UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
CINCINNATI, OHIO 45268

ORIGINAL (Red)

DATE: May 16, 1977

SUBJECT: Analysis of Samples Collected at Llangollen Landfill Site in Delaware

FROM: Donald E. Sanning, Research Chemist, DB
Solid and Hazardous Wast Research Division

TO: Albert Montague, Director, Region III
Office of Research and Development

THRU: Robert L. Stenburg, Director
Solid and Hazardous Waste Research Division RES

Francis T. Mayo, Director
Municipal Environmental Research Laboratory F.T.M.

As per your request of February 11, 1977, enclosed are GC/MS results of the analysis of the Llangollen landfill leachate samples. This work was performed for SHWRD by Dr. S. K. Chian, University of Illinois, and Foppe B. DeWalle, Stanford University in California.

As the results indicate, there are serious problems involved with the validity of the data. This is due to the unorthodox methods of sample handling employed by personnel at the Annapolis Field Office, Annapolis Science Center, Region III.

SHWRD desires to assist the regions whenever it is possible, but any further participation by our Division in relation to organic analyses of leachate samples from Llangollen would be contingent upon Region III acceptance of the recommendations contained on Page 10 of the enclosed report.

Donald E. Sanning

Donald E. Sanning

Enclosure

cc: Norbert B. Schomaker

RECEIVED

MAY 24 1977

R & D DIVISION
EPA, REGION III

AR300040

ORIGINAL
(Red)

Determination of Trace Organics in Well Waters Collected Around the Llangollon Landfill

by

Edward S. K. Chian
University of Illinois, Urbana, IL 61801

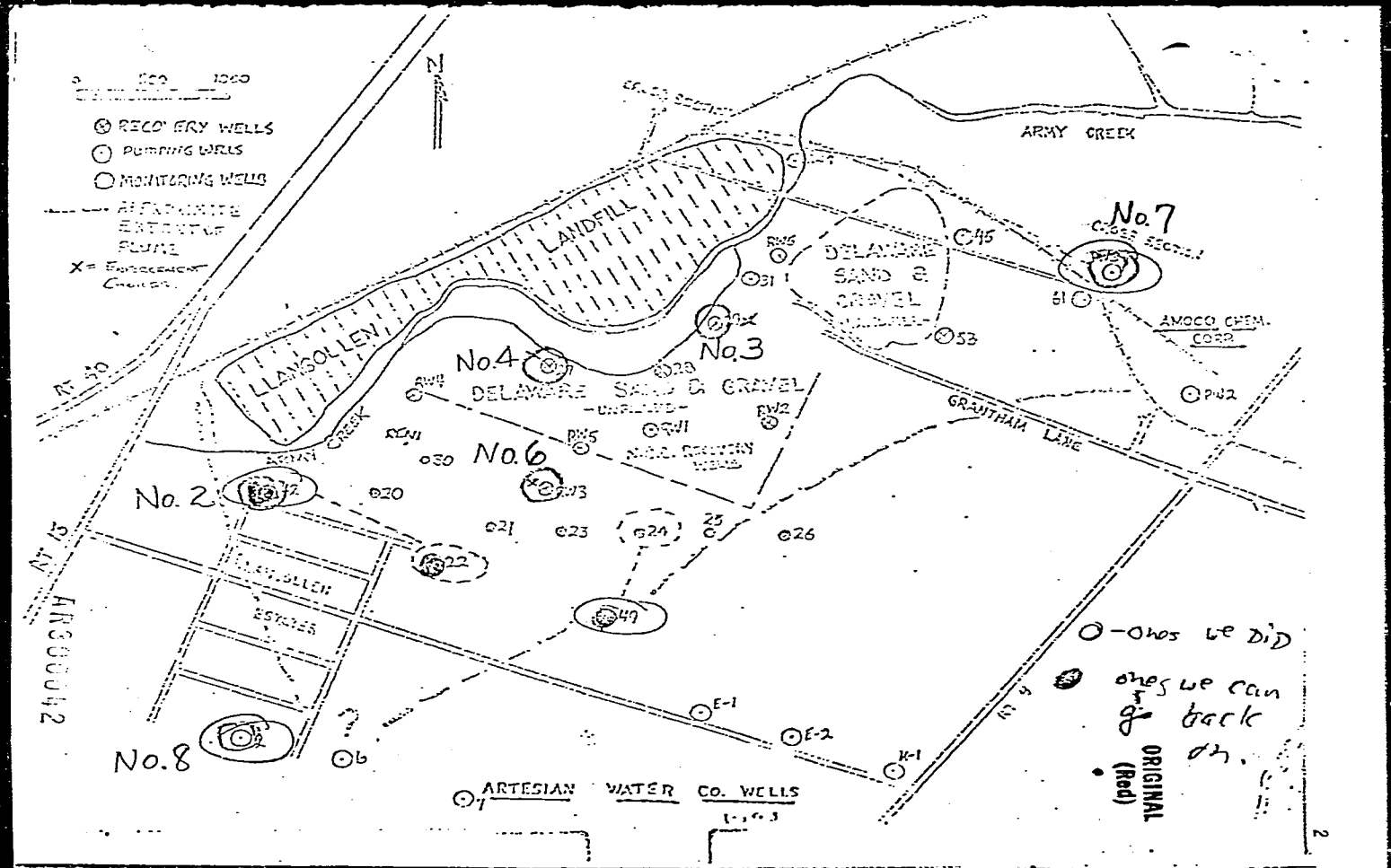
Foppe B. DeWalle
Stanford University, Stanford, CA 94305

