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EMFLUX[R] SOIL-GAS SURVEY

of

TECHNICAL AREA 54
LOS ALAMOS NATIONAL LABORATORY
NEW MEXICO

Subcontract No. 1490L0013-91

Prepared for

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Los Alamos National Laboratory
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EMFLUX^{R} SOIL-GAS SURVEY
of
TECHNICAL AREA 54
LOS ALAMOS NATIONAL LABORATORY
NEW MEXICO

The following EMFLUX^{R} Soil-Gas Survey Report has been prepared for the Regents of the University of California, Los Alamos National Laboratory, (the University-LANL) by Quadrel Services, Inc. (Quadrel) in accordance with the terms of Subcontract No. 1490L0013-91, executed between the University-LANL and Quadrel on August 13, 1993. The University Technical Representative for this project is Dr. Donald Neeper.

1.0 BACKGROUND

This EMFLUX^{R} Soil-Gas Survey was conducted on Material Disposal Areas (MDAs) G, J, and L in Technical Area 54 at Los Alamos National Laboratory (LANL), New Mexico. MDA L has been used for disposal of volatile organic compounds (VOCs) and MDA G (comprising sub-areas G-1 through G-8) for disposal of both VOCs and radioactive waste; MDA J has reportedly been used for disposal of waste without either of these contaminants. All three of the sites are currently active. Figure 1 shows the location of the three MDAs within Technical Area 54 of Operable Unit 1148.

Technical Area 54 is located on Mesita Del Buey, a mesa comprised largely of volcanic tuff and covered with light, grassy vegetation. The water table is some 300 feet below the top of the mesa; no information was provided to Quadrel concerning hydrological flow.

2.0 OBJECTIVES

The purpose of the EMFLUX^{R} Soil-Gas Survey was to determine the presence, identities, and relative strengths of contaminants within the three areas of LANL investigated. Quadrel understands that this information will be used in Phase-I assessment of these areas to determine flux rates of VOCs emanating from the ground.

3.0 WORK PLAN

The subparagraphs below describe the survey carried out by Quadrel, the schedule followed, and the overall quality-assurance and quality-control (QA/QC) procedures used.

3.1 Target Compounds

The survey was designed to detect a combination of VOCs on the U.S. Environmental Protection Agency's standard Target Compound List for EPA's Contract Laboratory Program (Document Number OLOM01.0, dated March 1990), and 15 additional VOCs (see Appendix A).

3.2 Site Survey Plan

The agreement between LANL representatives and Quadrel called for 257 field sample points, 12 duplicate field samples, 26 ambient-air control samples, and four trip blanks (for a total of 299 cartridges). LANL personnel determined the specific locations for field-collection devices and marked each location with a metal stake and an attached medallion bearing the sample-point number. [Note: Maps with specific locations of sample points were not available to Quadrel as of the time this report was issued; therefore, individual area site maps could not be included.]

The field samples and trip blanks were numbered 54-5000 to 54-5260, which is how they are designated in the laboratory report (Appendix D). For simplicity, however, only the last four digits of that nomenclature are used in the body of this Report.

3.3 Site Preparation

After LANL personnel staked sampling locations, Quadrel and LANL personnel prepared each site according to standard EMFLUX^R field procedures. Preparation in this instance involved removal of vegetation and/or small amounts of gravel at most emplacement points. [Note: A photoionization detector (PID) was used at sample points 5020-5100 to ascertain the presence of near-surface VOC contamination; when no VOCs were detected at these points, LANL and Quadrel personnel jointly decided that further use of the PID was unnecessary.]

3.4 Field Work

Quadrel and LANL personnel deployed EMFLUX^R collection devices at sample points 5000-5085 and 5091-5100 (on MDAs J and L and on sub-areas G-1 and G-2 of MDA G) on Thursday, August 26, 1993; the remaining devices were deployed the following day. Collectors deployed on Thursday were retrieved on Monday, August 30; those deployed on Friday were retrieved on Tuesday, August 31. Deployment and retrieval activities were carried out in conformity with the company's established Field Procedures (Appendix B).

3.5 Laboratory Analysis

Quadrel's contract laboratory, Maryland Spectral Services (MSS), analyzed all EMFLUX^R sample cartridges with GC/MS equipment, using a modified EPA Method 8240 (see Appendix C). The cartridges arrived at the laboratory on Thursday, September 2, 1993; MSS analyses were completed on Saturday, September 18; and Quadrel received the laboratory report on Thursday, September 23.

