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SOIL MOISTURE INVESTIGATION AND LYSIMETER-TENSIOMETER INSTALLATION AT GIANT REFINING COMPANY LAND TREATMENT UNIT

prepared for

Giant Refining Company
Gallup, New Mexico

by

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September, 1989

EXECUTIVE SUMMARY

An investigation of the Giant Refining Company Land Treatment Unit (LTU) treatment zone soils was conducted during the week of May 22, 1989 by K. W. Brown & Associates, Inc. (KWB&A). The investigation was conducted at the Giant Refining Facility located 17 miles east of Gallup, New Mexico. The primary objectives of this investigation were to determine the soil moisture regime and to install unsaturated zone monitoring (UZM) equipment to meet New Mexico Environmental Improvement Division (EID) requirements.

In summary, the field investigation involved the following:

1. collection of 48 ambient soil moisture samples from the investigation/installation pits;

2. collection of 25 soil profile samples for detailed physical analysis;

3. detailed soil profile descriptions of active and inactive LTU plots, and background plot;

4. in situ field infiltration data on active LTU plots and background plot;

5. water balance for the area calculated using monthly precipitation, evaporation, infiltration, and water added from waste;

6. installation of 4 soil moisture tensiometers; and

7. installation of 4 glass brick, and 6 porous cup lysimeters.

The data base developed during the site investigation allows determinations to be made about the moisture characteristics of the treatment zone soils at the Giant Refining LTU. Furthermore, it determines if soil-pore liquid and tensiometer equipment will function under the soil moisture conditions that were observed.

The soils which occur within the landfarm and background areas studied are very slowly permeable clays which are ideal for minimizing downward migration of hazardous constituents. The low infiltration rates of these soils indicated by the in situ field infiltration study, concluded that the soils at the facility have low permeability which greatly reduces the chance of water moving through the soil profile.

The presence of macropores was minimal within the upper 30 inches and practically nonexistent at greater depths. High bulk density, low porosity, and low available water holding capacity were characteristic of the soils investigated. While these soil characteristics are not favorable for agricultural purposes, they are favorable for land treatment practices.

Soil moisture samples collected during the investigation indicated that soil moisture decreased rapidly with depth. At depths of 54 inches

and greater, moisture was at such low levels and being held so tightly by the soil (>15 bars tension), that it was no longer available for for plant use.

Field tensiometers measure the tension with which water is held by soils. Their effectiveness is based on the principle that water in the tensiometer equilibrates through the porous cup with the surrounding soil water. The useful range of tensiometers is between 0 and 0.8 bars of tension. Moisture tensions encountered at the depths of tensiometer installation were in excess of 15 bars; therefore, it is unlikely that the tensiometers installed at Giant Refining will ever function properly.

Soil moisture conditions encountered during the investigation and equipment installation, were below the effective range for porous cup or glass brick lysimeters to collect samples. At the depths that the lysimeters were installed, moisture concentrations ranged from 16.79 to 12.59%. The associated moisture tensions determined at these moisture levels were all greater than 15 bars. Since the effective working range for lysimeters is between 0 and 0.75 bars, it is unlikely that soil moisture conditions will ever be encountered which enable the collection of soil-pore liquid samples.

Soil moisture retention curves were developed for three depths in the LTUs and one depth in the background area. All four of the curves developed were very similar in their moisture retention properties. These moisture retention curves can be used in the future to correspond ambient field moisture to soil moisture tension. By determining the soil moisture tension, it will ultimately indicate if soil-pore liquid sampling equipment, and/or tensiometers will be in a functional capacity.

The water balance based on the assumption of zero runoff indicated that there was no net downward movement of water in the soil profile at the LTU. The annual water storage/recharge showed a deficit of 24.04 inches. Water is shown to accumulate during the winter months, however, during the spring, summer, and fall months, water was moved out of the soil to satisfy the high-evaporative demands in that period.

LYSIMETER REINSTALLATION AT GIANT REFINING COMPANY LAND TREATMENT UNIT

prepared for

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by

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March, 1990

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INTRODUCTION

A lysimeter network was installed at the Giant Refining Land Treatment Unit (LTU) by K. W. Brown & Associates, Inc. (KWB&A), during May, 1989. The installation included 4 glass brick samplers, 6 porous cup samplers, and 4 sample stations. The 6 porous cup samplers were reinstalled on January 25, 1990 at the request of the New Mexico EID. Meeting textural requirements of the sand pack used in the lysimeter installation process was the objective of the reinstallation. Lysimeters are installed in compliance with unsaturated zone monitoring (UZM) regulations and guidance (EPA, 1986). This report discusses the lysimeter location and methods of installation.

