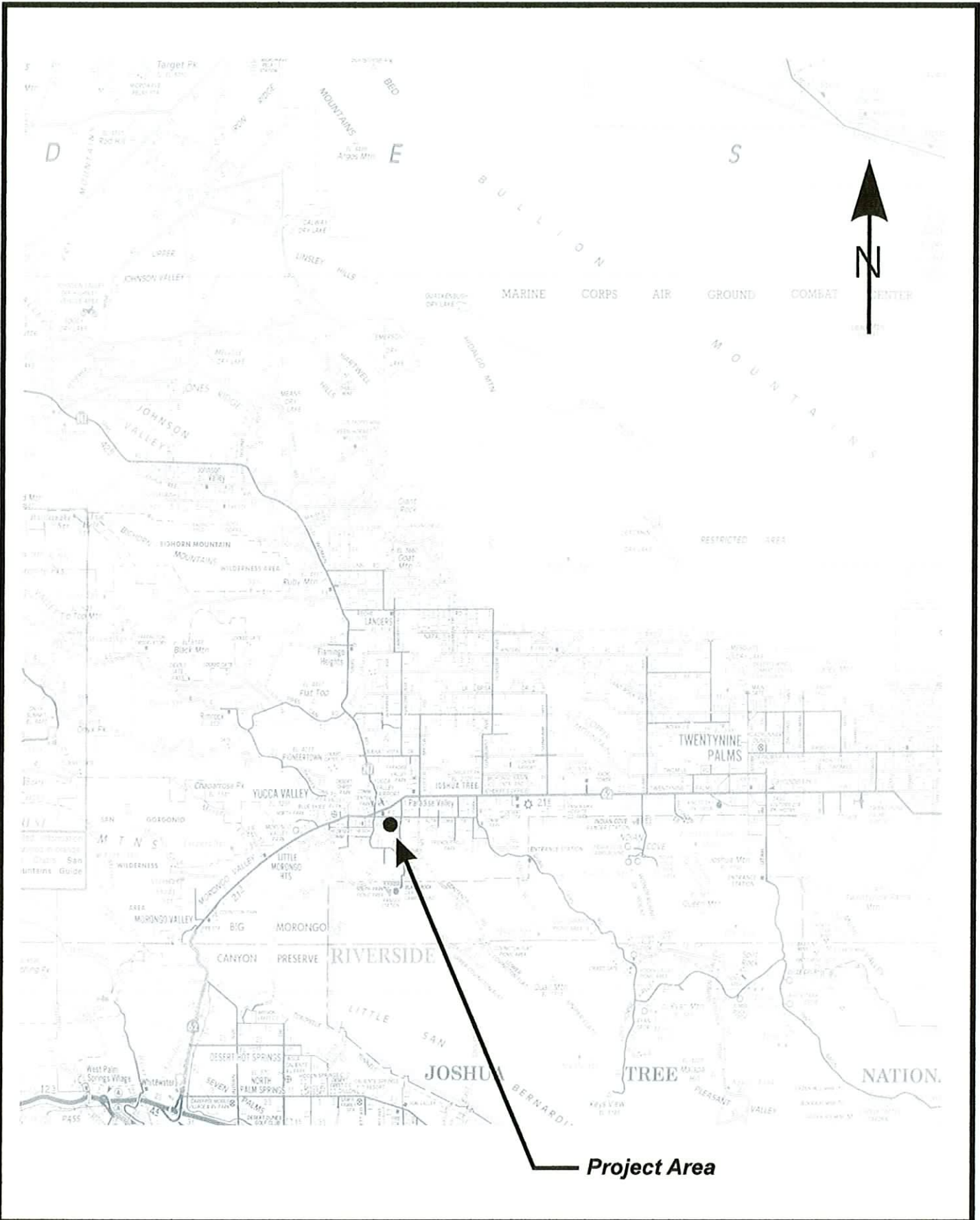


Kelly T. Nordmeyer
Staff Geologist

REFERENCES

- Bortugno, E. J. and Spittler, T. E., 1986, Geologic Map of the San Bernardino Quadrangle (1:250,000).
- CDMG, 2000, Yucca Valley South and Joshua Tree South, CA 7.5 min. Quadrangles A-P Earthquake Fault Zone Maps.
- Dibblee, T. W., Jr. 1967, Geologic Map of the Joshua Tree Quadrangle, San Bernardino and Riverside Counties, California.
- SCEC, 2004, Eureka Peak Fault, http://www.data.scec.org/fault_index/eureka.html.
- SCEC, 2004, Joshua Tree Earthquake, www.data.scec.org/chrono_index/joshuatr.html.

APPENDIX A



Project Area

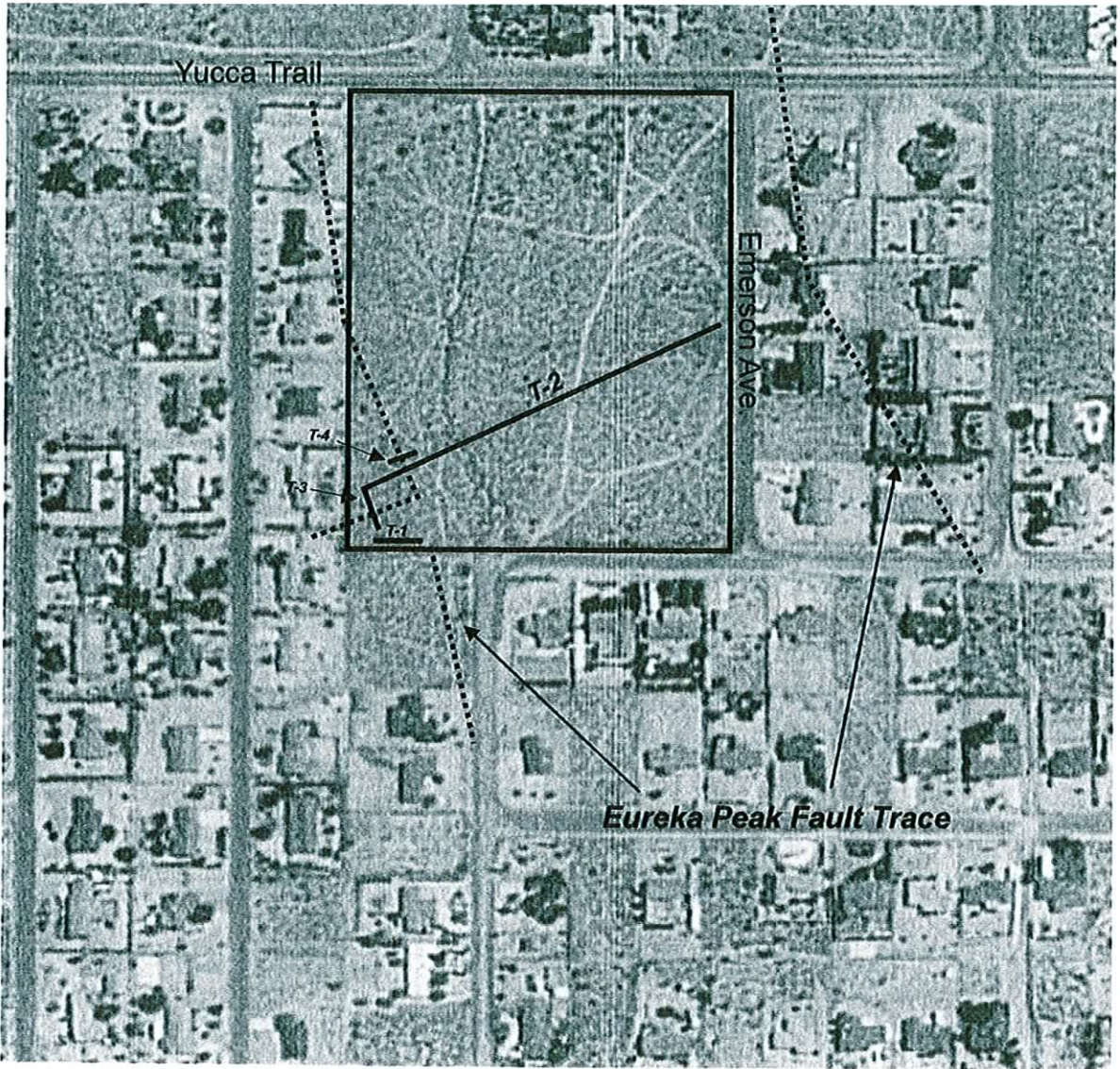
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Vicinity Map