3.6 Quality Assurance/Quality Control (General)

As noted above, the present survey involved 257 field samples, 12 duplicate field samples, 26 ambient-air control samples, and four trip blanks (299 adsorbent cartridges). Laboratory procedures included standards, surrogates, and blanks appropriate to the modified EPA Method 8240 employed. Field work and reporting were done under Quadrel's Quality Assurance Program Plan, while MSS analyses were performed under the laboratory's own Quality Assurance Plan.

EPA Contract Laboratory Program (CLP) Data Packages (EPA SOW 2/88) were prepared for 15 of the 257 field samples. The laboratory results were compiled in a Sample Data Package which contains (i) case narrative, (ii) chain of custody forms, (iii) tables of results, and (iv) volatiles data (i.e., surrogate percent recoveries, method blank summaries, GC/MS tuning and mass calibration, and chromatograms and raw data for standards, samples, and blanks). The laboratory randomly selected the 15 samples for which it provided CLP Data Packages; the resulting Sample-Data-Package Laboratory Results for this project are being sent under separate cover.

4.0 FINDINGS

The following section outlines laboratory procedures and results pertinent to this EMFLUX^R Survey.

4.1 EMFLUX^R Cartridge Analysis

As noted earlier, MSS analyzed EMFLUX^R cartridges for the VOCs listed in Appendix A. The laboratory results are expressed in nanograms of specific contaminant recovered per cartridge and are included as Appendix D.

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Laboratory results were converted to average emission flux rates, in nanograms per square meter per minute ($ng/m^2/min$), with the following formula:

$$F = C/ATR$$

where: F = Emission flux rate, $ng/m^2/min$,
C = Contaminant mass, ng,
A = Subtended area of EMFLUX^R collector shell,
T = Time of collection, minutes, and
R = Adsorbent recovery factor, decimal fraction.

Emission flux rates for each contaminant identified by the laboratory were computed by applying the actual collection area (6.207×10^{-3} m^2), the specific collection time (determined from the Field Deployment Report, submitted under separate cover), and the adsorbent recovery factor for the specific contaminant (Table 1). The resulting emission flux rate values are given in Tables 2, 3, and 4.

4.2 Quality Assurance/Quality Control (Specific)

The following summation is germane to any evaluation of the results of the EMFLUX^R Survey.

4.2.1 Integrity of Samplers

During retrieval, the EMFLUX^R collection shell at sample point 136 was found overturned, although the sorbent cartridge remained in position on its upright stainless-steel support. The cartridge was analyzed on the working hypothesis that it had been effectively covered for a majority of the sampling period. Unfortunately, the results of MSS laboratory analysis indicate to Quadrel that there was prolonged exposure and, therefore, that cartridge 136 must be disregarded as unreliable.

4.2.2 Laboratory Methods Blanks

The laboratory methods blanks analyzed in connection with this task revealed no contamination.

4.2.3 Trip Blanks

At least one trip blank, a cartridge carried to the site but not intentionally exposed, was used for each of the three areas. The trip blanks were designated and assigned as follows:

Trap		MDA
5257	-	J
5258	-	L
5259	-	G
5260	-	G

Contamination detected on trip blanks is subtracted from corresponding detections on other samples. However, none of the trip blanks employed in this survey detected contamination.

4.2.4 Control Samples

The function of these QC samples (given in Appendix D) is to identify contamination present in ambient air during deployment of EMFLUX^R collection devices; such measurements are routinely subtracted from readings of the same compounds at appropriate sample points.

For this project 26 control samples were collected over the entire survey area: eight on MDA L, one on MDA J, and 17 on the sub-areas of MDA G. The control samples are labeled with an "A" following the number of the sample-point at which the control was taken (e.g., 5005A). Table 5 shows the areas or sub-areas in which control samples were collected, the corresponding sample points, and the contaminants detected.

To provide a conservative estimate of the effect of ambient-air contamination on collection devices in a given area or sub-area, the highest measurement for each contaminant on the relevant control samples was subtracted from measurements of the same compound at corresponding sample points before converting those measurements to flux rates.

4.2.5 Duplicate Samples

Twelve field-sample duplicates were emplaced at random sample-point locations in the three areas. These are designated by the addition of the letter "D" to the number of the sample-point near which they were placed. Raw laboratory data for the duplicates are given in Appendix D and flux rate values are included in Tables 2 through 4. Duplicates were deployed at sample points 5020, 5030, 5040, 5060, 5080, 5140, 5160, 5170, 5180, 5200, 5220, and 5240.

