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SUMMARY REPORT  
WASTE BURIAL TRENCH INVESTIGATION  
LEHR FACILITY  
UNIVERSITY OF CALIFORNIA, DAVIS



July 1991  
Job No. 00234-213-044



**DAMES & MOORE**

A PROFESSIONAL LIMITED PARTNERSHIP

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FAX NO. (916) 387-0802

July 31, 1991

University of California  
Office of Environmental Health and Safety  
Davis, CA 95616

Attention: Mr. Steve Eckberg

Re: Summary Report  
Waste Burial Trench Investigation  
LEHR Facility  
University of California, Davis

Dear Mr. Eckberg:

Enclosed are ten copies of our revised summary of the investigative work performed to date on the waste burial trenches located at LEHR. Revisions of the report were based on UCD's comments contained in a letter to Dames & Moore dated 27 June 1991.

If you have any questions concerning the summary please call us at (916) 387-7530.

Sincerely,

DAMES & MOORE

Joseph J. Niland  
Senior Geologist

Jim Brake  
Project Geologist

WRS:JB:sdm

UCD4.020

SUMMARY REPORT  
WASTE BURIAL TRENCH INVESTIGATION  
LEHR FACILITY  
UNIVERSITY OF CALIFORNIA, DAVIS

1.0 INTRODUCTION

Shallow burial trenches located at the LEHR facility were used by the Department of Energy (DOE) and the University of California, Davis (UCD) to dispose of waste materials from experiments conducted at LEHR and the main UC Davis campus from the mid-1950s to 1974. Exploratory trenches have confirmed the presence of radioactive, chemical, and biological (bones) materials disposed of in these trenches. Disposal of experimental waste material in the trenches was separate from UCD standard landfill disposal operations also performed at the site since the 1940's, although some of the trenches were excavated adjacent to landfill disposal cells. Figure 1 shows the locations of waste burial trenches assumed to exist at LEHR based on compilation of historical documentation.

A total of 44 exploratory trenches have been excavated at LEHR since 1988 for the purpose of investigating the location and sampling the contents of waste burial trenches (Figure 1). Wahler Associates excavated 26 trenches in February 1988 and Dames & Moore excavated 18 trenches in November 1989.

The results of exploratory trenching are presented in Section 2.0. Dames & Moore also performed ground penetrating radar (GPR) surveys in an effort to locate waste burial trenches in 1990. GPR surveys are described and results are presented in Section 3.0. Soil samples were collected from selected trenches and analyzed for chemical and radiological constituents. Soil sample collection procedures and results of analysis are presented in Section 4.0, and recommendations for further characterization work are presented in Section 5.0.

In 1984 Rockwell International performed an investigation titled, "Initial Assessment Survey of the DOE LEHR Site of University of California - Davis". As part of this investigation, soil samples were collected at several locations at LEHR. Four locations were sampled in the southwest corner of the site near DOE burial trenches and scanned for gross beta and gross gamma activity. Two samples (Hole 13 at 10.0 feet and Hole 14 at 5 feet) had elevated readings of gross gamma activity. None of the samples had elevated beta activity.

## 2.0 EXPLORATORY TRENCHING

Exploratory trenching was performed by Wahler Associates and Dames & Moore to attempt to locate and verify the existence of waste burial trenches. The locations of exploratory trenches excavated by Wahler Associates (T-1 through T-26) and Dames & Moore (ET-1 through ET-18) are shown on Figure 1. Exploratory trenches were excavated in areas where documented waste burial trenches exist. These areas include: the vicinity of wells UCD-9/12, along the east side of the eastern block of the dog pens, along the south side of both blocks of dog pens, and in the southwest corner of the site (Figure 1).

The presence or absence of waste burial activities were evaluated in exploratory trench excavation by observation of disturbed soil and/or debris surrounded by in situ native soil in the wall of the exploratory trench. Past burial activity was evidenced by waste materials such as bones, glass, plastic, and gravel fill in intersected burial trenches. Each exploratory trench was logged in order to document exposed structures (i.e., native soil layering or intersected waste burial trenches). Logs of all exploratory trenches are attached in Appendix A.

### 2.1 RESULTS OF EXPLORATORY TRENCHING

Presented below are results from the Wahler Associates and Dames & Moore exploratory trenching. Results of chemical and/or radiological analysis of samples collected from exploratory trenches are presented in Section 4.0.

#### 2.1.1 Wahler Associates Exploratory Trenches

Eighteen of the 26 exploratory trenches excavated by Wahler Associates contained evidence that waste burial trenches were intersected. Figure 2 shows the locations of Wahler Associates exploratory trenches and indicates where these trenches exposed evidence of burial trenches. Evidence of waste burial trenches consisted of: 1) a trench form exposed in the walls of the exploratory trenches, and 2) debris within the exposed trench form including bones, dog pen gravel, plastic, bottles (some containing liquid), wood, wire, and concrete. According to the Wahler Associates report (December 1988), exploratory trenches were monitored for radioactivity with a hand-held survey meter. Survey meter readings from one trench (T-11) exceeded background levels. The measured level in this trench was 2,500 counts per

minute (cpm). Further evidence of waste burial trenches exposed in the Wahler Associates exploratory trenches is outlined below:

- Two or three waste burial trenches in the southwest corner of the site were intersected by T-1, T-2, T-3, T-4, T-5, T-9, and T-10. Maps supplied by the University show three separate waste burial trenches and a single waste burial pit in the southwest corner of the site (Figure 1). Trench logs for T-5 and T-9, which were excavated end to end, suggest that there are three trenches parallel to each other in this area.
- One waste burial trench south of the western block of dog pens was intersected by T-11, T-12, T-13, T-14, and T-15. University maps show two parallel, east-west-oriented burial trenches in this area.
- Three waste burial pits (short trenches) were intersected south of the eastern block of dog pens by T-17 and T-23. University maps show up to 47 burial pits in this area. Wahler Associates exploratory trenching was limited in extent in this area.
- Up to five waste burial trenches were intersected east of the eastern block of dog pens by T-18, T-21, T-24, T-25, and T-26. This is consistent with University maps that show five parallel, north-south-oriented burial trenches in this area. In one burial trench (T-24), containers were present. One container was removed for analysis. The results were positive for heptachlor (680,000 ppm), dieldrin (3,800 ppm) and carbophenothion (41,000 ppm). After analysis, this material was disposed of as chemical waste.
- A possible landfill cell from former disposal area #2 was intersected in T-16. Refuse observed in T-16 was not in a typical trench form deposit, as seen in other exploratory trenches, but was exposed in the entire western half of T-16. Also, no bones or dog pen gravel were noted on the trench log for T-16 suggesting that the refuse may be part of one of the landfill disposal cells.