SAMPLE COLLECTION

Dr. Tom Munson of the Annapolis Field Office, Annapolis Science Center, Region III, Environmental Protection Agency sent us on February 24, 1977 six groundwater samples collected from different sites around the Llangollon Landfill for analysis of trace organics. Each sample was shipped in a one-gallon glass container and in a 4-oz. vial. Due to the unavailability of an oven to muffle the one-gallon solvent containers, all of them were cleaned by rinsing with n-hexane solvent. Figure 1 gives the specific locations from which these samples were collected. They are marked by sample numbers 2, 3, 4, 6, 7, and 8 (Figure 1).

SAMPLE PREPARATION AND ANALYSIS

Each sample was subject to volatile organic analysis (VOA) and determination of organics in the acid and the base extracts. Figure 2 gives the procedures for stripping of volatile organic compounds in water samples. Figure 3 shows a schematic of the elution system for the


RECOVERY WELLS
PUMPING WELLS
MONITORING WELLS
APPROXIMATE EXTENT OF PLUME
N
ARMY CREEK
LANDFILL
LLANGOLLEN
DELAWARE SAND & GRAVEL
No.7
No.4
No.3
No.6
No. 2
No.8
AMOCO CHEM. CORP.
GRANTHAM LANE
LLANGOLLEN ESTATES
ARTESIAN WATER CO. WELLS
O-Ones we Did
ones we can go back on.
ORIGINAL (Red)

ORIGINAL
(Red)

125 ml of water collected in zero-head space glass container.

↓

Transfer sample to cleaned 1000 ml stripping flask.

↓

Strip water sample at 60°C for 20 minutes with a nitrogen flow rate of 200 ml per minute into a 17 cm x 0.625 cm OD (1/4 in.) stainless steel column containing 0.5 gram of Tenax GC.

↓

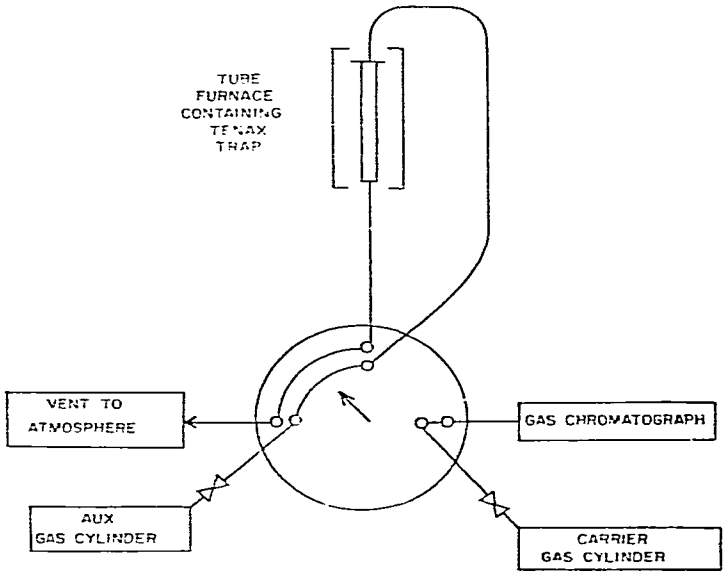
Seal Tenax trap at both ends with Swagelok caps and seal trap in glass tube which has been baked at 450°C overnight.