Although these samples are treated as duplicates, it is important to note that they are not placed at the same locations as the corresponding field samples nor are they taken from a larger, original sample.

Instead, they are samples collected in separate devices deployed within six inches of the base points; and while soil composition beneath any two adjacent samplers may be relatively uniform, there are often micro-scale variances which affect the quantities of gases migrating to the surface. Such variances can cause even adjacent sampling sites to emit significantly different levels of contamination. Quadrel's experience in both hazardous waste surveying and uranium exploration has repeatedly confirmed this.. Therefore, comparisons between duplicates and the corresponding field samples should be made on a qualitative basis, as quantitative results are sometimes subject to distortions for the reasons noted above.

Review of Tables 2 through 4 reveals a total of 59 compound were found on the duplicate samples, the field samples, or both. Of these, 42 compounds were found on both duplicates and base samples, a correspondence of 71%. Moreover, of the 17 compounds which were found on only one of the adjacent samples, 12 were detected at levels below 10.0 ng/m^2/min, a relatively low emission rate.

4.2.6 Data Loss

As noted in Table 5, the vial containing control sample 5195A was broken during transport to the laboratory; therefore, no data is available for that cartridge.

Data for samples 5009 and 5079 were lost because of two laboratory equipment malfunctions.

5.0 DISCUSSION

The comments herein highlight Survey findings and provide an overall view of the situation at the three MDAs with respect to the compounds detected. For reference, Tables 2 to 4 list calculated and corrected emission flux rates by sample point number and compound name. References to contamination levels (i.e., low, moderate, and high) are relative exclusively to other findings in the present survey and should not be compared to results of other EMFLUX^R investigations.

Specific locations of sample points were unavailable at the time this Report was issued, but Quadrel had access to notes describing approximate locations and can therefore identify the area or sub-area in which sample points are located.

5.1 MDA L (Sample Points 5000 to 5068 and 5131)

5.1.1 Chlorinated Compounds

Sample points in MDA L detected 12 different chlorinated compounds, 10 of which were found at sample point 5031 (Table 2). Sample points within the fence surrounding MDA L proper and at points near the edge and on the side of the mesa north of this fence detected relatively high emission rates; points east and south of MDA L, generally, reported lower emission rates.

Trichlorethene (TCE) was recorded at every sample point except points 5002, 5066, 5068, and 5131. The highest emission rate of TCE (4,517.9 ng/m²/min) was found at sample point 5031, the location reporting the most extensive overall contamination in MDA L.

Tetrachloroethene (PCE) was found at all but six of the sample locations. The highest levels were detected at sample points 5035 through 5039, at emission rates from 769.6 to 2,000.0 ng/m²/min. These sample points are located along the north side of the chain-link fence surrounding MDA L proper.

1,1,1-Trichloroethane (TCA) was detected at all but seven of the sample locations. The highest emission rates of TCA in this area were found at sample points 5048, 5047, and 5031 at levels of 1,829.3, 1,190.1, and 1,057.0 ng/m²/min, respectively.

1,1,2-Trichlorotrifluoroethane (Freon 113) was identified at 49 sample locations, the two highest levels, 668.4 and 478.6 ng/m²/min, being found at sample points 5045 and 5031, respectively.

Chloromethane was measured at 17 sample locations at low levels relative to other detections in MDA L. The highest levels, 30.5 and 24.7 ng/m²/min, were reported at sample points 5047 and 5048, respectively.

1,1-Dichloroethene (1,1-DCE) was found at nine sample locations, with sample points 5031 and 5048 showing the highest levels (140.7 and 120.9 ng/m²/min, respectively). It is worth observing that 1,1-DCE is a degradation product of TCE and that points 5031 and 5048 also reported the highest and third highest TCE levels, respectively.

Carbon tetrachloride was seen at nine sample locations at relatively low levels, with sample point 5031 measuring the highest level (15.4 ng/m²/min).

1,2-Dichloropropane was found also at nine sample locations, the highest level (11.3 ng/m²/min) being recorded at sample point 5006. Eight of these sample points are located near the edge of the mesa.

In addition to the above compounds, three detections of chlorobenzene and 1,2-dichloroethane were reported, as well as two detections of 1,1-dichloroethane and one detection of chloroform. The highest levels of these compounds were found at sample point 5031.