**Plate
A-1**

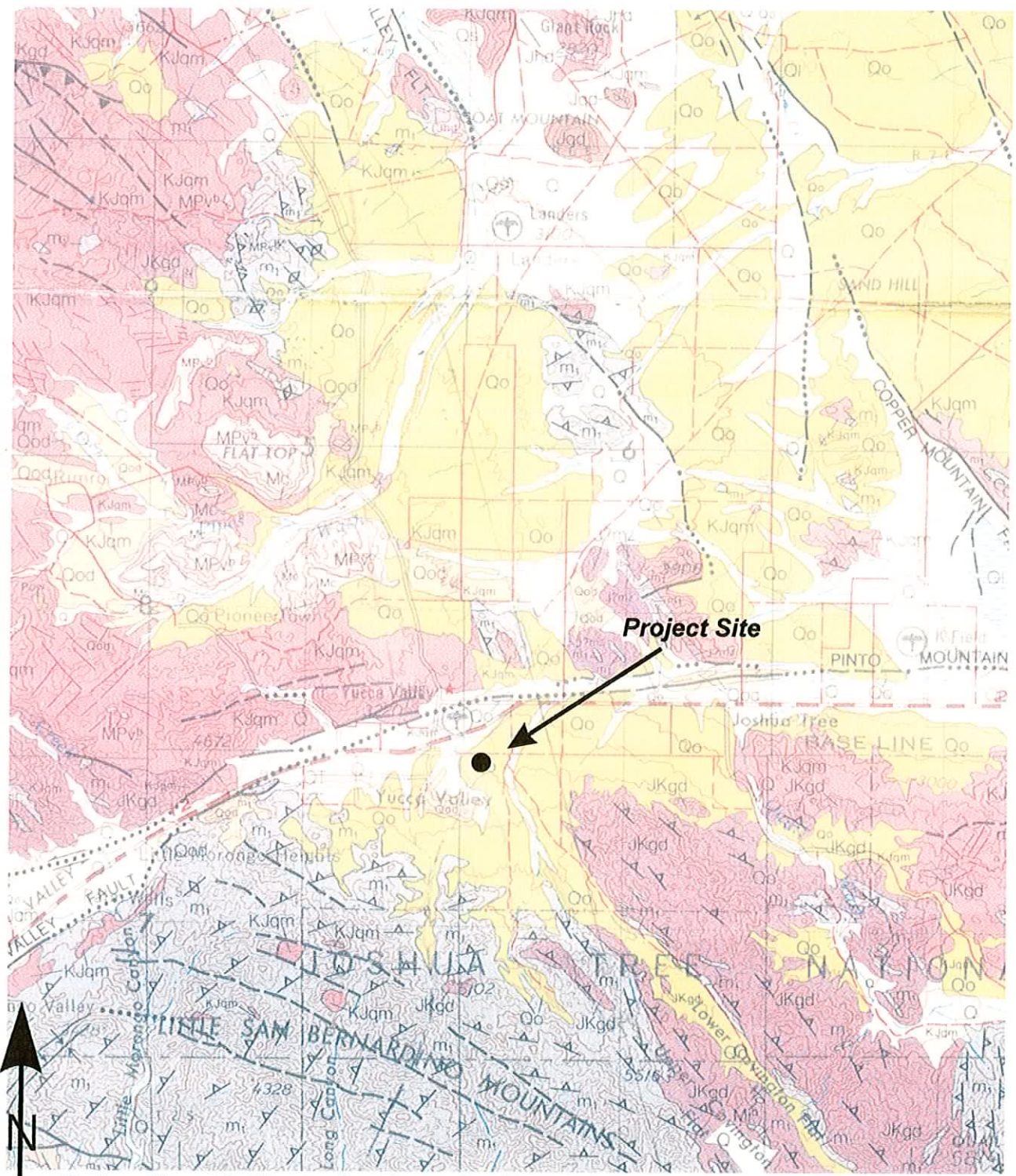


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Site and Exploration Plan

Plate
A-2



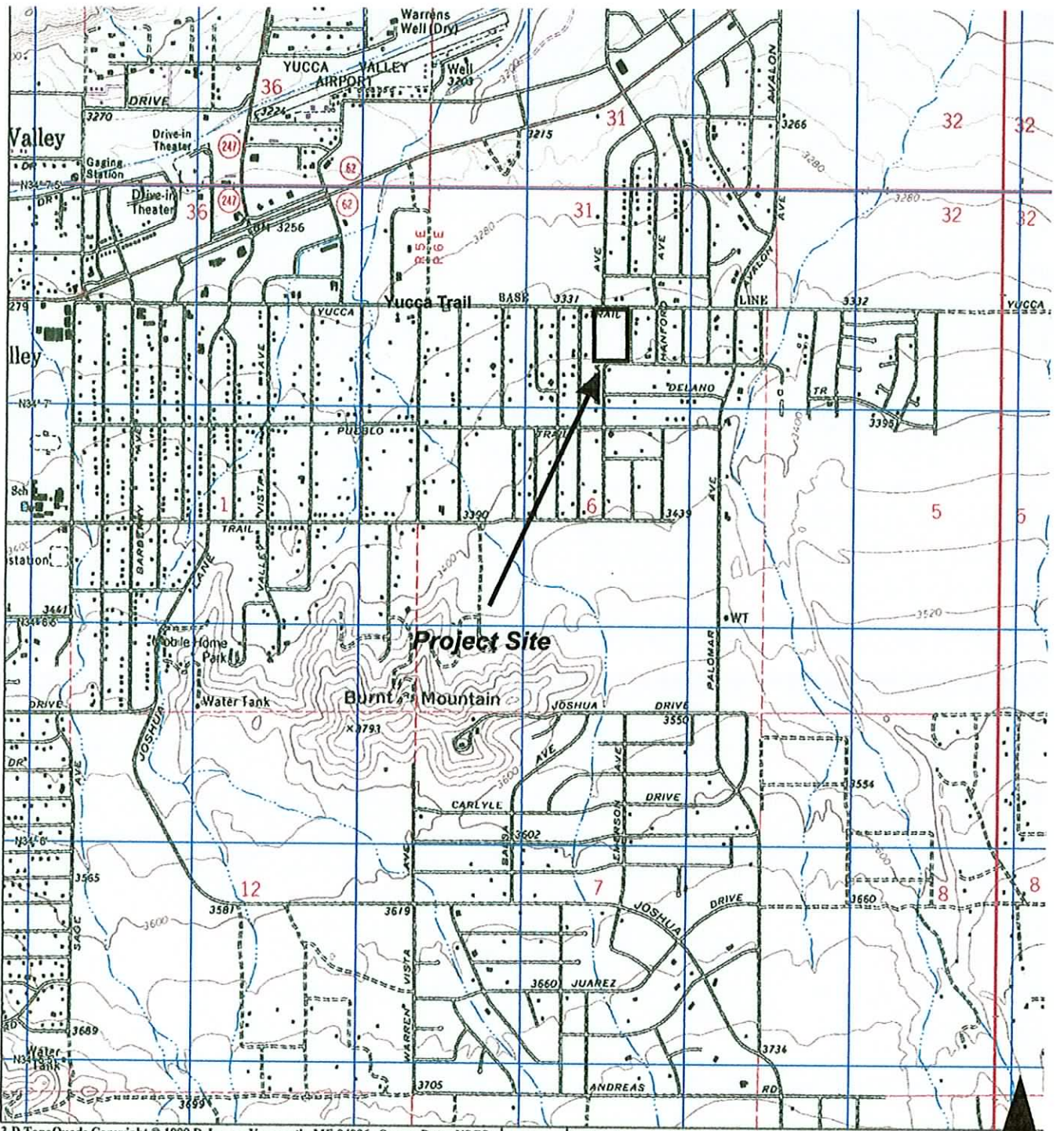
Geology Map of California - San Bernardino Sheet (1:250,000)

