

**Vapor Space Characterization of Waste  
Tank 241-BY-107: Results from *In Situ*  
Sample Collected on 3/25/94**

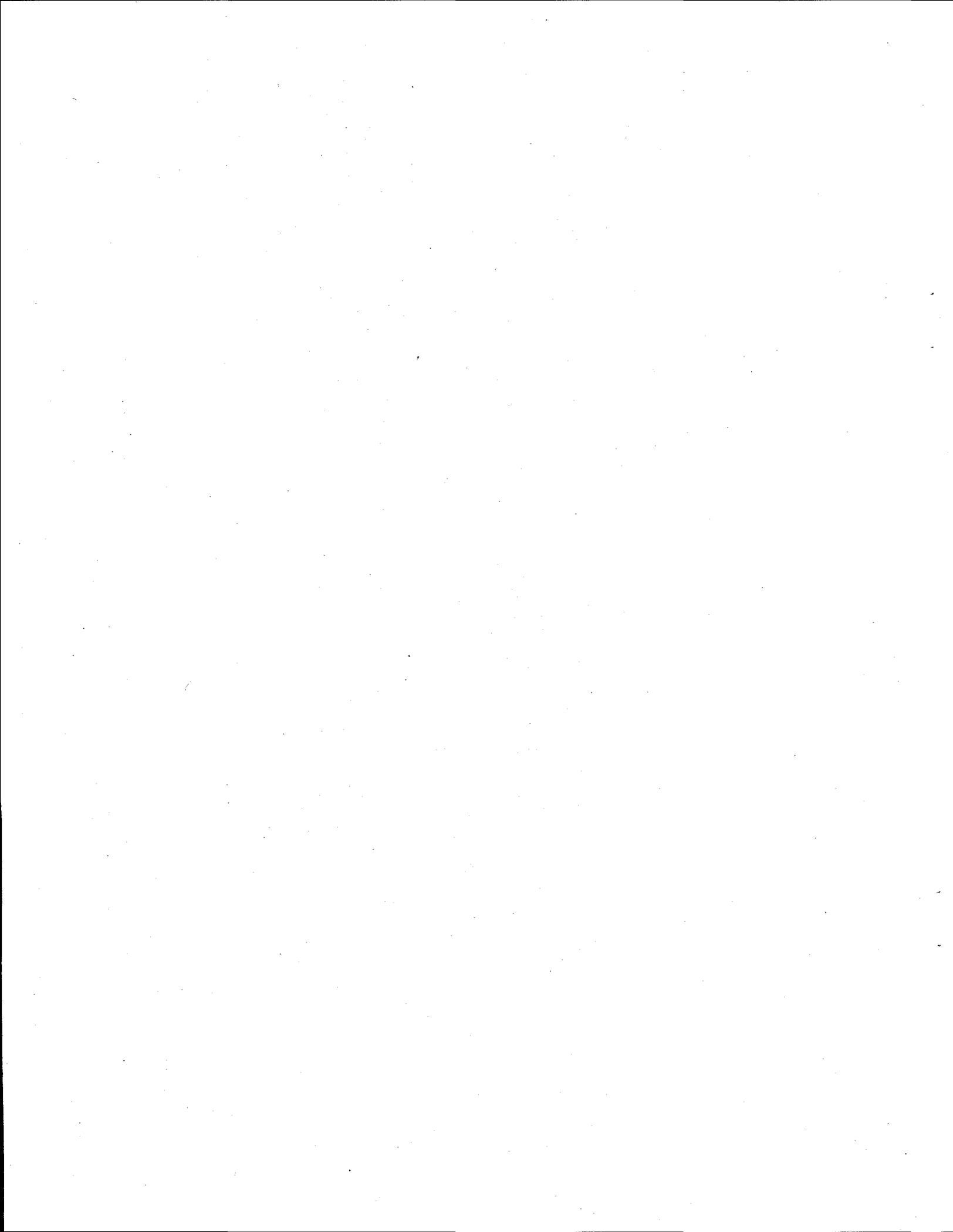
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Pacific Northwest Laboratory  
Richland, Washington 99352