↓

Samples are prepared in pairs for gas chromatographic quantitation and GC/MS identification. Analyses to be completed within one week.

Figure 2 Protocol for Stripping of Volatile Organic Compounds in Aqueous Samples.

Figure 3 Schematic Diagram of Volatile Organic Elution System

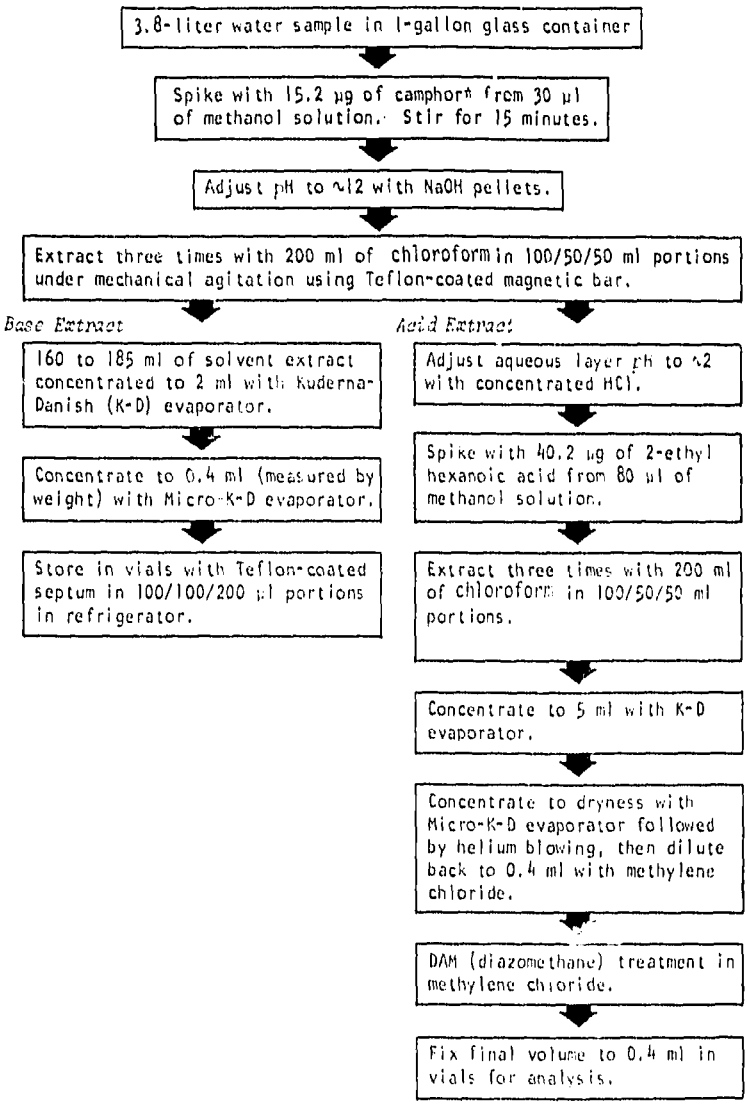


ORIGINAL
(Red)

stripped volatiles from the Tenox-GC traps. The valve, supplied by Valvco, is a two-position, six-port valve which can be heated to 200°C. When installed, both the Tenax-GC trap and the valve can be heated to 250°C while the valve, transfer lines and GC inlet are held at 200°C. The carrier flow to the GC column is not interrupted and the column is never exposed to the atmosphere. Also, traps can be swept with carrier gas before connecting them to the GC column, again eliminating exposure of the column to the atmosphere and in the GC/MS runs eliminating water vapor. The zero-dead volume construction of the valve virtually eliminates losses of sample and cross-contamination between samples.