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Regional Geologic Map

**Plate
 A-3**



3-D TopoQuads Copyright © 1999 DeLorme Yarmouth, ME 04096 Source Data: USGS 1000 ft Scale: 1 : 25,000 Detail: 13-0 Datum: WGS84



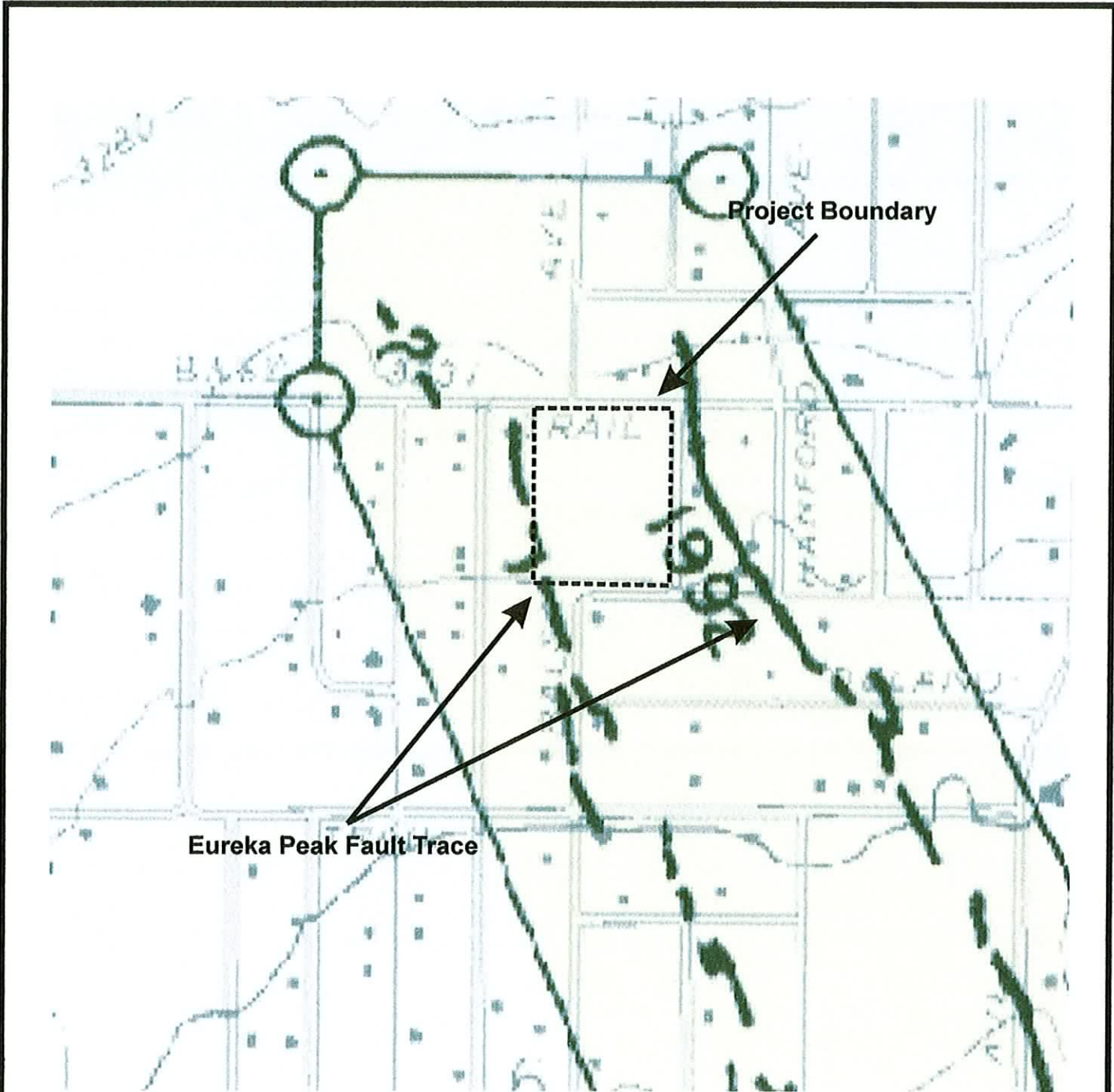
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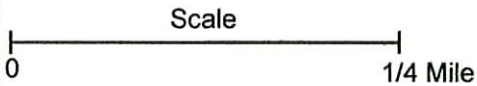
Topographic Map