**MASTER**



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## Summary

This report describes organic results from vapors of the Hanford single-shell waste storage Tank 241-BY-107 (referred to as Tank BY-107). Samples for selected inorganic compounds were obtained but not analyzed (Section 2.0). Quantitative results were obtained for several organic analytes, but quantities of analytes not listed in U.S. Environmental Protection Agency (EPA) compendium Method TO-14 were estimated (see Summary Table 1). Approximately 80 tentatively identified organic analytes were observed above the detection limit of (ca.) 10 ppbv, but standards for most of these were not available at the time of analysis, and their quantitative determination is beyond the scope of this study. The SUMMA™ canister samples were also analyzed for the 41 organic compounds listed in EPA compendium Method TO-14. Of these, only a few were observed above the 2-ppbv detection limits. These are summarized in Table 3.1. Estimated quantities were determined of tentatively identified compounds (TICs). A summary of these results (Table 3.2) shows quantities of all TICs above the concentration of ca. 10 ppbv. This consists of more than 80 organic analytes. The 12 organic analytes with the highest estimated concentrations are shown in Summary Table 1 below. These 12 analytes account for approximately 55% of the total organic components in Tank BY-107. Detailed descriptions of the results appear in the text.

**Summary Table 1.** Summary Results of Selected Organic Analytes

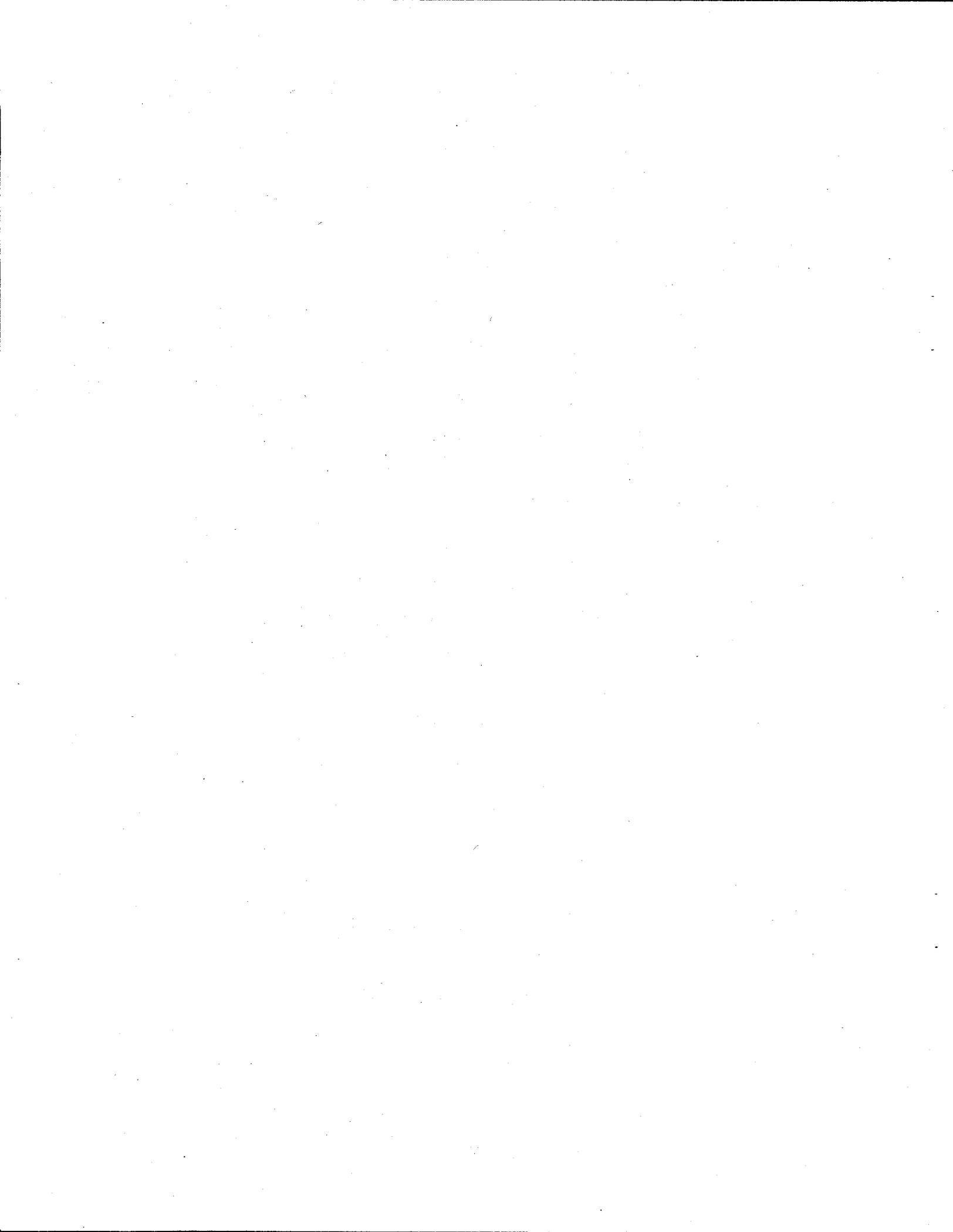
<u>Selected Organic Analytes (TIC)</u>	<u>Average Concentrations<sup>(a)</sup> (mg/m<sup>3</sup>)</u>
1-Propene/propane	4
n-Butane	5
Acetone	5
n-Pentane	5
2-Methylpentane	4
1-Hexane	3
1-Butanol	3
n-Dodecane	2
Other C14 Alkanes <sup>(a)</sup>	2
n-Tridecane	3
n-Tetradecane	2