5.1.2 Benzene, Toluene, Ethylbenzene, and Xylene (BTEX)

Benzene emissions were measured at 25 sample locations at rates of 1.4 to 12.6 ng/m²/min; the highest level was seen at point 5065.

Toluene was recorded at 29 sample locations at levels ranging from 0.7 to 18.8 ng/m²/min.

A single detection of ethylbenzene (1.1 ng/m²/min) was measured at sample point 5031.

Low levels of xylene were reported at six sample locations.

5.1.3 Other Compounds

Acetone was detected at 49 sample locations, the highest level, 308.2 ng/m²/min, being at point 5017.

Sample point 5031 exhibited 1.1 ng/m²/min of bromobenzene.

Four detections of 2-butanone (MEK) were reported; the highest level was 37.7 ng/m²/min at sample point 5063.

A single measurement of n-propylbenzene was detected at sample point 5047 at a level of 2.0 ng/m²/min.

PCE emissions occurred at 88 percent of the sample locations on MDA G, and 14 of the 17 highest PCE levels were found in sub-areas G-5 and G-6. The two highest levels, 371.1 and 370.2 ng/m²/min, were detected at sample points 5164 and 5211, respectively.

TCE was identified at 113 sample locations on MDA G; the four highest levels (from 67.2 to 202.6 ng/m²/min) were found in sub-area G-7 at points 5141, 5142, 5143, and 5216.

Freon 113 emissions were measured at 103 points, with the highest level, 193.7 ng/m²/min, being located at sample 124. The eight highest emission rates were on the western side of MDA G in sub-areas G-1 to G-3; in fact, of the 51 sample points in these three sub-areas, 38 detected at least low levels of Freon 113.

1,1-Dichloroethane (1,1-DCE) was detected at 41 sample points; 33 of these detections occurred in sub-area G-5 and G-6. The highest level reported was 305.1 ng/m²/min at sample point 5151.

Chloromethane was seen at 12 sample locations at levels of 3.6 to 21.8 ng/m²/min. While this compound was found over the entire area, there was a cluster of detections around points 5121 to 5123.

1,1-DCA was recorded at nine sample locations, seven in sub-area G-5 and two in sub-area G-6. The emission rates ranged from 3.1 to 17.7 ng/m²/min.

Trichlorofluoromethane (Freon 11) was measured at points 5083 and 5118 at levels of 11.5 and 15.4 ng/m²/min, respectively.

Methylene chloride was identified at points 5165 and 5166 (located in sub-area G-5) at levels of 8.9 and 8.0 ng/m²/min, respectively.

The Survey detected on occurrence each of carbon tetrachloride (point 5099) and chloroform (point 5219).

5.3.2 Other Compounds

Relatively low emission rates of acetone were seen at 28 sample locations across MDA G at levels ranging from 4.7 to 29.4 ng/m²/min.

Carbon disulfide emissions were measured at sample point 5240D (a duplicate sample) at a level of 18.6 ng/m²/min. This was the only detection of this compound throughout the three areas surveyed.

Toluene was found at 19 sample locations at low levels (0.6 to 3.9 ng/m²/min).

Low emission rates of benzene also were found at five sample locations, with detections spanning 1.3 to 1.8 ng/m²/min.

A single, low-level detection of xylene was reported at sample point 5122.

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Figure 1

Locations of Material Disposal Areas G, J & L
Technical Area 54
Operable Unit 1148
LANL, New Mexico