Plate
A-4



Yucca Valley South, CA 7.5 Min. Quadrangle

Site Location: 34.1194N
116.3960W

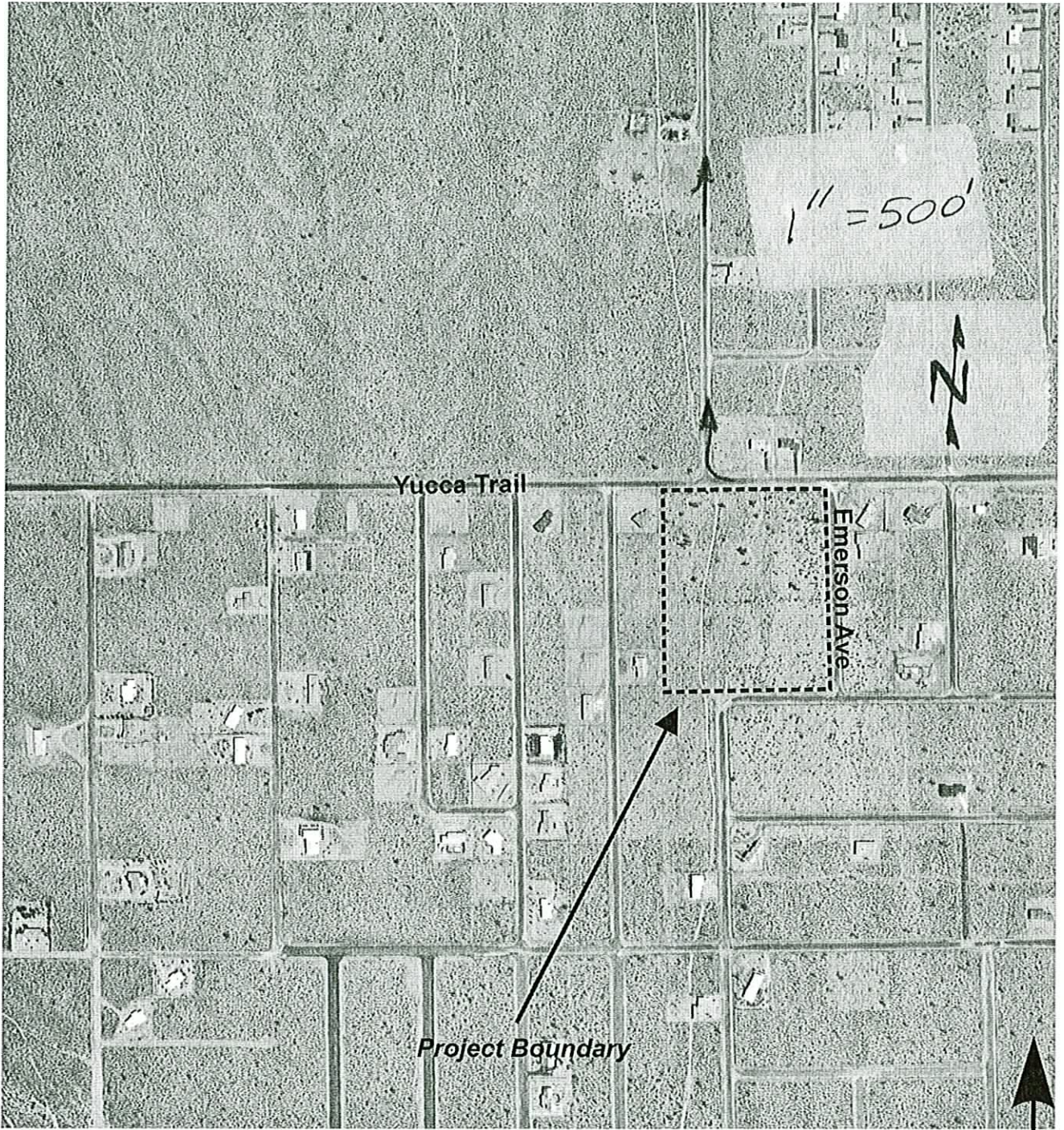


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A-P Earthquake Fault Zone Map