Wahler Associates exploratory trenches T-19 and T-20, excavated north of the eastern block of dog pens, did not expose evidence of burial trenches. University maps prepared from historical documents and used as guidance for exploratory trenching showed burial trenches in this area.

#### 2.1.2 Dames & Moore Exploratory Trenches

Dames & Moore excavated a total of 18 exploratory trenches in areas where Wahler Associates trenching was not concentrated (Figure 2). These areas included:

- The open field between the Toxic Pollutants building and wells UCD-9/12 (Figure 1);
- On the east side of the small set of dog pens adjacent to UCD-9/12 (Figure 1);
- Off the northwest corner of the <sup>60</sup>Co field (Figure 1); and
- On the south side and in between the two main blocks of dog pens (Figure 1).

Soil samples were collected by the University from selected trenches and analyzed for radiological and chemical parameters. Results of these analyses are presented in Section 4.0.

Evidence of waste burial trenches were exposed in Dames & Moore exploratory trenches as outlined below:

- One waste burial trench was exposed in ET-6 with debris consisting of bones and bottles. The burial trench appeared to be exposed lengthwise as debris was observed the entire length of the exploratory trench;
- Exploratory trenches ET-9 and ET-10 exposed evidence of up to three waste burial trenches. University maps show one north-south oriented burial trench in this area.
- Exploratory trench ET-17 exposed evidence of one waste burial trench. University maps show two east-west oriented burial trenches in this area.
- ET-16 exposed what appeared to be a large disturbed area (excavated then backfilled) that contained no debris. University maps show two large pit-shaped excavations in this area.

Logs of Dames & Moore exploratory trenches are included in Appendix A.

In some cases exploratory trenches (both Wahler Associates and Dames & Moore trenches) did not expose evidence of waste burial trenches where documented (see trenches 21 and 26, Figure 2) or did expose evidence of burial trenches where not previously documented (see trenches 9, 10, 11, 12 on Figure 2).

### 3.0 GROUND PENETRATING RADAR SURVEYS

Ground Penetrating Radar (GPR) surveys were performed along the south side of the eastern block of dog pens in an attempt to locate waste burial trenches and pits where exploratory trenching

exposed little evidence of burial pits shown on University maps. The GPR surveys were performed by Norcal Geophysical Consultants, Inc. of Petaluma, California.

The GPR method of investigation is an impulse system which radiates short-duration electromagnetic pulses into the ground from an antenna near the surface. These pulses are reflected from various interfaces within the earth and are picked up by the receiver section of the antenna and returned to the control unit for processing and display (profile). These reflections occur at different soil horizons, soil/rock interfaces, rock/air interfaces (voids), manmade objects, or at any interface which creates a contrast in complex dielectric properties. For example, digging a trench and filling it again can create a difference between the dielectric properties of the disturbed earth and undisturbed earth which can be sensed by the GPR. The reflections caused by the differences of dielectric properties appear on the survey profile as features or anomalies distinguishable from typical "background" conditions. The survey antenna can be calibrated to existing background conditions by performing a survey line across soil which is known to be undisturbed.

The depth of radar penetration is site specific. Depths of 3 to 10 meters can be attained under ideal conditions. However, sufficiently high concentrations of fine grained materials (silts and clays) attenuate the radar pulse and may limit penetration to less than one meter.

The GPR surveys consisted of 13 parallel lines approximately two feet apart. Lines were also run perpendicular to the east-west lines to help confirm or support anomalies.

An interpretation of the GPR survey profiles was provided by Norcal. Figure 3 shows the locations of the survey lines and the location of anomalies found by the GPR surveys. Several anomalies from the GPR survey appear to correlate to burial pits expected to be located in the survey area. However, several suspected burial pit locations were not apparent on the GPR printout.

## 4.0 RESULTS OF RADIOLOGICAL AND CHEMICAL ANALYSES

### 4.1 WAHLER ASSOCIATES EXPLORATORY TRENCH SAMPLES

A total of three grab samples were collected from Wahler Associates exploratory trenches from DOE burial trenches in the southwest corner of the LEHR site. Samples were collected from trenches T-1, T-5, and T-9 (Figure 1) and analyzed by TMA/Norcal Laboratory of Richmond, California for gross alpha and gross beta radiation, Cesium-137, Radium-226, tritium, and Strontium-90. Detectable levels of tritium were reported for all three samples at levels between 1.9 to 6.1 picoCuries per gram (pCi/g). An elevated level of Strontium-90 was reported for the sample collected from trench T-1 at  $1.14 \pm 0.32$  pCi/g.

Twelve grab samples were collected from Wahler Associates exploratory trenches that targeted UCD burial trenches along the south and east sides of the dog pens. Samples collected from all trenches, except T-12 and T-25, were analyzed by CEP Laboratories of Santa Fe, New Mexico. All samples had elevated levels of tritium reported ( $452 \pm 23$  to  $4839 \pm 110$  pCi/g). Other reported detections were:

- Strontium-90 from T-22 at  $0.9 \pm 0.2$  pCi/g;
- Cesium-137 from T-21 at  $0.18 \pm 0.09$  pCi/g;
- Cesium-137 from T-14 at  $0.18 \pm 0.11$  pCi/g; and
- Cesium-137 from T-11 at  $15.1 \pm 0.3$  pCi/g.