The volatile organics were analyzed on a 366 cm (12-foot) by 2-mm-ID glass column packed with 0.2% Carbowax 1500 on 60/80 mesh Carbopack C (Supelco, Inc., Bellefonte, PA). The trapped compounds were desorbed from the Tenax-GC column trap at a peak temperature of 250°C for six minutes with a helium flow of 40 ml/min. The glass GC column was held at ambient temperature during this period. The oven temperature was then programmed to increase at 8°C/min to 200°C and held there for the remainder of the run. Mass spectra were acquired for m/e 33 to m/e 350 at a scan rate of 2.3 seconds per mass decade and at an ionization potential of 70 eV on a Varian-MAT 311A GC/MS. Data were acquired on a Varian-MAT SS100 data system and stored on a magnetic tape or disk carttridge for later analysis with ADP-Cyphenetrics Mass Spectral Search System (MSSS).

The less volatile organic compounds present in the aqueous samples were recovered by a series of extractions as outlined in Figure 4. The extractions shown allow the separation and identification of a large number of compounds. Samples of 3.0 liters were spiked with camphor as the internal standard. The pH was adjusted to 12, and then they were extracted with Spectra grade chloroform (Burdick and Jackson Lab, Muskegon, MI).



*Low recovery (~70%) due to enolization at high pH. The sensitivity for camphor on OV-17 columns and the FID is higher than for naphthalene.

Figure 4 Procedure for base and acid extraction of the less volatile organics.

The solvent was thus evaporated to 2 ml in a Kuderna-Danish evaporator (Kontes, Vineland, NJ), and, subsequently, to 0.4 ml in a micro-Kuderna-Danish evaporator. This sample was subject to quantitation by gas chromatography and identification by GC/MS. The aqueous sample was further acidified to pH 2 and after the addition of a second internal standard (2-ethyl hexanoic acid) it was extracted with chloroform. It was evaporated to 5 ml in a Kuderna-Danish evaporator. Methylation of the concentrated acid extract was carried out in a hood using purified diazomethane. Prior to methylation chloroform was replaced by methylene chloride. The final volume was adjusted to 0.4 ml and the sample was examined by the GC and GC/MS procedures to separate, quantitate, and identify the various organic species present. The solvent extracts were analyzed on a 366-cm (12-foot) by 2-mm-ID glass column packed with 3% OV-17 on Supelcoport 80/100 mesh (Supelco, Inc., Bellefonte, PA). One microliter of extract was injected on column. The column temperature was held at 50°C for 6 minutes and then programmed at 10°/min to 300°C, where it was held for the remainder of the analysis. The specific column and GC conditions employed here, however, do not provide good separation of low MW volatile fatty acids, i.e., C_1-C_6 monocarboxylic acids, since the C_8 fatty acid internal standard appears in a very early stage of the GC run. Other columns and GC conditions should be used for determining these low MW volatile fatty acids. MS scans were made from m/e 33 to m/e 600 with the same conditions as in the analysis of VOA.

RESULTS AND DISCUSSION

Results of organic analysis of these samples are given in Tables 1 to 18. Table 19 summarizes the overall rating of the level of contamination

of each sample based on the number of organic compounds present in concentrations of above 1 μg/ℓ (ppb) in all three fractions, i.e., VOA, acid and base extracts. It is seen from Table 19 that water sample No. 8 from the Artisian well appears to be the cleanest. This is followed by sample No. 2 from the Monitoring Well #42. Sample No. 3 and No. 4 represent the most contaminated water samples among all six analyzed. They are followed by sample No. 7 and No. 6 which are somewhat less contaminated than sample No. 3 and No. 4 and are more contaminated than sample No. 8 and No. 2. The fact that the sample No. 2 is much cleaner than the corresponding samples (No. 3 and No. 4) collected from well located immediately around the landfill, indicates that either the groundwater moves in the southeastward direction as shown on the map (Figure 1) or the landfill around the Monitoring Well #42 (sample No. 2) is more stabilized or is located somewhat higher above the water table than that where the other two wells are located.

Since only one bottle of 4-oz. vial, instead of 3 as required for VOA, was received for each sample, they were used mainly for quantitation purposes. The VOA samples prepared for GC/MS identification were actually taken from the one-gallon glass containers previously used for containing various solvents, such as hexane, methylene chloride, chloroform, and acetone as indicated by the labels on these bottles. Because the high background contamination levels exerted by these solvents greatly impaired the GC/MS analysis, only 5 ml of the water samples from the one-gallon glass containers were used for VOA analysis. This reduces greatly the sensitivity of the VOA method employed in this study. Also, the C_6 hydrocarbons, e.g., n-hexane, methyl pentane, and hexene-1, have been found ubiquitously in all VOA samples, suggesting contamination by the n-hexane used for rinsing all these one-gallon glass containers. The presence of high

concentrations of methylene chloride, chloroform and acetone in VOA of these samples also suggests carrying-over from the glass containers previously used for containing these solvents. Since the detection limit of the specific VOA method employed in this study is as low as 0.1 ppb, they are highly susceptible to contamination by other volatile organic solvents. Even a small quantity of solvent vapors normally present in the laboratory environment would tend to contaminate the VOA analysis.