(a) Other structural isomers should be considered.



## **Acknowledgments**

The authors gratefully acknowledge the support of other project staff at Pacific Northwest Laboratory who contributed to the successful completion of this sampling and analysis activity. Jeff Edwards served as the PNL single-point-of-contact and coordinated sample handling and communications with Westinghouse Hanford Company. Jeff also supported work in the analytical laboratory. Annalisa Krupsha and Gary Dennis prepared the solid-sorbent sample trains. Georgia Ruebsamen provided word processing support.



## Abbreviations

COC	chain of custody
EPA	U.S. Environmental Protection Agency
GC/MS	gas chromatography/mass spectrometry
HEPA	high efficiency particulate air
HP	Hewlett Packard
IS	internal standard
NPH	normal paraffin hydrocarbon
ppbv	part per billion by volume
ppmv	part per million by volume
PNL	Pacific Northwest Laboratory
STP	standard temperature and pressure
TIC	tentatively identified compound
WHC	Westinghouse Hanford Company



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## 1.0 Introduction

This report describes results of the analysis of vapor samples taken from the Hanford waste Tank 241-BY-107 (referred to as Tank BY-107) on March 25, 1994. Preliminary results of the SUMMA™ canister analysis for this tank are included in the interim letter report *Hanford Waste Tank BY-107 and BY-108 Preliminary Report Draft* submitted to Westinghouse Hanford Company (WHC) on 4/22/94<sup>(a)</sup>. The WHC sample job number was S4011.

Sampling devices including sorbent trains (for inorganic analyses) and SUMMA™ canisters (for organic analysis) were supplied to the WHC sampling staff on March 23, 1994. Samples were taken (by WHC) on March 25 and were returned from the field on March 29. Inorganic (sorbent trains) samples delivered to Pacific Northwest Laboratory (PNL)<sup>(b)</sup> on chain of custody (COC) 006857 (Figure 1a) included 6 samples. SUMMA™ samples delivered to PNL on COC 006850 (Figure 1b) included one surrogate and one tank-headspace SUMMA™ canister sample.

The samples were inspected upon delivery to the 326/23B laboratory and logged into PNL laboratory record book 55408. Sorbent trains were found to contain levels of radioactivity exceeding our standard inorganic laboratory capacity. These samples were subsequently returned to WHC. The canisters were stored in the 326/23B laboratory at ambient (25°C) temperature until the time of analysis. Access to the 326/23B laboratory is limited to PNL personnel working on the waste tank safety program. Analyses described in this report were performed at PNL in the 300 area of the Hanford Reservation. Methods used for organic analyses are described in the text of this report. Organic analyses were performed using gas chromatography/mass spectrometry (GC/MS).

## 2.0 Inorganic Analysis

Solid sorbent trains for ammonia, nitrogen dioxide, nitric oxide, hydrogen cyanide, and water were supplied. The traps were inserted into the waste tank and used to sample the tank headspace. Available information from a radiological survey of the samples indicated the presence of external contamination and potential internal contamination; therefore, the samples were not analyzed chemically; gravimetric results indicated a vapor mass concentration of approximately 7 mg/L (expected to be largely water vapor). To reduce the possibility of contamination in subsequent sample jobs, a wrapped high-efficiency particulate air (HEPA)-filtered inlet manifold has since been designed for use upstream of *in situ* trains.