### 4.2 DAMES & MOORE EXPLORATORY TRENCH

A total of three grab samples were collected from Dames & Moore exploratory trenches. Two samples were submitted to TMA/Norcal for analysis of pesticides and PCBs (EPA Method 8080), ICP metal composites of material collected from several locations. One sample was analyzed by CEP for the same radiological constituents as trench T-14. One control sample collected from a background area away from the trenches was also analyzed. Results of analysis can be summarized as follows:

- None of the reported levels of metals exceeded Title 22 Total Threshold Limit Concentrations (TTLCs);
- No detections of semi-volatile organic compounds were reported;
- One pesticide compound, technical chlordane, was detected at 688  $\mu\text{g}/\text{kg}$  in the sample from ET-1;
- Detections of Radium-226 were reported for all samples at  $0.38 \pm 0.12$  to  $0.44 \pm 0.06$  pCi/g;
- Detections of Thorium-232 were reported for all samples at  $0.41 \pm 0.13$  to  $0.51 \pm 0.08$  pCi/g;
- Tritium was reported for the sample from ET-3 at  $0.61 \pm 0.23$  pCi/g; and
- The background sample had detections of Cesium-137, Radium-226, and Thorium-232 reported at  $0.04 \pm 0.02$ ,  $0.21 \pm 0.09$ , and  $0.34 \pm 0.11$  pCi/g, respectively.

*Collected from where?*

## 5.0 CONCLUSIONS

Results of exploratory trenching performed by Wahler Associates and Dames & Moore suggest that the majority of waste burial trenches exist as documented, however some burial trenches exist that are not documented, while others do not exist where documented.

Chemical and radiological analysis of soil samples collected from trenches has been limited in scope. Results of analysis are consistent with materials expected or known to have been buried at the site.

## 6.0 PRELIMINARY RECOMMENDATIONS

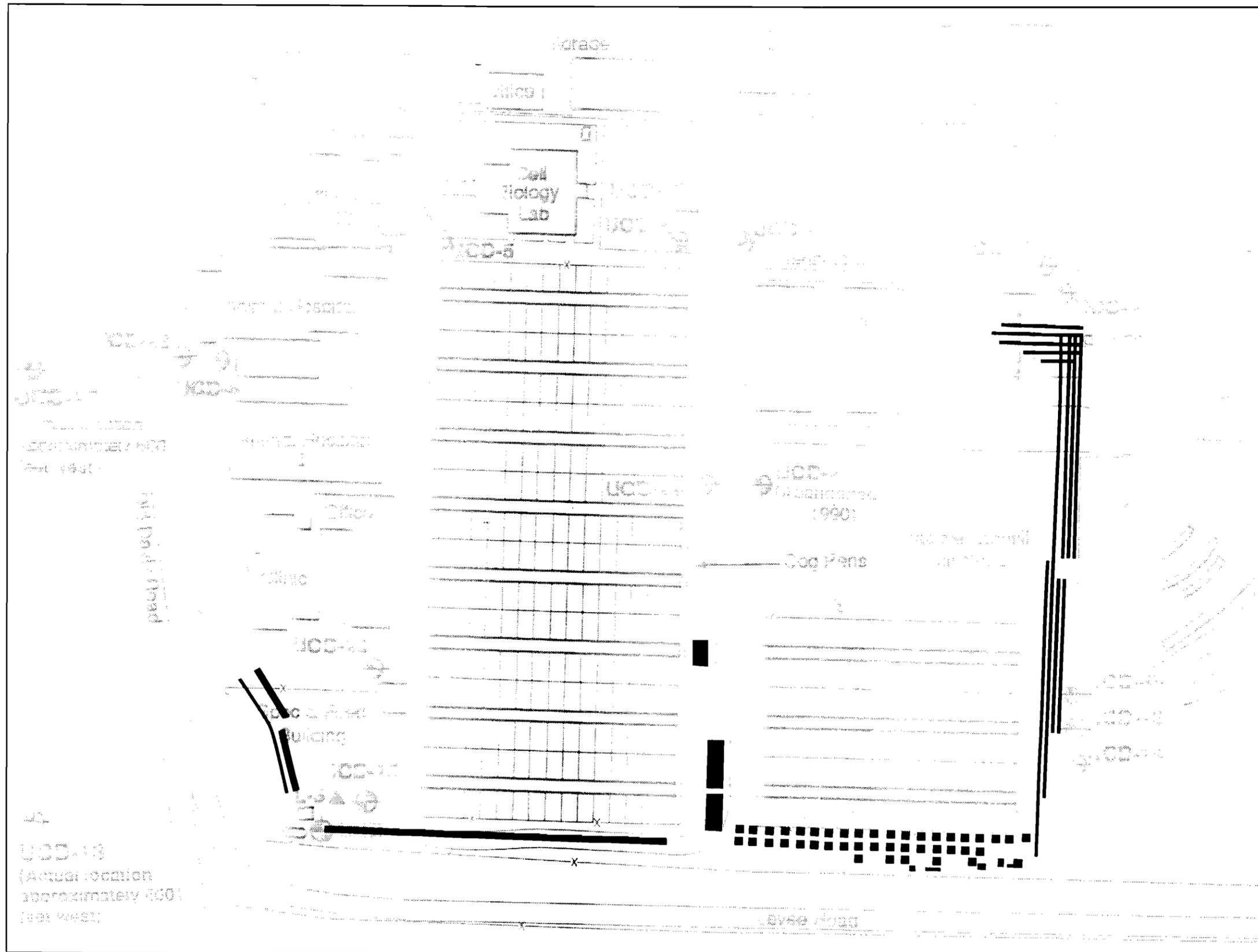
The following preliminary recommendations are for further characterization of soil in and around the burial trenches that have been located by exploratory trenching and GPR surveys. The recommendations are for work that will be part of a site-wide program of remediation. Currently, a draft Closure Plan outline is being prepared for the site which will address all aspects of soil and groundwater remediation at the site.