**Plate
A-5**



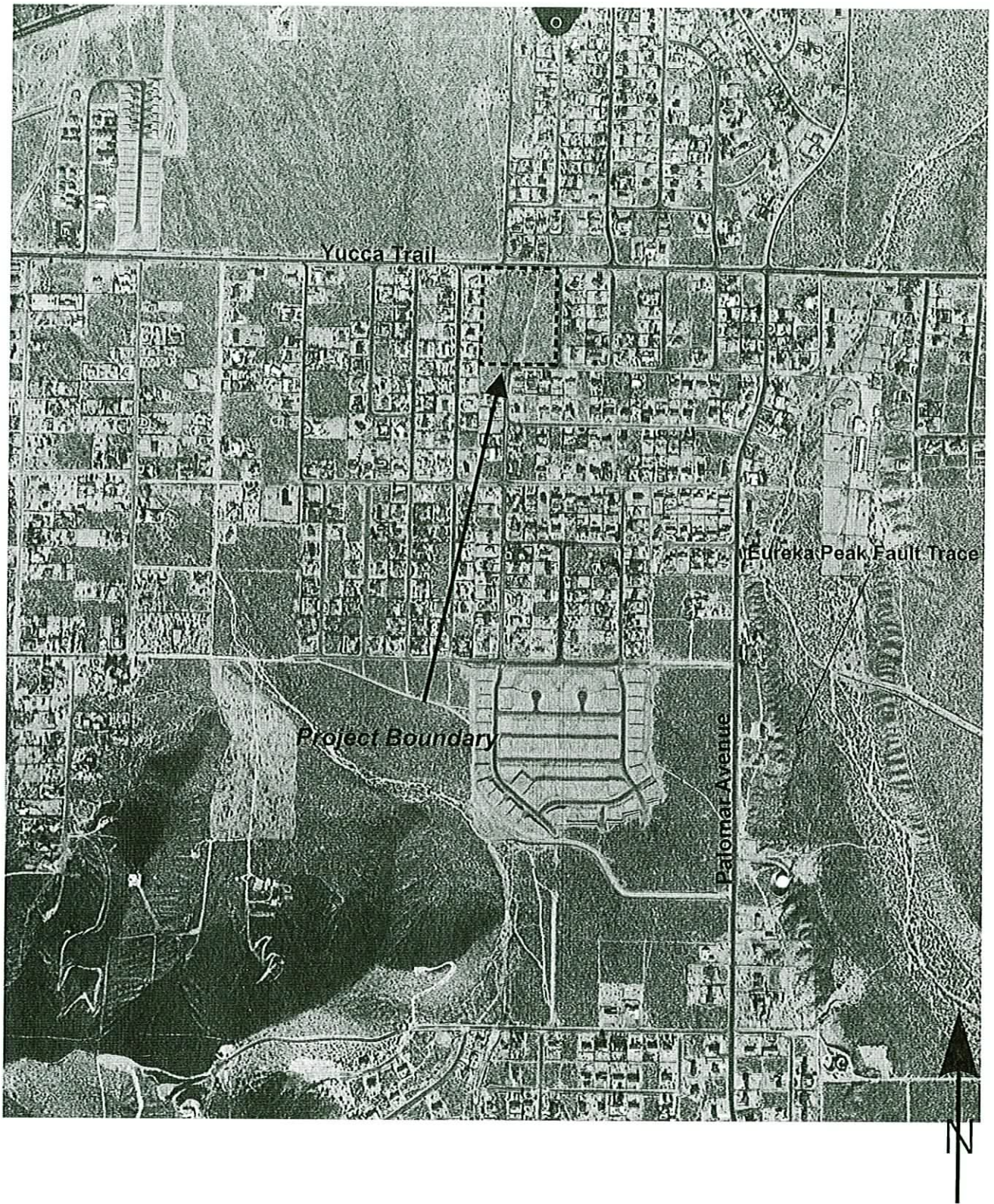


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1977 Aerial Photograph

Plate
A-7

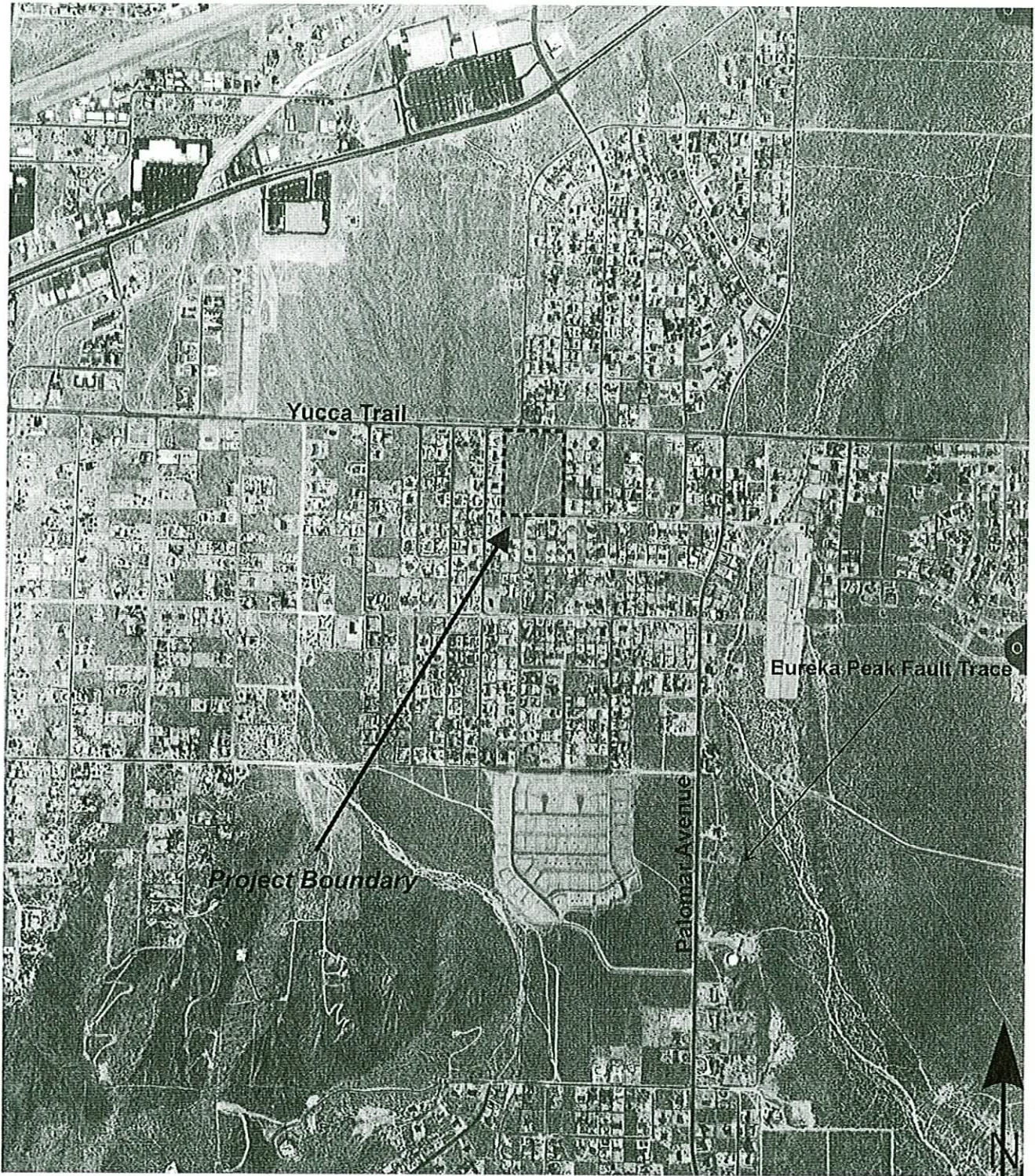


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1989 Aerial Photograph

Plate
A-8



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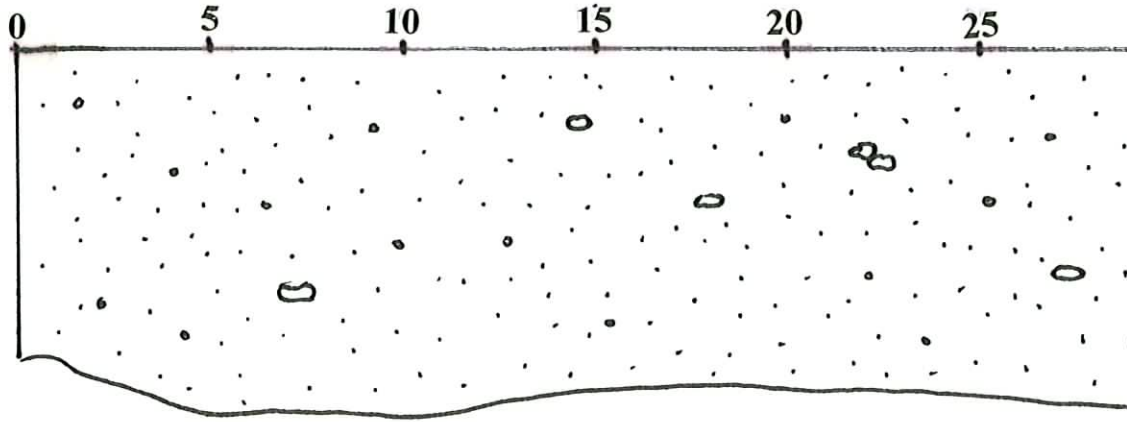
1993 Aerial Photograph

Plate
A-9

APPENDIX B

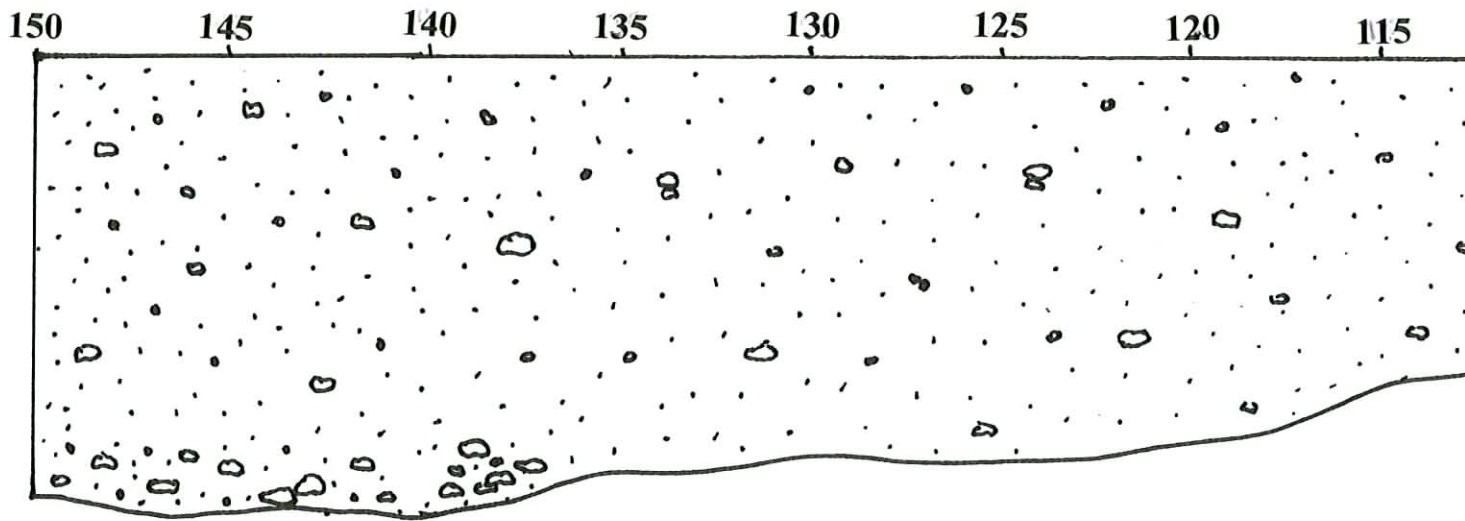
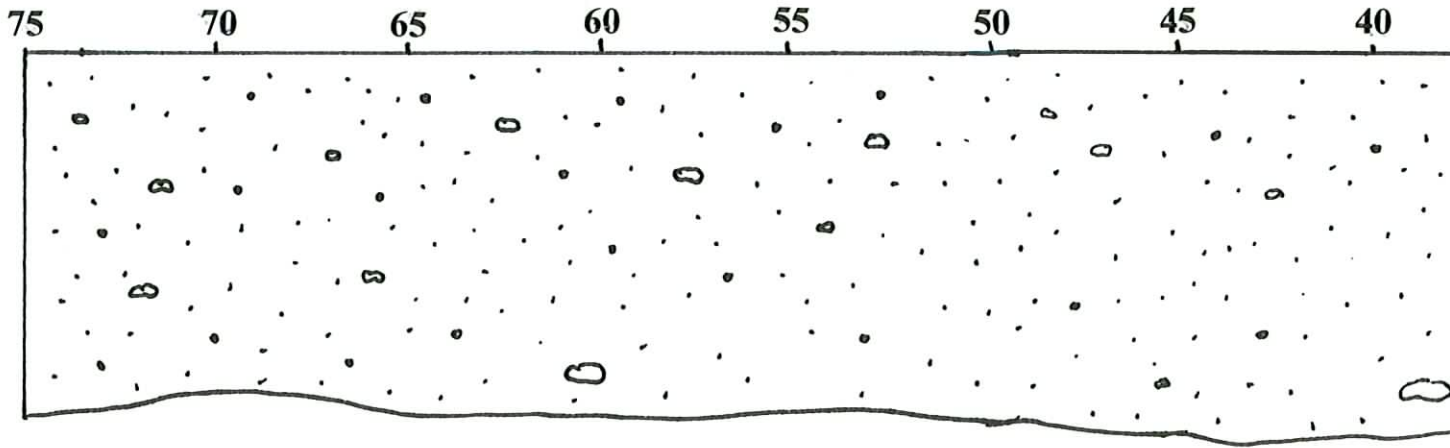
West