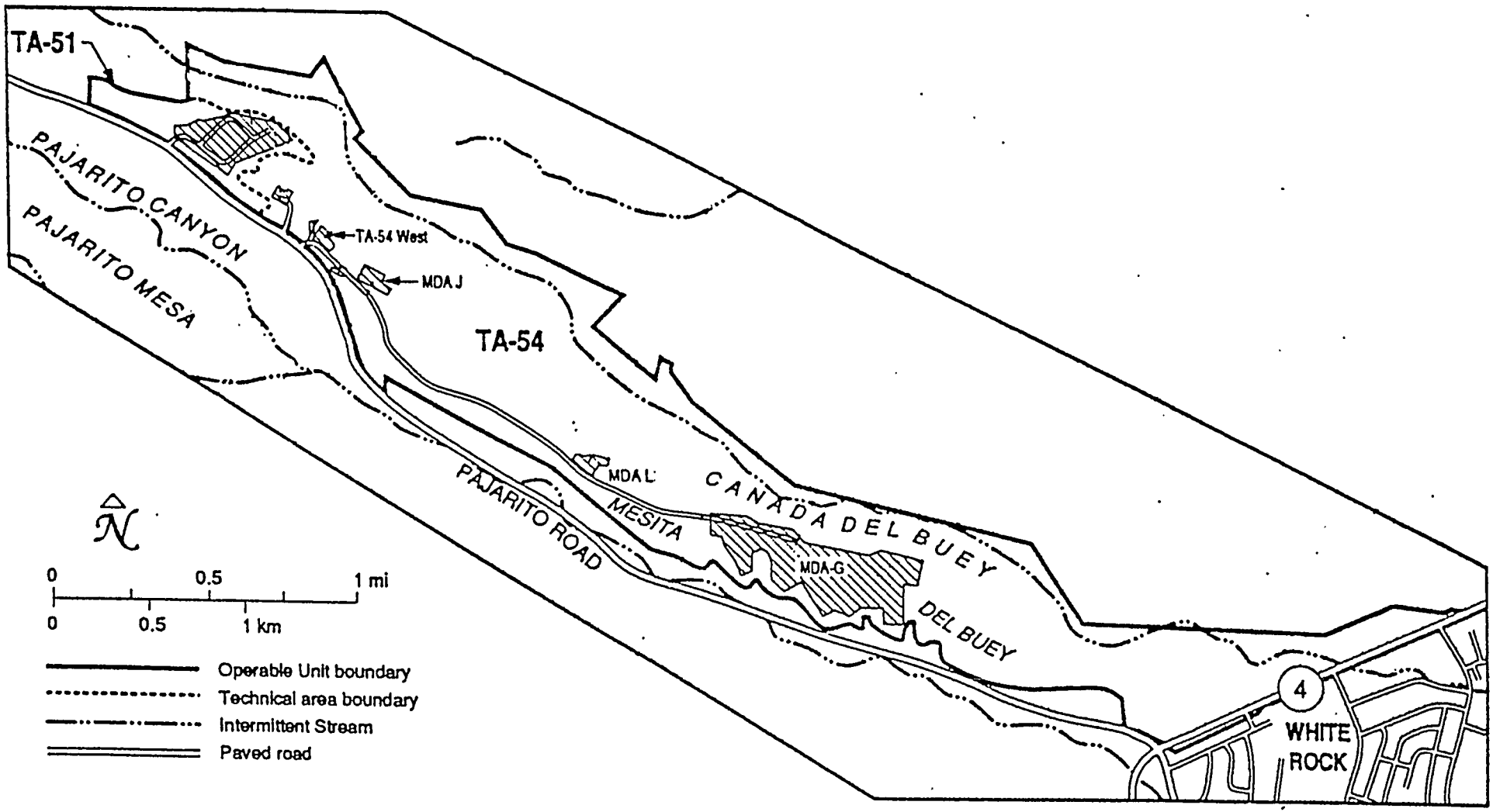

Table 2

Emission Flux Rates (ng/m2/min)
Material Disposal Area L
Technical Area 54
LANL, New Mexico

SAMPLE LOCATION	5000	5001	5002	5003	5004	5005	5006	5007	5008	5010
CONTAMINANTS										
Acetone	15.9	---	---	---	7.1	31.5	9.5	21.2	85.9	69.5
Benzene	---	---	6.1	1.4	---	1.7	---	---	1.5	---
Bromobenzene	---	---	---	---	---	---	---	---	---	---
2-Butanone	---	---	---	---	---	---	---	---	---	---
Carbon Tetrachloride	---	---	---	---	---	---	---	2.5	---	---
Chlorobenzene	---	---	---	---	---	6.5	---	---	---	---
Chloroform	---	---	---	---	---	---	---	---	---	---
Chloromethane	---	---	---	---	---	8.8	---	---	---	---
1,2-Dichloroethane	---	---	---	---	---	---	---	---	---	---
1,1-Dichloroethane	---	---	---	---	---	---	---	---	---	---
1,1-Dichloroethene	9.2	---	---	---	---	---	10.7	---	---	---
1,2-Dichloropropane	---	---	---	---	---	3.2	11.3	8.9	9.0	2.1
Ethylbenzene	---	---	---	---	---	---	---	---	---	---
n-Propylbenzene	---	---	---	---	---	---	---	---	---	---
Tetrachloroethene	39.3	30.2	1.1	204.4	233.4	473.4	218.7	194.3	148.7	99.0
Toluene	1.2	0.8	---	---	1.0	4.0	1.7	1.7	13.2	4.3
1,1,1-Trichloroethane	510.8	1.0	---	6.3	4.3	130.3	290.6	477.0	390.4	140.8
Trichloroethene	302.7	80.8	---	3.7	14.3	213.5	233.5	212.5	59.4	39.8
112-Trichlorotrifluoroethane	28.8	---	---	---	---	14.6	42.9	171.9	57.9	60.7
Xylene	---	---	---	---	---	1.1	---	---	---	1.8

NOTES:
1) "---" denotes value below the reported quantitation level.
2) Data for sample 5009 was lost because of a laboratory equipment malfunction.