In order to evaluate possible remedial alternatives for the waste burial trenches, the extent of site constituents of concern (radiological, chemical, or both) must be more accurately defined. Work

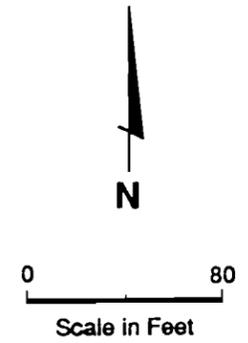
performed to date has been valuable in providing a preliminary assessment of burial trench locations and contents, but has not provided data necessary to define the lateral and vertical extent of impact to soil. We recommend a field sampling program that would:

- 1) provide adequate delineation of the site constituents of concern in soil;
- 2) be statistically valid; and
- 3) be in compliance with SW-846 guidelines and recent DHS proposed regulations and therefore acceptable to regulatory agencies.

Details of such a program will be contained in the Closure Plan to be prepared for the site.



**EXPLANATION**  
 — Waste Burial Trenches



**SITE MAP SHOWING LOCATIONS OF WASTE BURIAL TRENCHES**

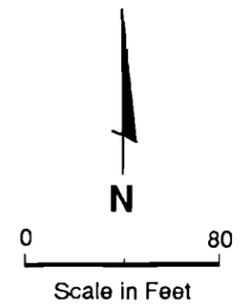
LEHR Facility  
 University of California, Davis  
 JULY 1991



**EXPLANATION**

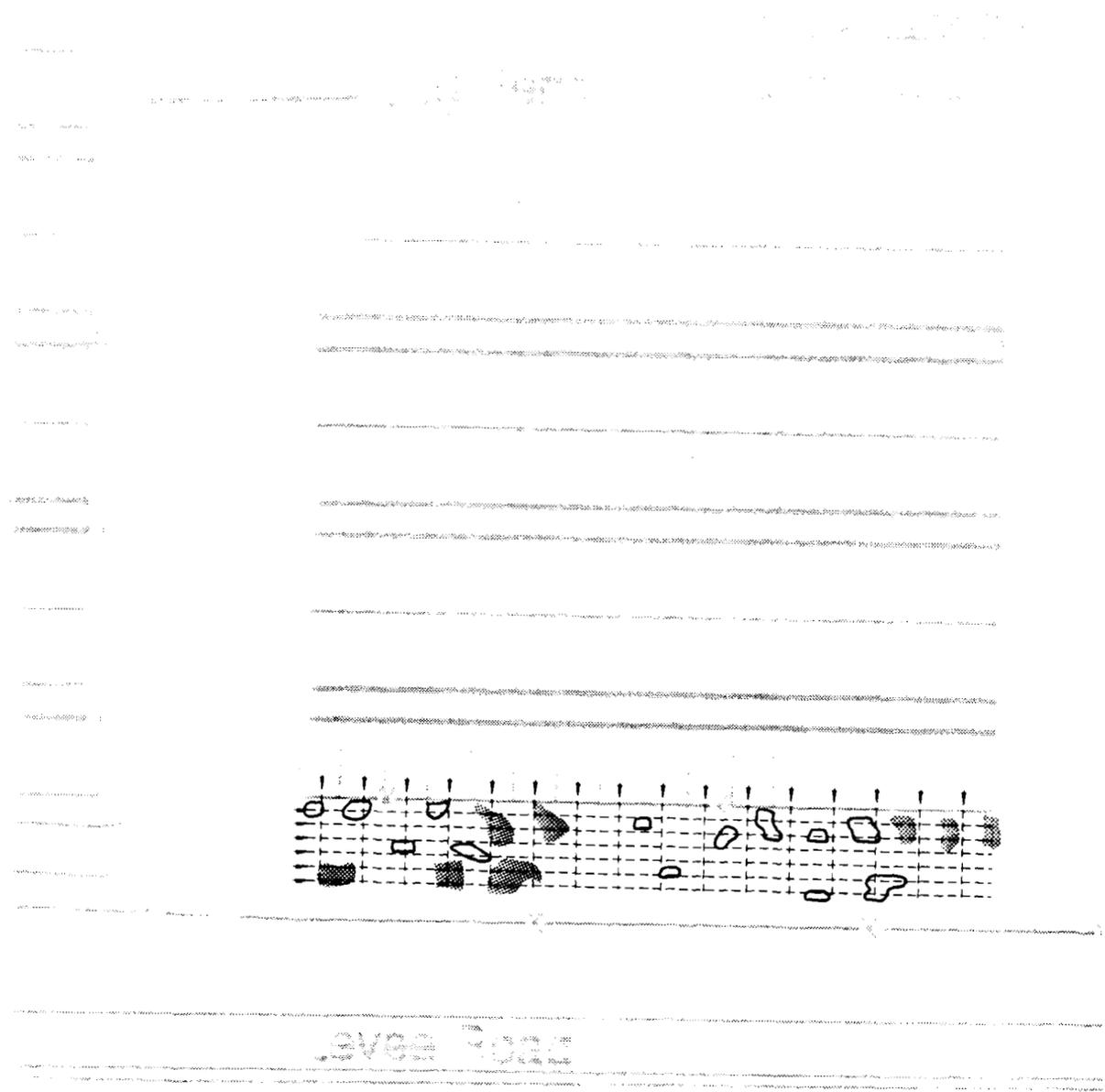
-  D & M Exploratory Trench
-  Wahler Associates Exploratory Trench
-  Intersection of Exploratory Trench and Waste Burial Trench

- \* Note: Wahler Associates trench #16 exposed buried debris that appears to be part of an old landfill cell and not a UCD waste burial trench.
- \*\* Note: Dames & Moore trench ET-6 exposed what appeared to be a waste burial trench parallel to ET-6. Evidence of North - South burial trenches was not observed in ET-6.