- 
- (a) Report written by B. D. McVeety, J. S. Fruchter, R. B. Lucke, and S. C. Goheen. Pacific Northwest Laboratory, Richland, Washington.
- (b) Pacific Northwest Laboratory is operated for the U.S. Department of Energy by Battelle Memorial Institute under Contract DE-AC06-76RLO 1830.

Westinghouse  
Hanford Company

CHAIN OF CUSTODY

WHC 006857

Custody Form Initiator J. A. Edwards

Company Contact J. L. Huckaby

Telephone (509) 373-0141

Project Designation/Sampling Locations 200 East Tank Farm  
BY Tank 107 Vapor Sample SAF S4011, (ISS)  
Ice Chest No. ①

Collection Date 03-24-94 <sup>25</sup> ②

Field Logbook No. WHC-N-647 <sup>797 LAP 3-24-94</sup>

Bill of Lading/Airbill No. N/A

Offsite Property No. N/A

Method of Shipment Government Truck

Shipped to WHC

Possible Sample Hazards/Remarks Unknown at time of sampling

Sample Identification

S4011 - SOR .X00 ✓	SAP Ref	HCN / H2O SAMPLE #1
S4011 - SOR .X01 ✓	SAP Ref	HCN / H2O SAMPLE #2
S4011 - SOR .X02 ✓	SAP Ref	HCN / H2O SAMPLE #3
S4011 - SOR .X03 ✓	SAP Ref	NH3 / NOx / H2O SAMPLE #1
S4011 - SOR .X04 ✓	SAP Ref	NH3 / NOx / H2O SAMPLE #2
S4011 - SOR .X05 ✓	SAP Ref	NH3 / NOx / H2O SAMPLE #3
* S4011 - SOR .X06 ②	SAP Ref	OVS / H2O (TO RADIOLOGICAL SURVEY)

SAMPLE S4011-SOR.X06 TRANSFERRED TO WHC CHAIN OF CUSTODY # 006548  
3-25-94/1425 JG Hogan

[X] Field Transfer of Custody		[ ] Chain of Possession		(Sign and Print Names)		
Relinquished By	Date	Time	Received By	Date	Time	
J. A. Edwards	03-23-94	0845	J.E. Darling	03-23-94	0845	JG Hogan
JG Hogan	03-25-94	0900	J.A. PANGEL	03-25-94	0900	JG Hogan
JG Hogan	03-25-94	1425	JG Hogan	03-25-94	1425	JG Hogan
JG Hogan	03-29-94	1145	J.A. Edwards	03-29-94	1145	JG Hogan

Final Sample Disposition

Disposal Method:

Disposed by:

Date/Time:

Comments

A-6000-407 (12/92) WEP061

Figure 1a. Chain of Custody for Inorganic Samples from Tank BY-107

<b>Westinghouse Hanford Company</b>	<b>CHAIN OF CUSTODY</b>	<b>WHC 006850</b>
---	-------------------------	-------------------

Custody Form Initiator      J. A. Edwards

Company Contact      J. L. Huckaby / LA Pingel <sup>LAP</sup> 3-24-94      Telephone      (509) 373-0141

Project Designation/Sampling Locations      200 East Tank Farm      Collection Date      03-25-94 <sup>LAP</sup> 797 3-24-94

Tank BY 107 Vapor Sample SAF S4001 <sup>LAP</sup> (ISS)      Ice Chest No.      ② S4011 3-24-94

Field Logbook No.      WHC-N-047

Bill of Lading/Airbill No.      N/A      Offsite Property No.      N/A

Method of Shipment      Government Truck

Shipped to      WHC

Possible Sample Hazards/Remarks      Unknown at time of sampling

Sample Identification

S4011 - SUMMA .075	SAP Ref	PNL summa Day 1	PNL# SUMMA 075
S4011 - SUMMA .082	SAP Ref	PNL suggate #1	PNL# SUMMA 082

<input checked="" type="checkbox"/> Field Transfer of Custody		Chain of Possession (Sign and Print Names)			
Relinquished By	Date	Time	Received By	Date	Time
J. A. Edwards	03-23-94	0845	J.E. Darling J.G. Hogan J.P. Hogan	3-23-94	0845
J.P. Hogan	03-25-94	0900	J.L. Huckaby LA Pingel	03-25-94	0900
J.P. Hogan	3-29-94	0900	J.P. Hogan J.G. Hogan	3-29-94	0900
J.P. Hogan J.G. Hogan	3-29-94	1150	J.A. Edwards J.A. Edwards	3-29-94	1150