The detection of a number of phthalates, e.g., dibutyl, di-(2 ethyl hexyl), diethyl, etc., in both the acid and the base extracts may be a result of contamination from the plastic materials (e.g., plasticizers) used in the lid and the liner of the one-gallon glass solvent bottle, or that used in the well casing, pump parts, and transfer tubings. In future samplings a piece of Teflon liner should be placed between the lid and the container and efforts to avoid using any plastic parts, except Teflon, in sample collection should be made.

The fact that a large number of the unidentifiable peaks present in the acid and the base extracts of samples No. 3 and No. 4 is rather discouraging. This is actually limited by the mass spectra data available in the Mass Spectra Search System (MSSS) employed in this study. Although the MSSS is considered to be one of the most comprehensive library (35,000 chemical compounds) for MS search, the last time the MSSS was revised was about two years ago. A large number of mass spectra data have since been developed by the US EPA Laboratories at Athens and Cincinnati which have not yet been incorporated into the current MSSS. Nevertheless, all of the bar charts and mass lists for these unknowns are available for future identification of these compounds. Another approach is to use glass capillary columns to better resolve these peaks so that they can be identified more positively. We are currently in the process of developing

capillary glass high-resolution columns which can be used for separating a few of the highly contaminated water samples. The SCOT and the WCOT high resolution glass capillary columns will be studied.

RECOMMENDATIONS

In order to eliminate any confusion in the future, the water samples shall be collected according to the following procedures.

1. The specific sampling sites shall be selected in consultation with Dr. F. B. DeWalle

2. A 1-gallon Pyrex glass container shall be used to store the water sample in which the organics in the acid and the base extracts will be determined. This container shall be muffled (450°C) overnight prior to use. In the event when a muffled furnace is not available, a new 1-gallon Pyrex container shall be used. In no circumstance shall the organic solvent bottles be used for sample collection. A small piece of Teflon liner shall be placed between the lid and the container to minimize contamination by the lid

3. Three (3) muffled (450°C, overnight) 4-oz serum bottles with zero-dead volume and Teflon faced septum shall be used to store the water sample in which the volatile organics will be determined

4. Prior to sample collection, all containers and vials are to be rinsed several times with the water sample to be collected. The use of any plastic materials, with the exception of Teflon shall be avoided in sample collection. No preservatives shall be added. The sample shall be refrigerated or iced down as soon as it is collected

5. All samples are to be shipped air-freight within one day after collection to the attention of

   Dr. Edward S. K. Chian
   3217 Civil Engr. Bldg.
   University of Illinois
   Urbana, IL 61801

   Upon delivery of the samples for shipping, it should be followed up with a telephone call (217-333-6962) to notify Dr. Chian of the approximate time of sample arrival at the Urbana-Champaign Airport so the proper arrangement can be made to pick up the samples.

ORIGINAL
(Red)

Table 1

Llangollon Landfill Sample No. 2, VOA

Monitoring Well #42
(Total number of Peaks > 1 PPb 20)

Relative Retention Time*	Compound	Approximate Level (PPb)
0.59	Acetone	1
0.95	Tetrahydrofuran	6
1.00	Chloroform	32
1.01	Dichloroethene	< 1
1.15	Dichloroethane	< 1
1.17	Methyl ethyl ketone	< 1
1.33	Hexene-1	32
1.40	Trimethyl Siol	1
1.52	Methyl pentane	32
1.57	Bezene	5
1.58	Trichloroethene	5
1.71	n-Hexane	40
1.94	Hexanone (Pinacolone)	1.5
2.05	3-Hexanone	1
2.10	2-Hexanone	< 1
2.17	Toluene	1
2.21	N-Hexanol	1

*Relative to Chloroform

ORIGINAL
(Red)