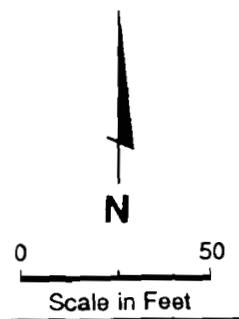
**SITE MAP SHOWING LOCATIONS OF EXPLORATORY TRENCHES**

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JUNE 1991



**EXPLANATION**

-  GPR Anomaly - Interpretation of Profile  
Less Confident
-  GPR Anomaly - Interpretation of Profile  
More Confident
-  GPR Survey Lines

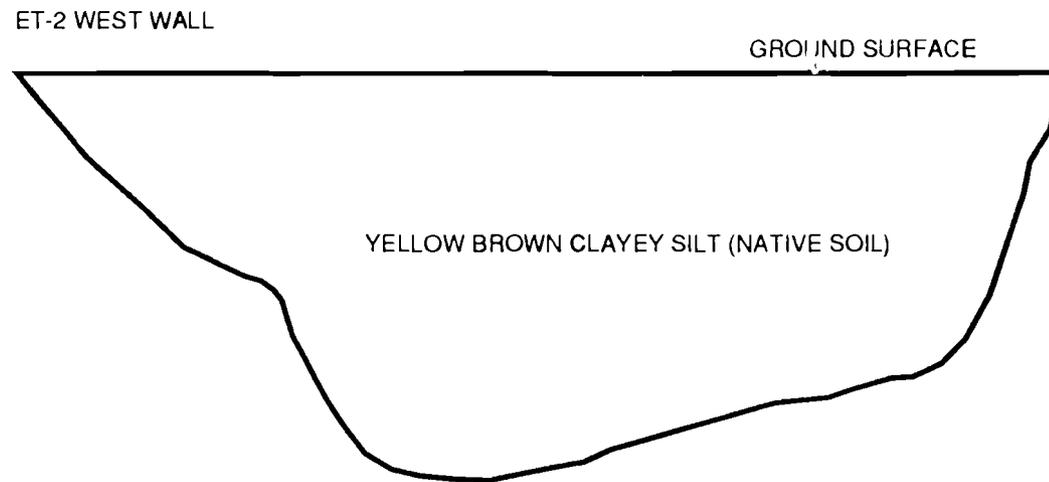
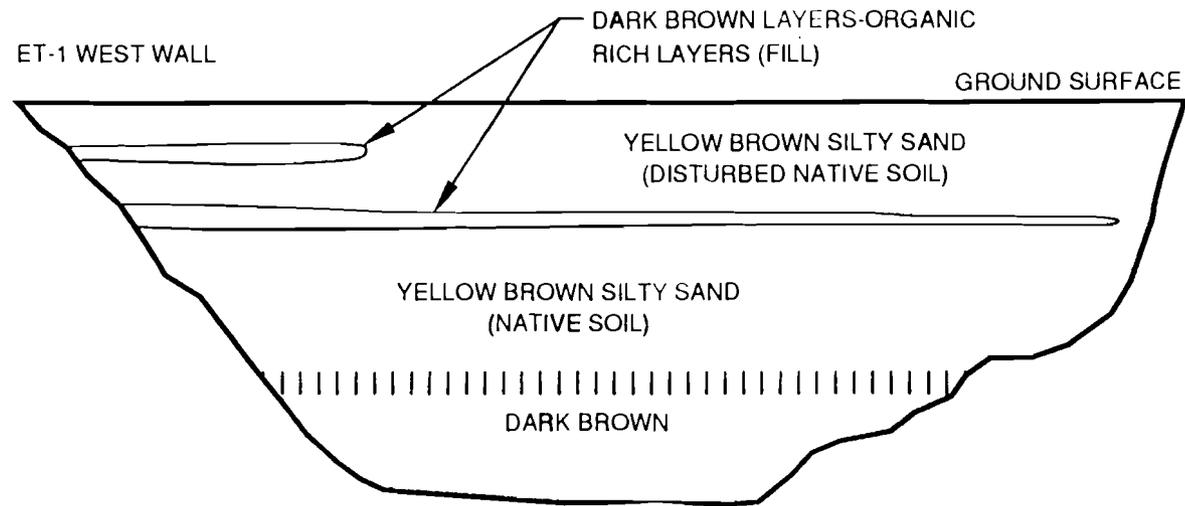