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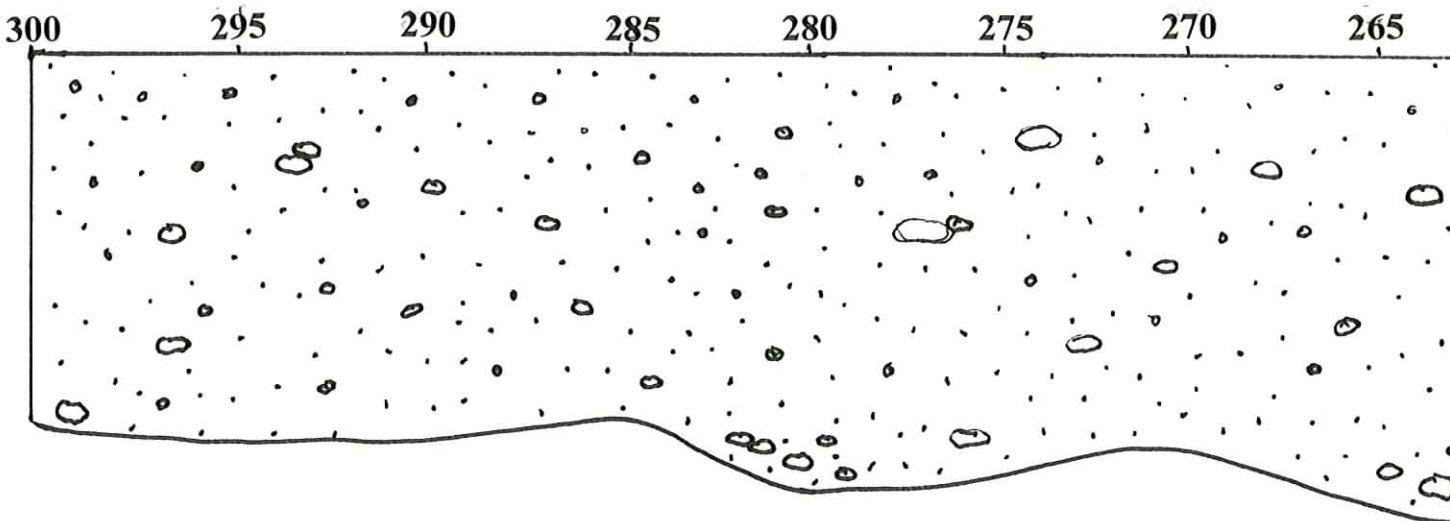
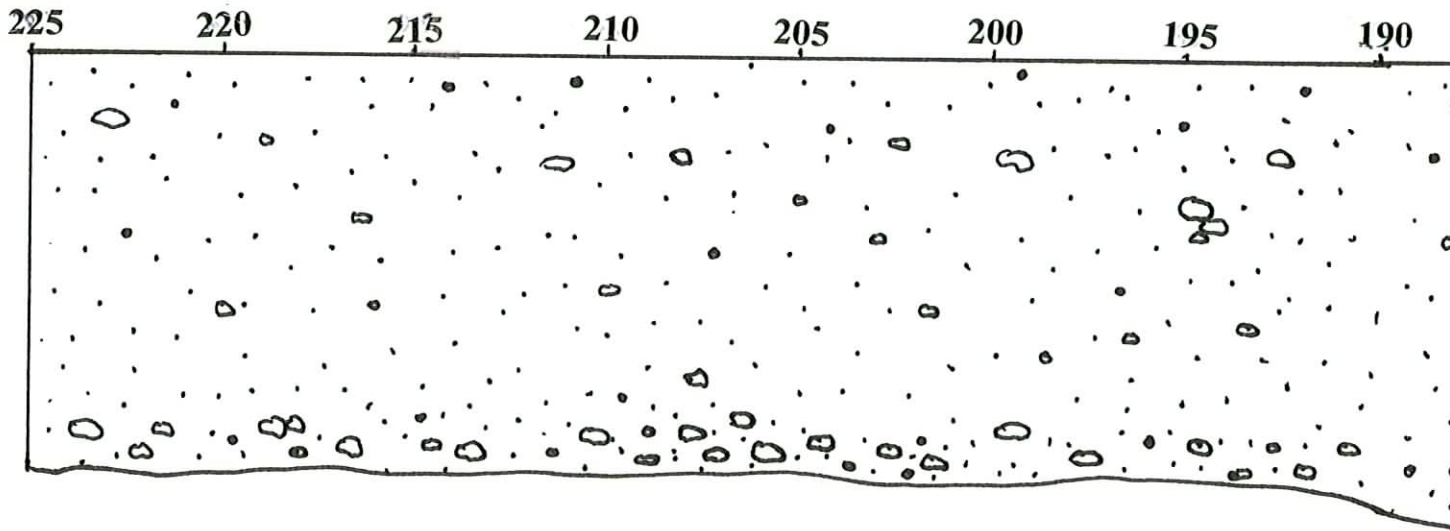
Southwest

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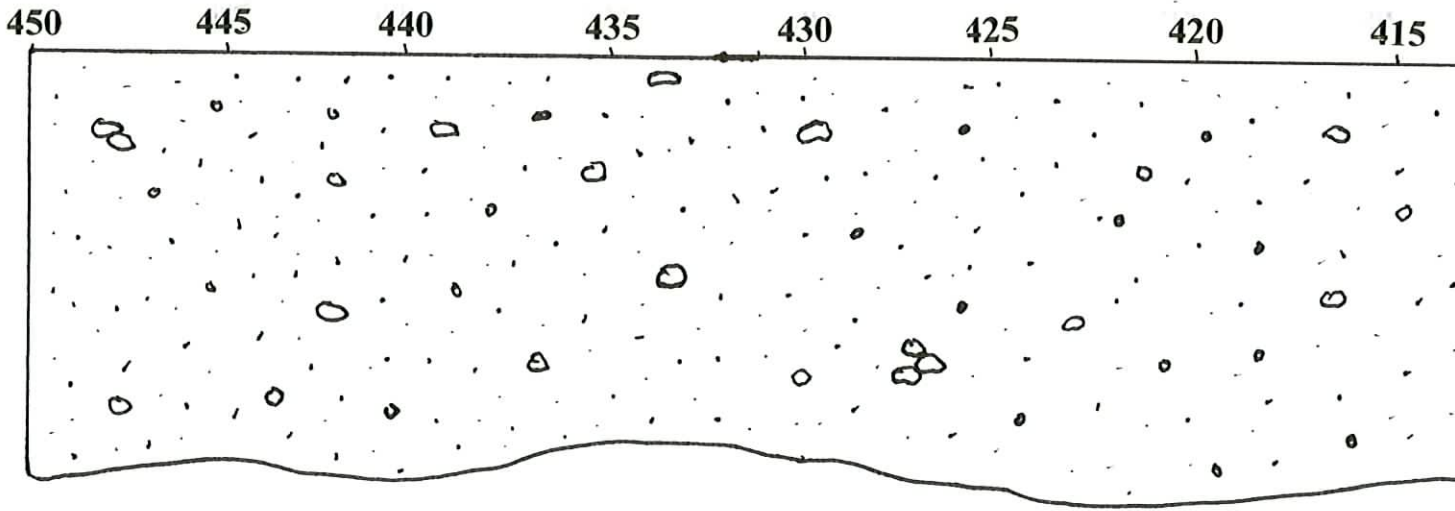
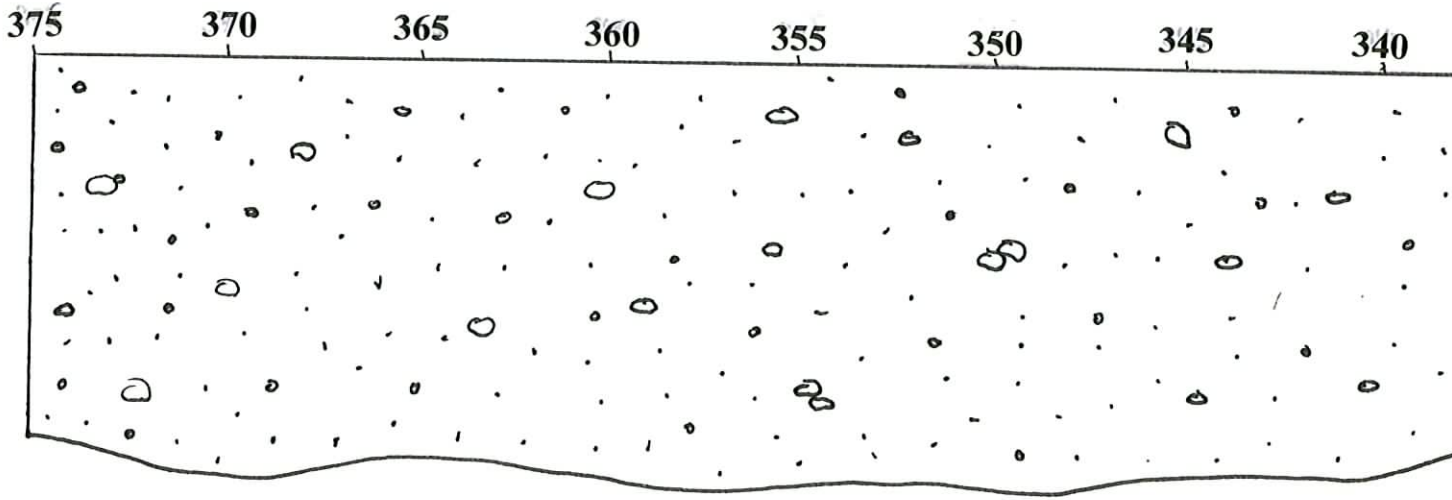
Southwest