INSTALLATION PROCEDURES

During the initial study, lysimeters were installed in the active, inactive, and background areas of the LTU. The pits excavated for the soil survey and sampling were also used for the lysimeter installation (Figures 1 and 2). The pits located in the active LTU received 1 glass brick and 2 porous cup type lysimeters each. The pits located in the inactive LTU and the background area received 1 glass brick and 1 porous cup each. Lysimeters located in the LTU were installed 5 feet below the original landfarm surface (Figure 3). The soil-pore liquid samplers located in the background (Control) area were installed 5 feet below ground surface, which corresponds to the below treatment zone depth interval within the LTUs. The installation locations for the lysimeters were chosen by determining random distances from plot corners. (See Appendix A, Photograph Log.)

During the lysimeter reinstallation process, all porous cup lysimeters initially installed by KWB&A were replaced. The new set of porous cup lysimeters were installed at identical depths as before, only 8 to 12 feet east of the existing locations (Table 1).

The following installation procedures were followed at each lysimeter reinstallation location:

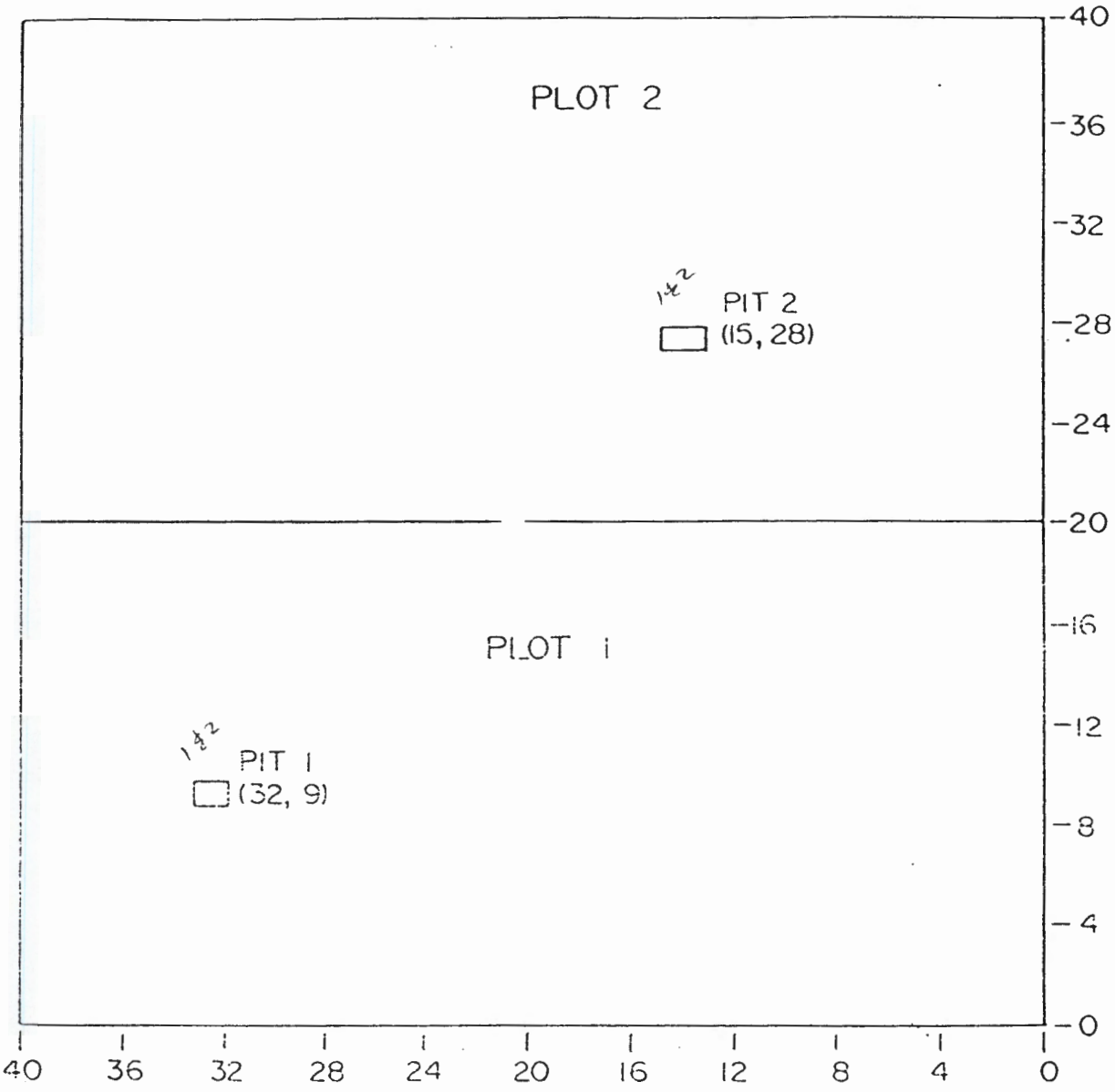
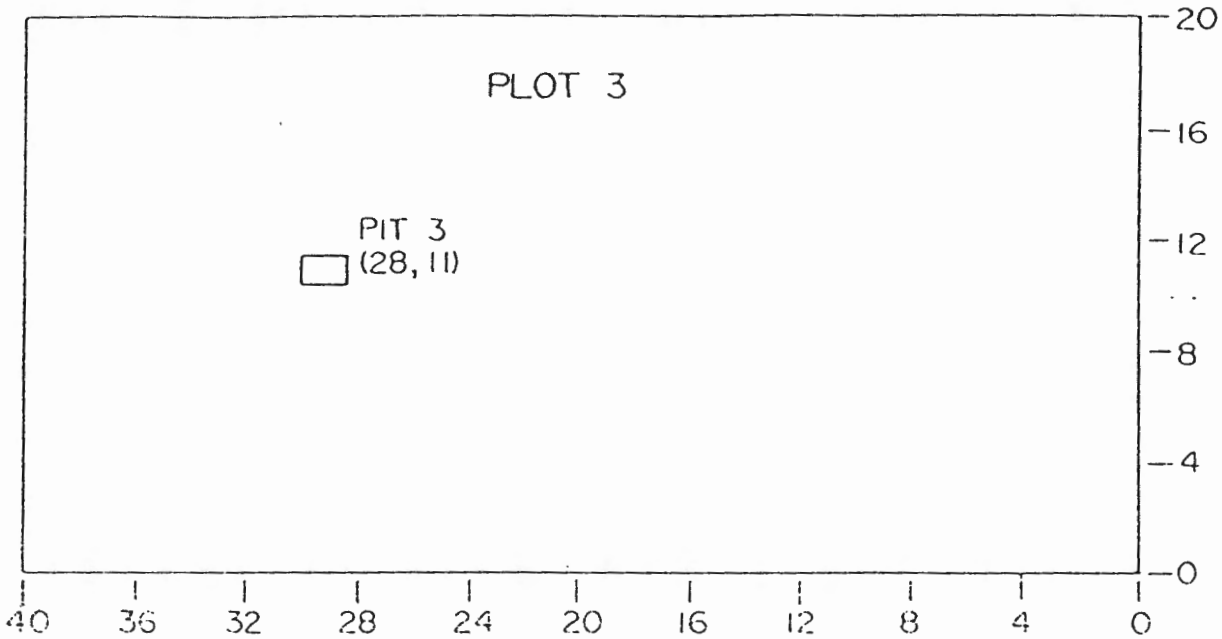


FIGURE 1. LOCATION OF SOIL CHARACTERIZATION/LYSIMETER INSTALLATION PITS FOR ACTIVE LAND TREATMENT PLOTS 1 AND 2.