**SITE MAP SHOWING  
GROUND PENETRATING RADAR  
ANOMALIES**

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JULY 1991

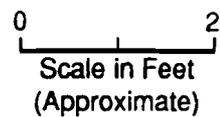
FIGURE 3



NOTE: SEE FIGURE 1 FOR TRENCH LOCATION

EXPLANATION

||||| GRADATIONAL CONTACT IN SOIL



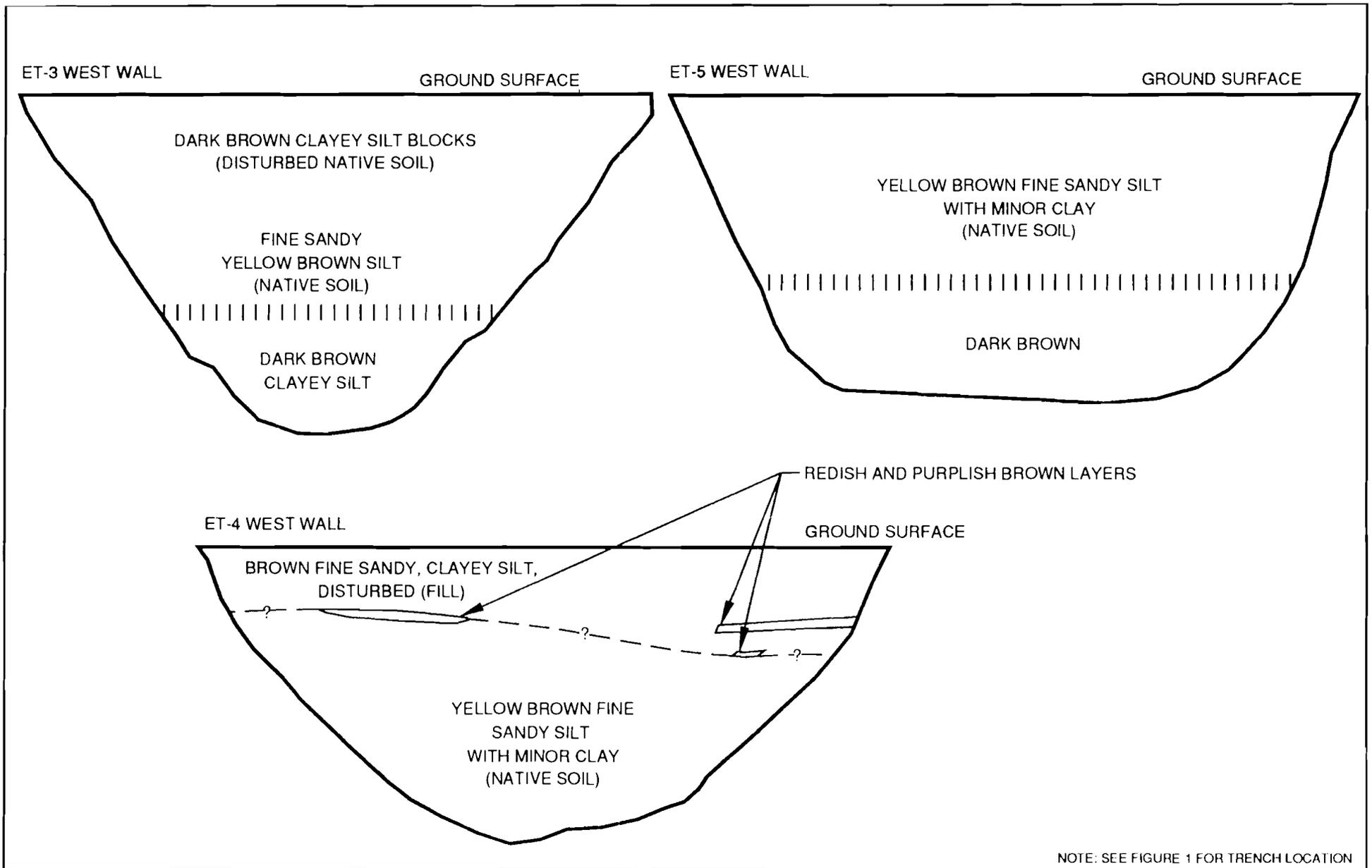
**SCHEMATIC TRENCH LOG**

**ET-1, ET-2**

Trench Investigation  
UCD LEHR Facility  
Davis, California

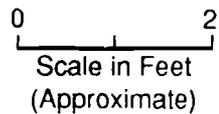
APRIL 1991

FIGURE A-1



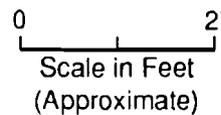
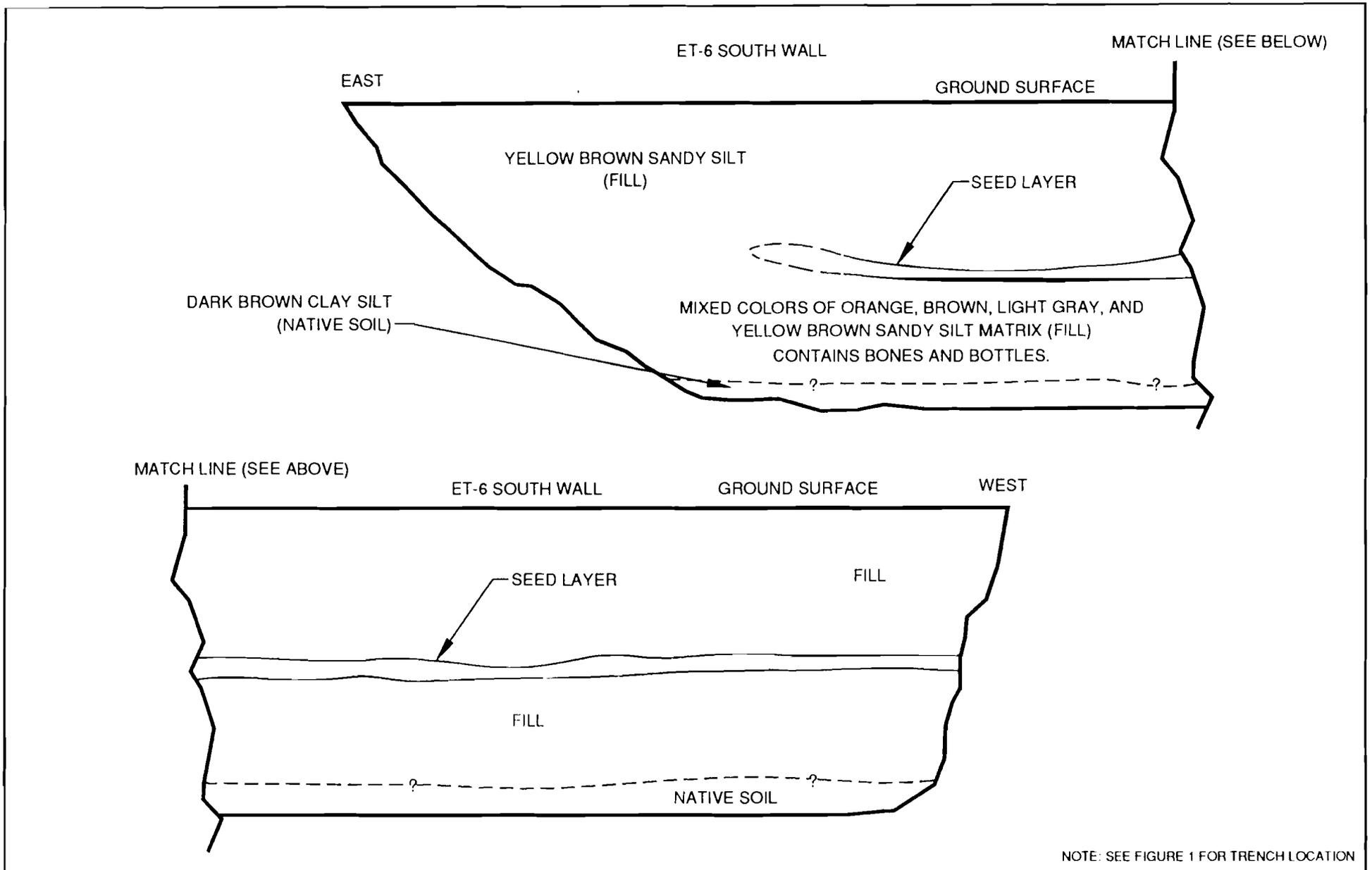
EXPLANATION