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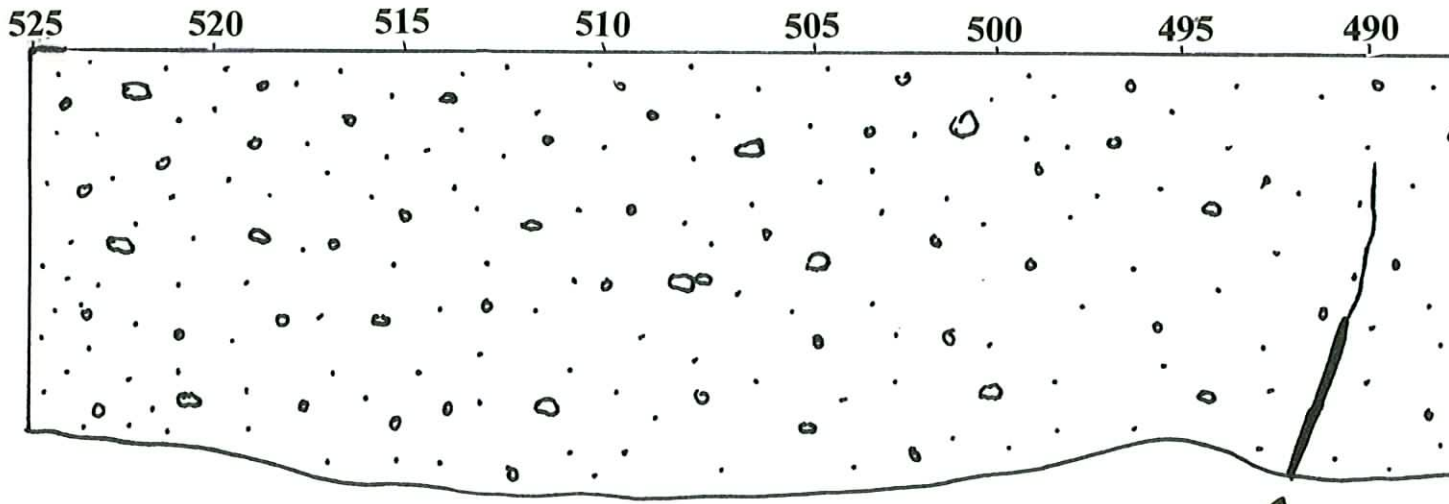
Southwest

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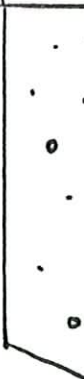
Southwest

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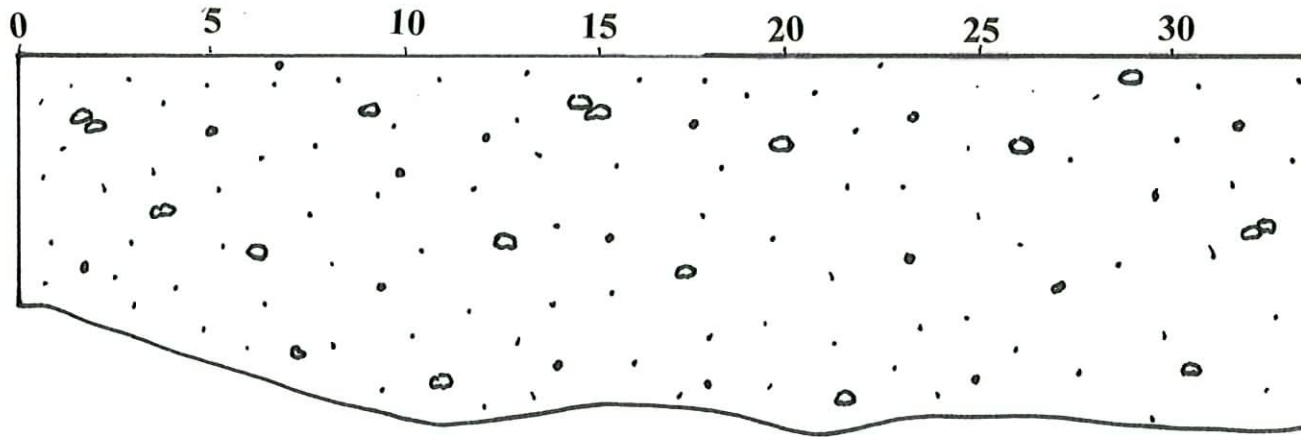
Fault N22W, 75W

565



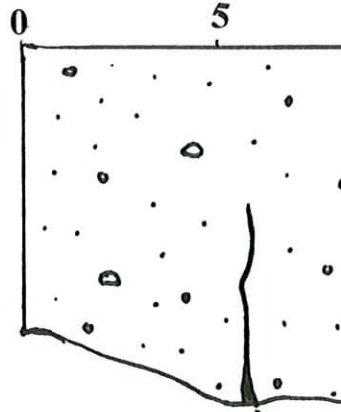
Northwest

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Southwest

Trench



Fault N22W, Vertical

APPENDIX C



Photo 1: Fault trench No. 2 located across the site traveling in a southwest-northeast direction. A discernable fault trace was located within the trench near the southwest.