Table 2

Llangollon Landfill Sample No. 2, Acid Extract

Monitoring Well #42
(Total Number of Peaks > 1 PPb 7)

Relative Retention Time*	Compound	Approximate Level (PPb)
0.42	2-Ethyl hexanoic acid (Is)	--
0.69	Acenaphthene (or Diphenyl)	5
0.76	C_{10} Terpineol	10
0.92	Methyl palmitate	1.5
1.00	Dibutyl phthalate + Methyl Stearate	3
1.01	Bleed	--
1.05	Bleed	--
1.22	di-(2-ethyl hexyl) phthalate	3
1.28	C_{15} Terpineol	1

*Relative to methyl stearate

Table 3

Llangollon Landfill Sample No. 2, Base Extract

Monitor Well #42

(Total Number of Peaks > 1 PPb 7)

Relative Retention Time*	Compound	Approximate Level (PPb)
0.13	Diethoxyethane	3
0.35	Dichlorobutane	21
0.37	Unknown	< 1
0.51	Camphor (IS)	-
0.76	C_{10} - Terpineol	1
0.83	Diethyl phthalate	3
1.00	Dibutyl Phthalate	2
1.15	Bleed	1
1.22	C_{15} terpineol	1

*Relative to methyl palmitate

Table 4
Llangollon Landfill Sample No. 3, VOA
Monitoring Well #42
(Total Number of Peaks > 1 PPb 29)

Relative Residence Time*	Compound	Approximate Level (PPb)
0.54	Acetone	1180
0.94	Diethyl ether	63
1.00	Chloroform	881
1.26	Hexene - 1	251
1.32	Methyl-Tetrahydrofuran	10
1.36	Trimethyl Silol	5
1.44	Methyl Pentane	13
1.49	Benzene	2
1.63	Hexane	923
1.97	3-Hexanone	130
2.02	2-Hexanone	99
2.10	Toluene	56
2.13	n-Hexanol	61
2.24	Chlorobenzene	4

*Relative to chloroform

ORIGINAL (Red)

Table 5

Llangollon Landfill Sample No. 3, Acid Extract

Recovery Well #29

(Total Number of Peaks > 1 PPb 41)

Relative Retention Time*	Compound	Approximate Level (PPb)
0.35	Unidentified	28
0.41	2-Ethyl hexanoic acid	--
0.45	Unidentified	< 1
0.47	"	< 1
0.56	"	< 1
0.69	"	5
0.71	Bleed	--
0.73	Unidentified	1
0.79	C_4 substituted Naphthalene	1
0.81	Unidentified	1
0.82	"	10
0.86	"	16
0.89	"	8
0.92	Methyl palmitate	9
0.93	Unidentified	8
0.95	"	19
1.0	Dibutyl phthalate + Methyl Steearate	24
1.03	Unidentified	8
1.06	$C_{15}H_{26}O$(C_{15} Camphor Type)	19
1.12	Unidentified	8
1.15	Bleed	--
1.17	Butyl phthalyl butyl glycolate	11
1.90	Unidentified	14
1.20	Methyl abientenoate	10
1.22	di(2-ethyl hexyl) phthalate	19
1.24	Unidentified	10
1.25	"	11
1.26	"	22

Table 5 (continued).

Relative Retention Time*	Compound	Approximate Level (PPb)
1.26	C_{15} terpineol	21
1.29	Unidentified	21
1.31	C_6H_{12}, Polyaromatic hydrocarbons	30
1.33	Unidentified	21
1.36	"	36
1.38	"	27
1.40	"	91

*Relative to Methyl Stearate

Table 6

Llangollen Landfill Sample No. 3, Base Extract

Recovery Well #29

(Total Number of Peaks > 1 PPb 42)

Relative Retention Time*	Compound	Approximate Level (PPb)
0.11	Diethoxyethane	1360
0.15	Unidentified	1
0.33	Dichlorobutane	10
0.34	Unidentified	14
0.40	Dichlorobenzene	13
0.46	Unidentified	18
0.48	"	15
0.50	Camphor (IS)	--
0.55	Unidentified	3
0.57	"	1
0.82	"	10
0.89	"	20
0.93	"	12
0.95	"	10
1.0	Dibutylphthalate	2
1.04	Bleed	1
1.07	Unidentified	45
1.11	Bleed	--
1.15	Bleed	--
1.16	Butyl Phthalyl butyl glycolate	2
1.22	di-(2-ethyl hexyl) phthalate	1
1.36	Bleed	--