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VOLATILE ORGANICS BY EPA GC/MS METHOD MODIFIED 8240

CLIENT SAMPLE ID:	54-5000 LANL	54-5001 LANL	54-5002 LANL	54-5003 LANL	54-5004 LANL	54-5005 LANL
LAB SAMPLE ID:	930904000	930904001	930904002	930904003	930904004	930904005
RECEIVED DATE:	09/02/93	09/02/93	09/02/93	09/02/93	09/02/93	09/02/93
ANALYSIS DATE:	09/05/93	09/05/93	09/06/93	09/06/93	09/06/93	09/06/93
FILE NAME:	0904000	0904001	0904002	0904003	0904004	0904005
INSTRUMENT ID:	MSD	MSD	MSD	MSD	MSD	MSD
UNITS:	NG/TRAP	NG/TRAP	NG/TRAP	NG/TRAP	NG/TRAP	NG/TRAP
VOLATILE COMPOUNDS						
Acetone	165	50 U	50 U	50 U	73	325
Benzene	25 U	25 U	122	27	25 U	34
Bromobenzene	25 U	25 U	25 U	25 U	25 U	25 U
Bromoform	25 U	25 U	25 U	25 U	25 U	25 U
Bromomethane	50 U	50 U	50 U	50 U	50 U	50 U
2-Butanone	50 U	50 U	50 U	50 U	50 U	50 U
Carbon Disulfide	25 U	25 U	25 U	25 U	25 U	25 U
Carbon Tetrachloride	25 U	25 U	25 U	25 U	25 U	25 U
Chlorobenzene	25 U	25 U	25 U	25 U	25 U	232
Chloroethane	50 U	50 U	50 U	50 U	50 U	50 U
Chloroform	25 U	25 U	25 U	25 U	25 U	25 U
Chloromethane	50 U	50 U	50 U	50 U	50 U	216
Dibromomethane	25 U	25 U	25 U	25 U	25 U	25 U
1,2-Dichlorobenzene	25 U	25 U	25 U	25 U	25 U	25 U
1,3-Dichlorobenzene	25 U	25 U	25 U	25 U	25 U	25 U
1,4-Dichlorobenzene	25 U	25 U	25 U	25 U	25 U	25 U
Dichlorodifluoromethane	25 U	25 U	25 U	25 U	25 U	25 U
1,2-Dichloroethane	25 U	25 U	25 U	25 U	25 U	25 U
1,1-Dichloroethane	25 U	25 U	25 U	25 U	25 U	25 U
1,1-Dichloroethene	33	25 U	25 U	25 U	25 U	25 U
1,2-Dichloroethene (total)	25 U	25 U	25 U	25 U	25 U	25 U
1,3-Dichloropropane	25 U	25 U	25 U	25 U	25 U	25 U
2,2-Dichloropropane	25 U	25 U	25 U	25 U	25 U	25 U
1,2-Dichloropropane	25 U	25 U	25 U	25 U	25 U	76
trans-1,3-Dichloropropene	25 U	25 U	25 U	25 U	25 U	25 U
cis-1,3-Dichloropropene	25 U	25 U	25 U	25 U	25 U	25 U
1,1-Dichloropropene	25 U	25 U	25 U	25 U	25 U	25 U
Ethylbenzene	25 U	25 U	25 U	25 U	25 U	25 U
4-Methyl-2-Pentanone	50 U	50 U	50 U	50 U	50 U	50 U
Methylene Chloride	25 U	25 U	25 U	25 U	25 U	25 U
n-Propylbenzene	25 U	25 U	25 U	25 U	25 U	25 U
Tetrachloroethene	1290	990	36	6700	7650	15500
Toluene	42	27	25 U	25 U	34	143
1,1,1-Trichloroethane	7200	106	25 U	179	152	1900
1,1,2-Trichloroethane	25 U	25 U	25 U	25 U	25 U	25 U
Trichloroethene	10800	2880	25 U	132	510	7600