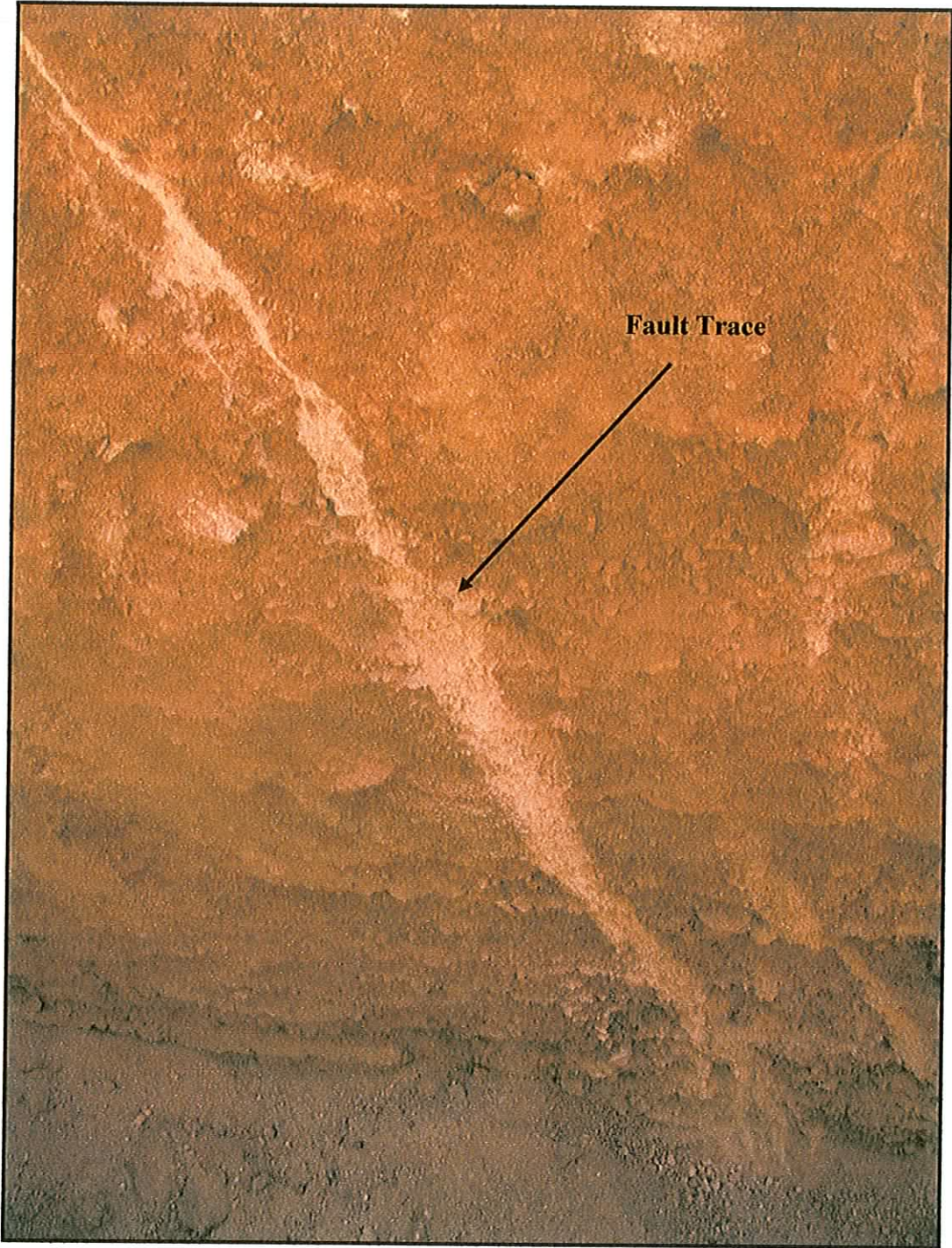


Photo 2: Fault trace on south sidewall at approximately 490 feet within Trench T-2.

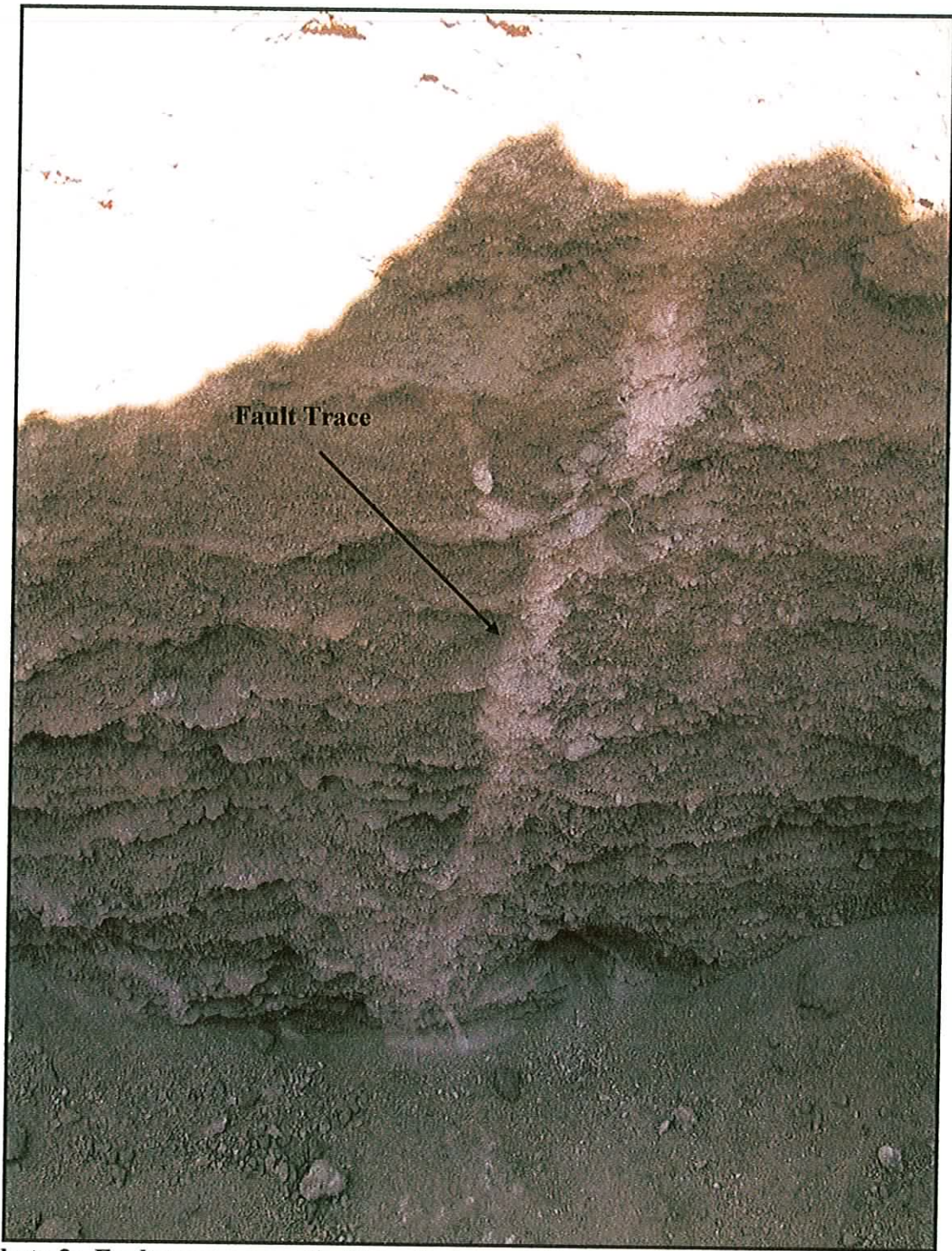


Photo 3: Fault trace on north sidewall at approximately 490 feet within Trench T-2.



Photo 4: Fault trench No. 4 located directly to the north of Fault trench No. 2. A discernable fault trace was located within the trench.



Photo 5: Fault trace on south sidewall at approximately 5 feet within Trench T-4.