*Relative to Methyl Stearate

Table 7

Llangollon Landfill Sample No. 4, VOA

Recovery Well #27
(Total number of Peaks
> PPb 27)

Relative Retention Time *	Compound	Approximate Level (PPb)
0.42	Methylene Chloride	> 2500
0.53	Acetone	1100
1.00	Chloroform	5
1.24	Hexene-1	310
1.34	Trimethylsilol	4
1.41	Methyl Pentane	28
1.45	Benzene	3
1.60	N-Hexane	975
1.81	Hexanone (Pinacolone)	4
1.92	3-Hexanone	5
1.96	2-Hexanone	6
2.04	Toluene	1
2.07	n-Hexanol	39
2.32	bis (2-chloroethyl) ether	4
2.35	Xylene (or Ethyl Benzene)	1

*Relative to Chloroform

Table 8

Llangollon Landfill Sample No. 4, Acid Extract

Recovery Well #27

(Total Number of Peaks > 1 PPb 22)

Relative Retention Time*	Compound	Approximate Level (PPb)
0.33	Dichlorobutane	21
0.40	2-Ethyl hexanoic acid (IS)	--
0.43	Methyl pentanoate	< 1
0.46	Unidentified	1
0.56	"	1
0.67	"	2
0.69	"	165
0.76	C_{10} Terpinoel	3
0.82	Bleed	--
0.87	Unidentified	1
0.91	Methy palmitate	2
1.00	Dibutylphthalate + Methyl Stearate	2
1.02	Bleed	--
1.05	Bleed	--
1.20	Phthalate (unidentified cpd)	3
1.22	Di (2-ethyl hexyl) phthalate	4
1.25	Bleed	--
1.28	C_{15} Terpeneol	21
1.31	Bleed	--
1.36	Unidentified	26
1.41	"	169

*Relative to Methyl stearate

Table 9

Llangollon Landfill Sample No. 4, Base Extract

Recovery Well #27

(Total Number of Peaks > 1 PPb 40)

Relative Retention Time*	Compound	Approximate Level (PPb)
0.20	Diethoxyethane	25
0.30	Dichlorobutane	20
0.32	Unknown	10
0.49	Camphor (IS)	--
0.63	Unknown	49
0.85	Bleed	28
0.93	Unknown	19
0.98	Bleed	10
1.0	Dibutyphthalate	11
1.03	Bleed	15
1.09	Bleed	10
1.13	Bleed	16

*Relative to Methyl Palmitate

ORIGINAL
(Red)

Table 10
Llangollon Landfill Sample No. 6, VOA
Recovery Well #3
(Total Number of Peaks > 1 PPb 28)

Relative Retention Time*	Compound	Approximate Level (PPb)
0.45	Methylene Chloride	>2500
0.56	Acetone	10
1.00	Chloroform	2
1.06	Dichloroethane	700
1.25	Hexene-1	420
1.47	Benzene	82
1.62	n-Hexane	550

*Relative to Chloroform

Table 11

Llangollon Landfill Sample No. 6, Acid Extract

Recovery Well #3

(Total Number of Peaks > 1 PPb 5)

ORIGINAL (Red)

Relative Retention Time*	Compound	Approximate Level (PPb)
0.43	2-Ethyl hexanoic Acid (IS)	--
0.70	Unidentified	14
1.00	Dibutyl Phthalate + Methyl Stearate	1
1.21	Di-(2-ethyl hexyl)phthalate	5

*Relative to Methyl Stearate

ORIGINAL
(Red)

Table 12

Llangollon Landfill Sample No. 6, Base Extract

Recovery Well #3

(Total Number of Peaks > 1 PPb 9)

Relative Retention Time*	Compound	Approximate Level (PPb)
0.17	Diethoxyethane	7
0.34	Dichlorobutane	4
0.35	Unknown	1
0.51	Camphor (IS)	-
1.0	Dibutyl phthalate	1
1.15	Bleed	3
1.16	Butylphthalyl butyl glycolate	2
1.22	di (2-ethyl hexyl)phthalate	100