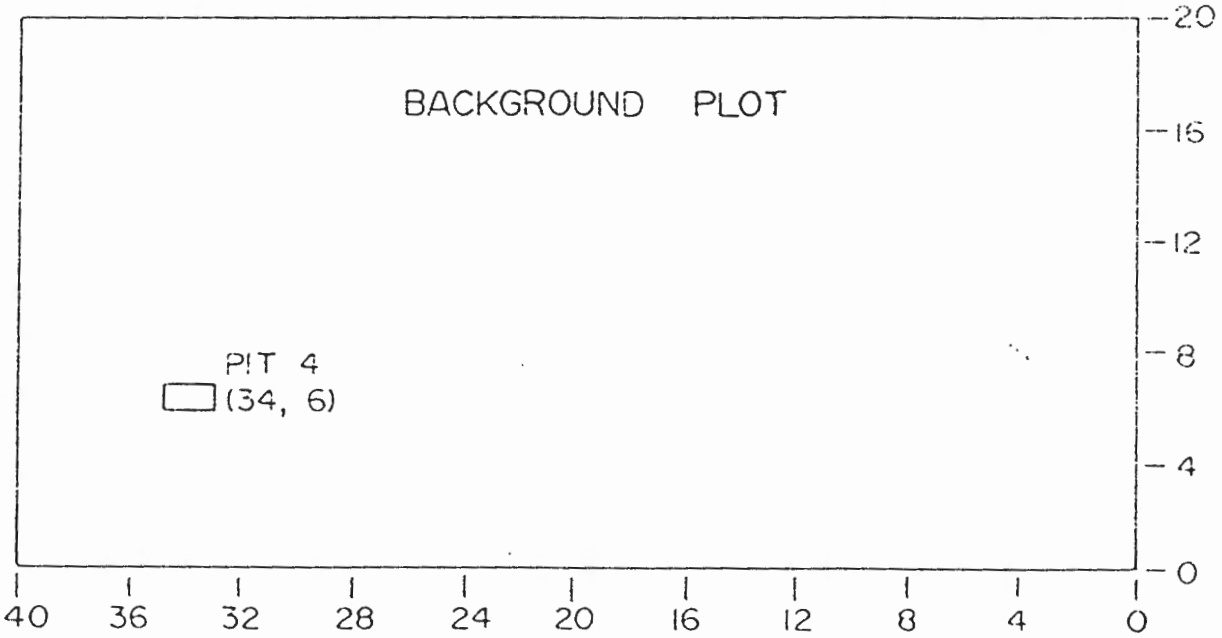
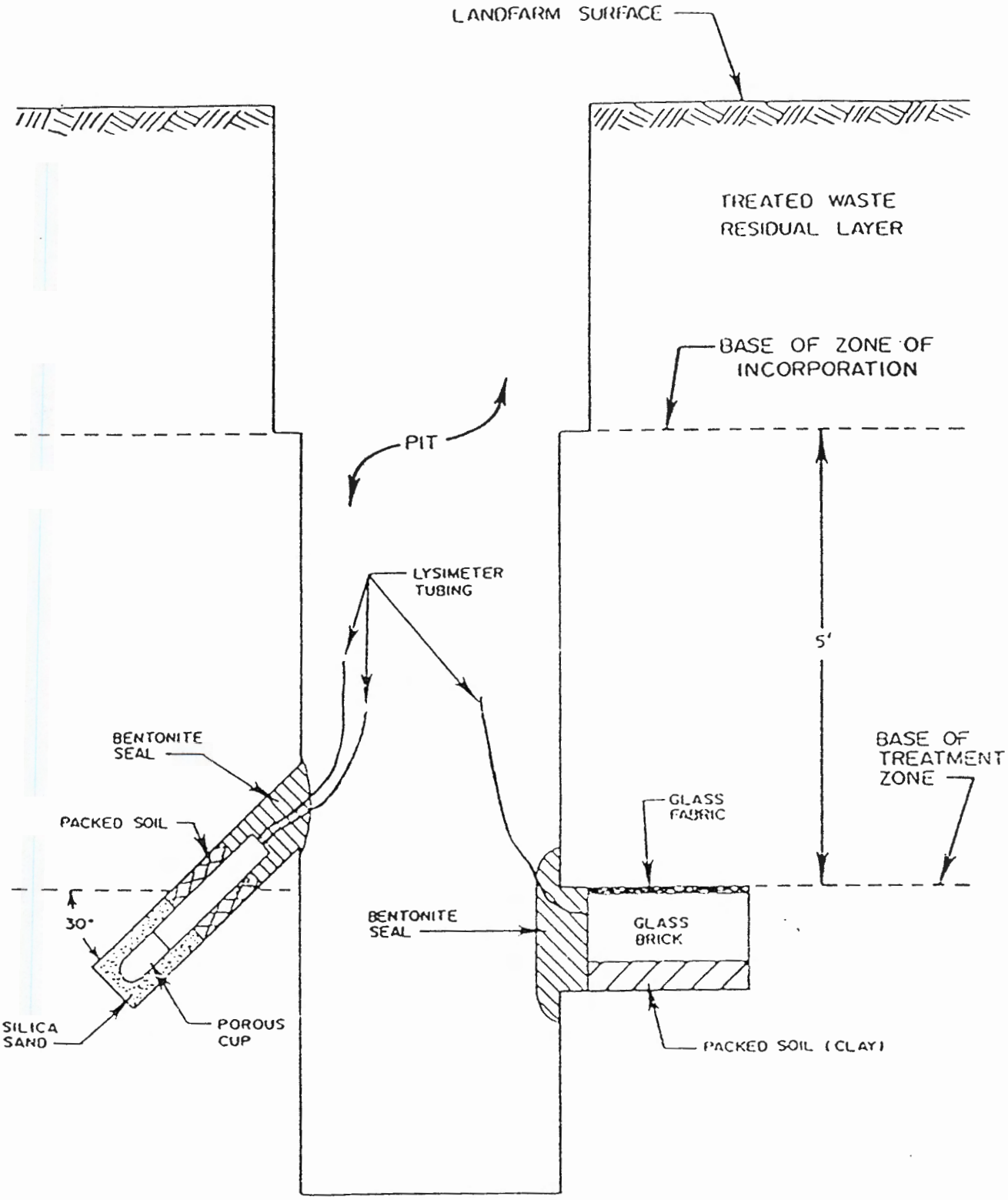