- ||||| GRADATIONAL CONTACT IN SOIL
- - - CONTACT UNCERTAIN



**SCHEMATIC TRENCH LOG**  
**ET-3, ET-4, ET-5**

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FIGURE A-2



## SHEMATIC TRENCH LOG, ET-6

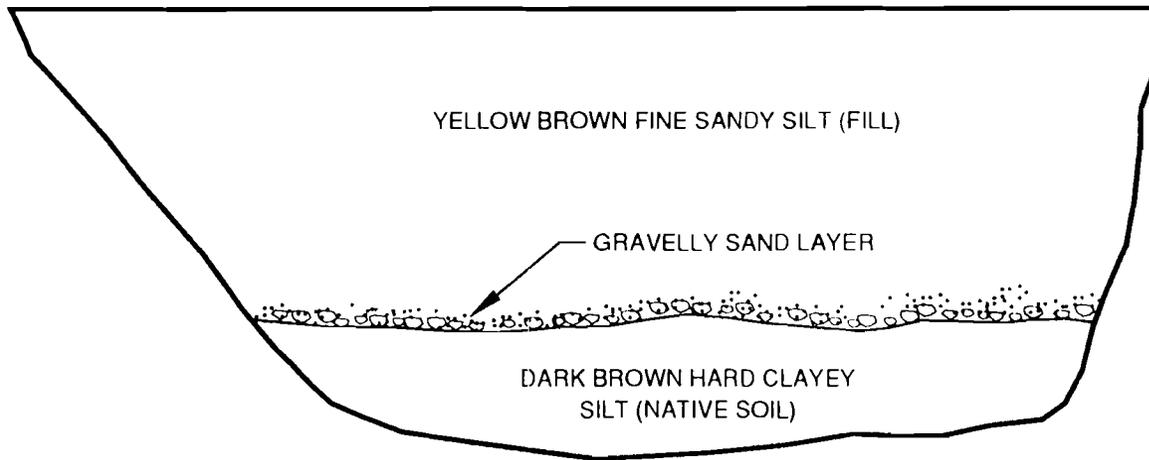
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APRIL 1991

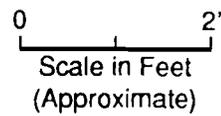
FIGURE A-3

ET-7 WEST WALL

GROUND SURFACE



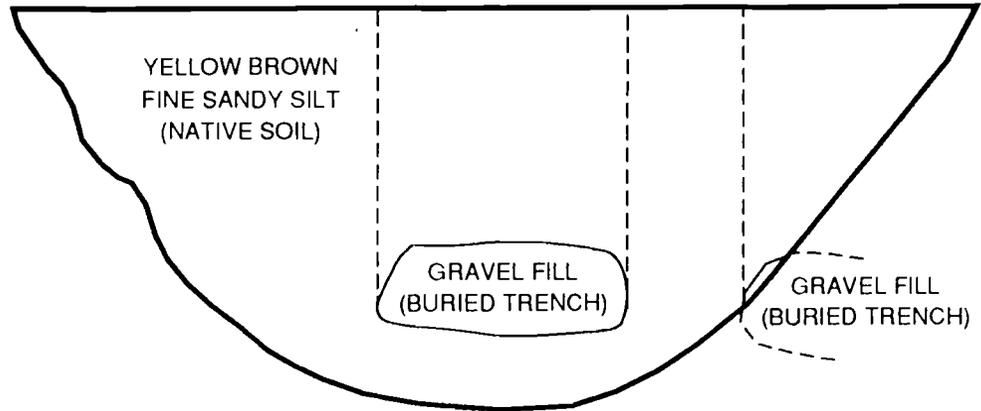
NOTE: SEE FIGURE 1 FOR TRENCH LOCATION  
ET-8 SAME AS ET-7



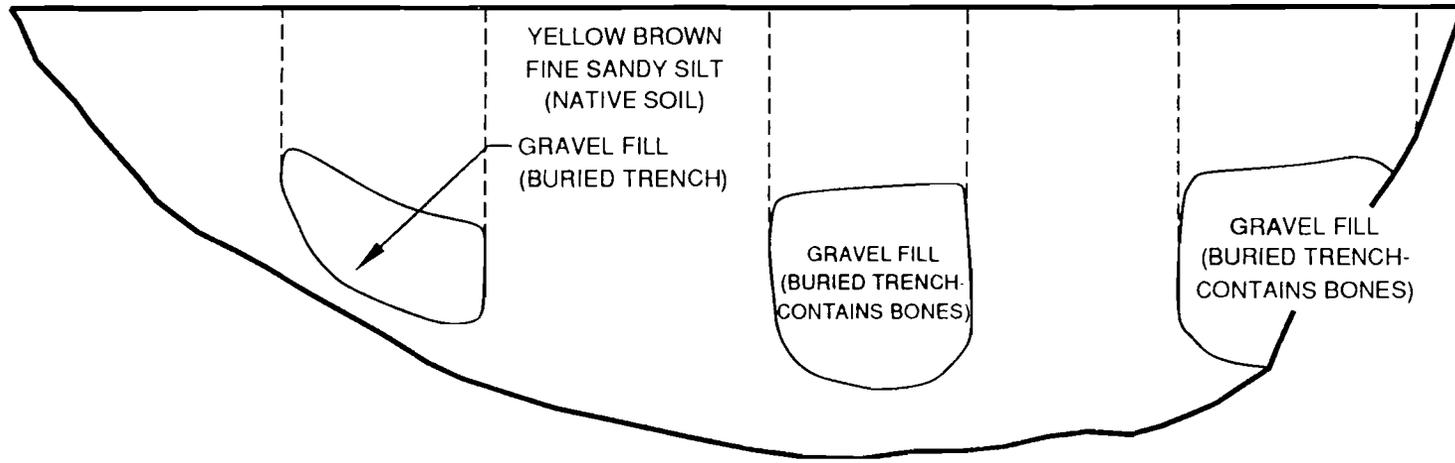
### SCHEMATIC TRENCH LOG, ET-7

Trench Investigation  
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FIGURE A-4