*Relative to Methyl palmitate

Table 13

Llangollon Landfill Sample No. 7, VOA

Amoco PW 3 Well

(Total Number of Peaks 1 PPb 24)

ORIGINAL (Red)

Relative Retention Time*	Compound	Approximate Level (PPb)
0.44	Methylene chloride	> 2500
0.58	Acetone	1700
1.00	Chloroform	6
1.22	Hexene-1	890
1.42	Methyl Pentane	285
1.45	Benzene	20
1.60	n-Hexane	1000
1.94	3-Hexanone	19
1.99	2-Hexanone	14
2.07	Toluene	26

*Relative to Chloroform

Table 14

Llangollon Landfill Sample No. 7, Acid Extract

Amoco PW 3 Well

(Total Number of Peaks > 1 PPb 4)

ORIGINAL (Red)

Relative Retention Time*	Compound	Approximate Level (PPb)
0.42	2-Ethylhexanoic acid (IS)	--
0.76	Unidentified	5
0.91	Methyl palmitate	1
1.0	Dibutyl phthalate + Methyl Stearate	< 1
1.14	Bleed	--
1.21	Di(2-ethyl hexyl)phthalate	< 1
1.27	C_{15} Terpneol	< 1

*Relative to Methyl Stearate

ORIGINAL
(Red)

Table 15

Llangollon Landfill Sample No. 7, Base Extract
Amoco PW 3 Well
(Total Number of Peaks > 1 PPb 12)

Relative Retention Time*	Compound	Approximate Level (PPb)
0.14	Diethoxyethane	15
0.33	Dichlorobutane	27
0.34	Identified	2
0.42	"	40
0.46	"	16
0.51	Camphor (IS)	--
0.74	Identified	7
0.76	"	2
1.0	Dibutylphthalate	1
1.11	Bleed	--
1.15	Bleed	--
1.21	di-(2-ethyl hexyl)phthalate	2

*Relative to Methyl palmitate

ORIGINAL
(Red)

Table 16
Llangollon Landfill Sample 8, VOA
Artisian Water Well #2
(Total Number of Peaks > 1 PPb 11)

Relative Retention Time*	Compound	Approximate Level (PPb)
0.44	Methylene Chloride	> 2500
0.68	Acetone	80
0.87	Dichloroethane	1
1.00	Chloroform	770
1.24	Hexene-1	80
1.41	Methyl pentane	600
1.55	Diisoprophyl ether	< 1
1.59	n-Hexane	70
1.95	Tetra chloroethene	< 1
2.02	Toluene	< 1

*Relative to Chloroform

ORIGINAL
(Red)

Table 17
Llangollon Landfill Sample No. 8, Acid Extract
Artisian Water Well #2
(Total Number of Peaks > 1 PPb 1)

Relative Retention Time*	Compound	Approximate Level (PPb)
0.42	2-Ethyl hexanoic acid (IS)	--
0.92	Methyl palmitate	< 1
1.00	Dibutyl phthalate + Methyl Stearate	< 1
1.15	Bleed	--
1.22	Di-(2-ethyl hexyl)phthalate	2
1.28	C_{15} Terpineol	< 1

*Relative to Methyl Stearate

ORIGINAL (Red)

Table 18

Llangollon Sample No. 8, Base Extract

Artisian Water Well #2

(Total Number of Peaks > 1 PPb 3)

Relative Retention Time*	Compound	Approximate Level (PPb)
0.12	Diethoxyethane	4
0.33	Dichlorobutane	19
0.35	Unknown	1
0.51	Camphor (IS)	--
1.00	Dibutyl phthalate	< 1
1.22	di-(2-ethyl hexyl) phthalate	< 1

*Relative to Methyl Stearate

ORIGINAL (Red)

Table 19

Overall Ratings of Organic Contaminants in Groundwater Samples from Llangollon Landfill

Sample	Location	Number of Peaks 1 ppb VOA	ACID	BASE	Overall Ratings*
No. 8	Artisian Well #2	11	1	3	A
No. 2	Monitoring Well #42	20	7	7	B
No. 7	Amoco Well PW3	24	4	12	C
No. 6	Recovery Well #3	28	5	9	D
No. 4	Recovery Well #27	27	22	40	E
No. 3	Recovery Well #29	29	41	42	F

*A refers to the cleanest and E the most contaminated.