FIGURE 2. LOCATION OF SOIL CHARACTERIZATION/LYSIMETER INSTALLATION PITS FOR INACTIVE PLOT 3 AND BACKGROUND PLOT.



*DRAWING NOT TO SCALE

FIGURE 3. LYSIMETER INSTALLATION DIAGRAM.

Table 1. Lysimeter Reinstallation Locations at Giant Refining, January 1990.

Location	Installation Depth *	Proximity to Sample Station**
PIT 1 ACTIVE LTU		
Porous Cup #1	73″	11.5'
Porous Cup #2	73″	10.0'
PIT 2 ACTIVE LTU		
Porous Cup #1	70″	12.0'
Porous Cup #2	70″	10.0'
PIT 3 INACTIVE LTU	70″	12.0'
PIT 4 BACKGROUND	60″	8.0'

* lysimeters were installed 60-inches below residual waste layer
** lysimeters reinstalled east of existing sample stations.

1. Trenches for the lysimeters were excavated using a backhoe. Each trench was excavated to a depth of 2.5 to 3.0 feet below the original soil surface. This procedure allowed adequate space to install soil-pore liquid sampling equipment. During the excavation of the LTU pits, the treated waste residual layers were segregated and piled away from the open pit to prevent contaminated soil from falling into the pit. Clean soils excavated from the lower portions of the pit were kept separate for use in backfilling the pit.

2. A 3-inch diameter by 30-inch deep hole, at an angle of approximately 30 degrees, was augered into the trench sidewall (Figure 4). A moist bentonite plug was then packed into the bottom of the hole to isolate the sampler from the soil below. This was followed by pouring in a slurry of 200 mesh silica-flour.The porous cup lysimeter was then inserted into the hole with silica-flour slurry being packed around it about one-third of the way up the unit. Clean backfill was tightly packed around the porous cup till it was completely covered. A bentonite slurry plug was then used to fill and seal the remaining portion of the hole.

3. Sample tubing from the installed lysimeters was secured along the trench walls with bentonite puddy and collected at the sample station located at the end of the trench.

4. The trenches were backfilled with the clean portion of the excavated soil from the trench in 12 inch lifts. Each trench was backfilled and compacted with clean fill back to the level of the lower depths of the ZOI. The remainder of the pit was covered with the ZOI material that was removed during pit excavation. Due to the small size and shallow depth of the installation trenches, the backfill was compacted without the aid of additional moisture using the backhoe bucket.