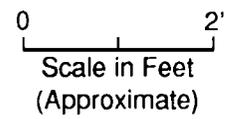
ET-9 NORTH WALL



ET-10 SOUTH WALL



NOTE: SEE FIGURE 1 FOR TRENCH LOCATION



**SCHEMATIC TRENCH LOG**  
**ET-9, ET-10**

Trench Investigation  
UCD LEHR Facility  
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FIGURE A-5

ET-11 NORTH WALL

GROUND SURFACE

DARK BROWN CLAYEY SILT WITH MINOR GRAVEL (FILL)

DARK BROWN CLAYEY SILT WITH SAND (FILL)

LIGHT BROWN SILT AND FINE GRAIN  
SAND (NATIVE SOIL)  
FINELY LAMINATED

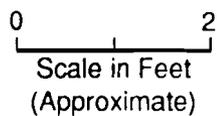
ET-12 NORTH WALL

GROUND SURFACE

DARK BROWN CLAYEY SILT WITH MINOR GRAVEL (FILL)

LIGHT BROWN SILT AND FINE GRAIN  
SAND (NATIVE SOIL)  
FINELY LAMINATED

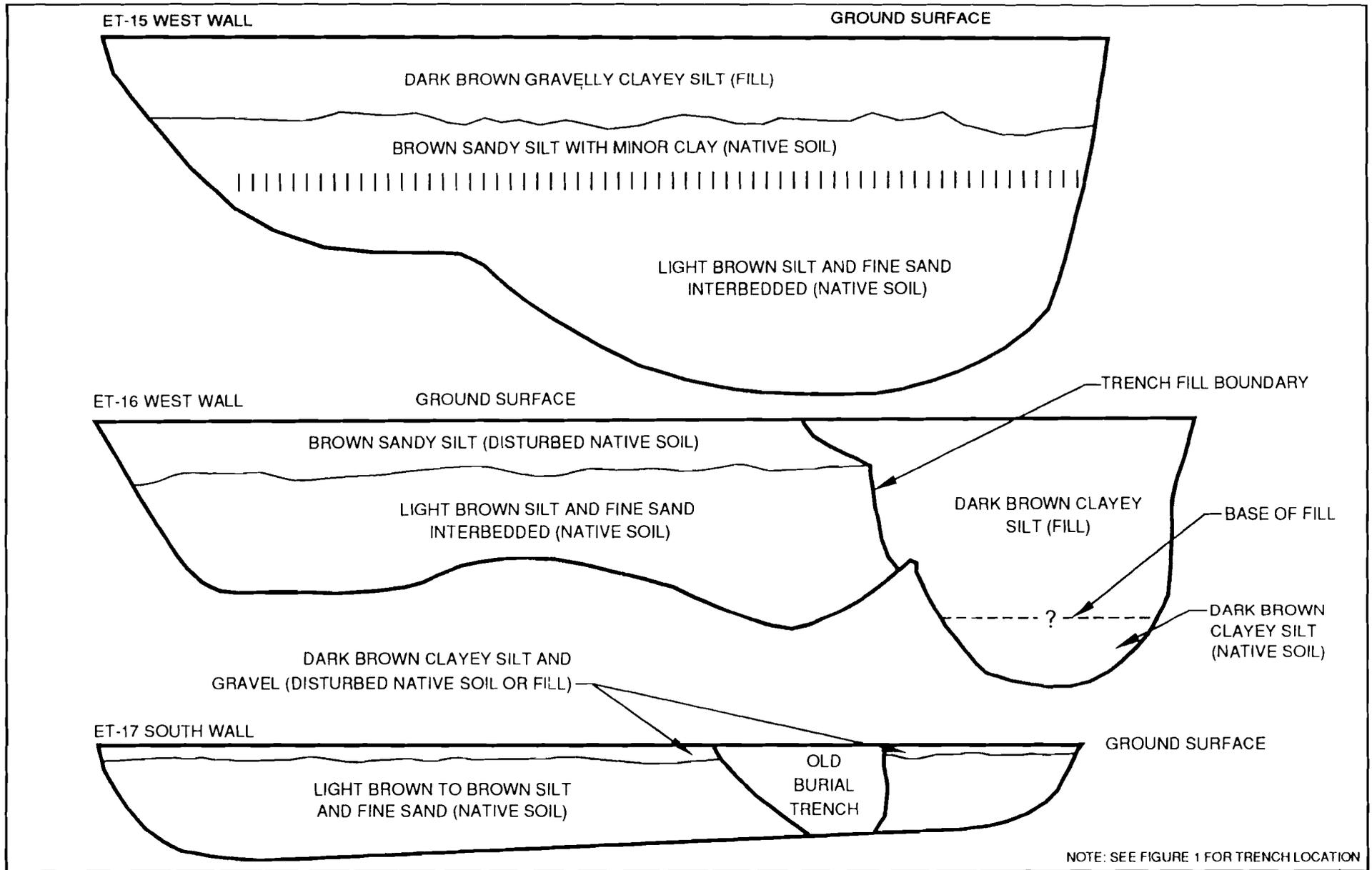
NOTE: SEE FIGURE 1 FOR TRENCH LOCATION



### SCHEMATIC TRENCH LOG ET-11, ET-12

Trench Investigation  
UCD LEHR Facility  
Davis, California  
APRIL 1991

FIGURE A-6



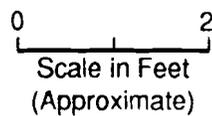
EXPLANATION

||||| GRADATIONAL CONTACT IN SOIL

----- CONTACT UNCERTAIN

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00234-213-044 LEHR-1



**SCHEMATIC TRENCH LOG**  
**ET-15, ET-16, ET-17**

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FIGURE A-7