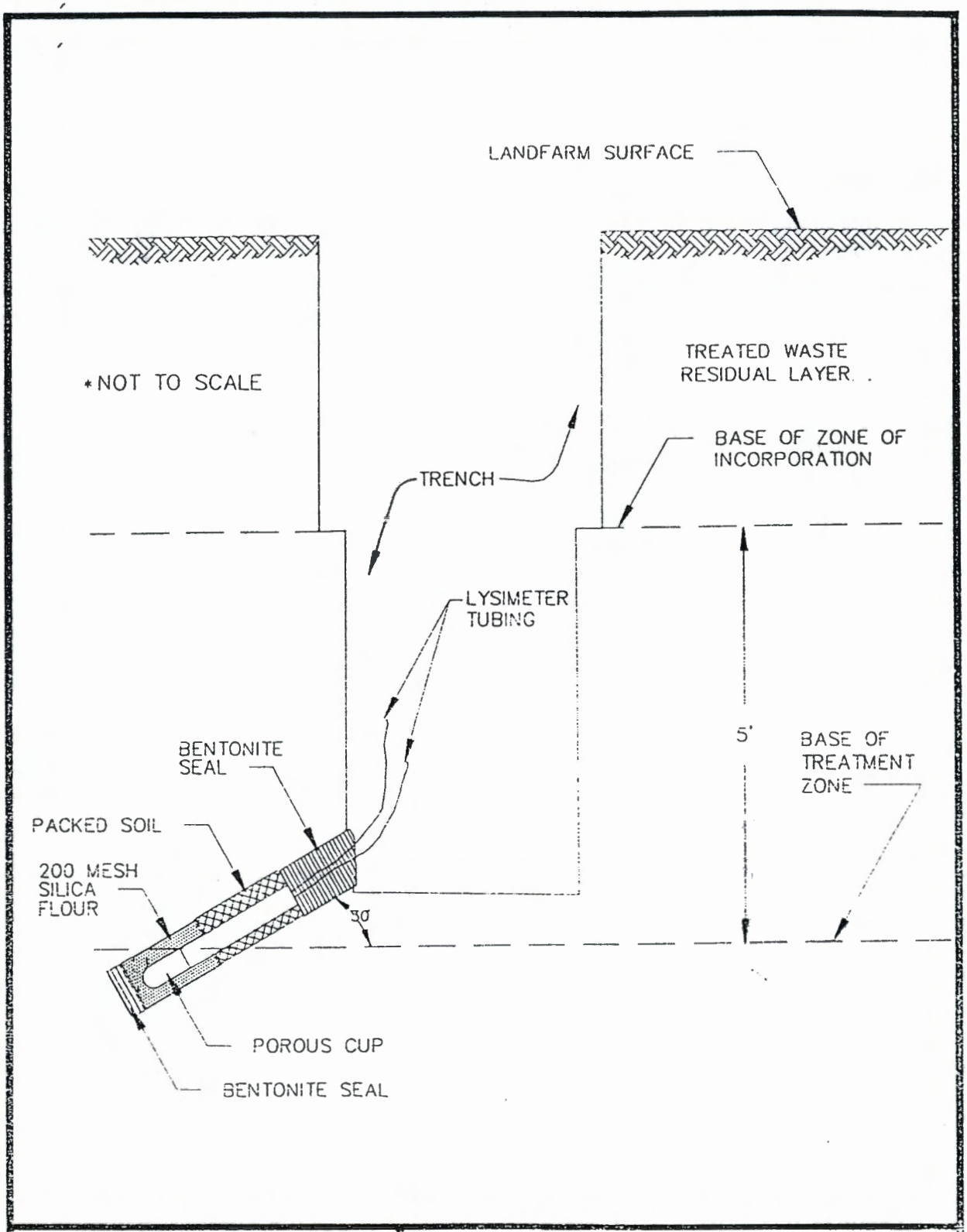
DISCUSSION

Previous to the lysimeter reinstallation, porous cup lysimeters were installed at the Giant Refining LTU in conjunction with the facility Land Treatment Demonstration (LTD). To date, attempts at sample collection from these soil-pore liquid samplers have failed. Soil moisture conditions encountered during the soils investigation and equipment installation, were too low for porous cups or glass brick lysimeters to collect samples.

The porous cup lysimeters initially installed by KWB&A were left in place with the sampling tubing stored in the bottom of the sample station. These units are functional with the only difference being the texture of the sand pack around the unit.

REFERENCES

U.S. EPA. 1986. Permit Guidance Manual on Unsaturated Zone Monitoring for Hazardous Waste Land Treatment Units. EPA/530-SW-86-040. Office of Solid Waste. Washington, D.C. 140 p.



GIANT REFINING COMPANY

LYSIMETER INSTALLATION DIAGRAM

PROJECT: GIANT 43301 (LYSINST)		LOCATION: GALLUP, NEW MEXICO	
K.W. BROWN & ASSOCIATES, INC.			DATE: 2-22-90
APPR:	DRAWN BY:	RSW	SCALE: NONE
DATE:	DATE:	2-22-90	FIGURE: 4