Final Sample Disposition

Disposal Method:

Disposed by:

Date/Time:

Comments

A-6000-407 (12/92) WEP061

**Figure 1b. Chain of Custody for Organic Samples from Tank BY-107**



## 3.0 Organic Analysis

### 3.1 SUMMA™ Canister Preparation

Before sending SUMMA™ canisters out to the field for sampling, the canisters are cleaned and verified contaminant free according to PNL Technical Procedure PNL-TVP-02<sup>(a)</sup>. The cleaning procedure uses an EnTech 3000 cleaning system that controls 1) filling the canisters with purified humid air and 2) evacuating, for several cycles with applied heat, before allowing the canister to evacuate overnight. The canister is filled a final time with purified humid air for analysis by PNL Technical Procedure PNL-TVP-01<sup>(b)</sup>, which is a modification of U.S. Environmental Protection Agency (EPA) Compendium Method TO-14. If the canister is verified as clean, free of TO-14 contaminants to a level of 5 ppbv, the canister is evacuated to 30 in. Hg, tagged, and stored for use in the field. Before sending the canisters out to the field for sampling, the canisters are prehumidified with 100 µL of distilled water and labeled with a field sampling identification. Canisters not used after 30 days of storage are recleaned and validated before use.

### 3.2 Sample Analysis Method

The SUMMA™ canister sample was analyzed according to PNL Technical Procedure PNL-TVP-03, *Determination of TO-14 Volatile Organic Compounds in Hanford Waste Tank Headspace Samples Using SUMMA™ Passivated Canister Sampling and Gas Chromatographic-Mass Spectrometry Analysis*. The method uses an EnTech cryoconcentration system that is interfaced with a Hewlett Packard (HP) 5971 GC/MS. The EnTech concentrator is used to pull a metered volume of sample air from the SUMMA™ canister, cryogenically concentrate the air volume, then transfer the volume to the GC/MS for analysis. A 100-mL volume of sample is measured and analyzed from the tank headspace sample. The organic components in the sampled air are separated on an analytical column, J&W Scientific DB-1 phase, 60-m by 0.32-mm inside diameter with 3-µm film thickness. The GC column is programmed for a temperature gradient beginning at 40°C, holding for 5 min, and ramping at 4°C per min to a final temperature of 260°C, with a 5-min hold.

### 3.3 Quality Assurance/Quality Control

Before the tank sample was analyzed, a diagnostic check was performed on the GC/MS instrument by running an instrument "quick tune," as described in PNL-TVP-03<sup>(c)</sup>. Upon satisfactory completion of the instrument diagnostic check, a blank volume of purified nitrogen was analyzed to check the cleanliness of the system. The instrument was then calibrated over 6 data points ranging from 2 ppbv to 100 ppbv, using a standard gas mixture containing 40 volatile organic compounds listed in U.S. Environmental Protection Agency (EPA) compendium Method TO-14. A gas mixture containing bromochloromethane, 1,4-difluorobenzene, and chlorobenzene-d<sub>5</sub> was used as an internal standard (IS) for all blank, calibration standard, and sample analyses. The calibration curve was generated by

- (a) Pacific Northwest Laboratory. 1994. *Cleaning SUMMA™ Canisters and the Validation of the Cleaning Process*, PNL-TVP-02 (Rev. 0), PNL Technical Procedure, Richland, Washington.
- (b) Pacific Northwest Laboratory. 1994. *Determination of TO-14 Volatile Organic Compounds in Ambient Air Using SUMMA™ Passivated Canister Sampling and Gas Chromatographic-Mass Spectrometric Analysis*, PNL-TVP-01 (Rev. 0). PNL Technical Procedure, Richland, Washington.
- (c) Pacific Northwest Laboratory. 1994. *Determination of TO-14 Volatile Organic Compounds in Hanford Waste Tank Headspace Samples Using SUMMA™ Passivated Canister Sampling and Gas Chromatographic-Mass Spectrometry Analysis*, PNL-TVP-03 (Rev. 0), PNL Technical Procedure, Richland, Washington.

calculating the relative response ratios of the IS to calibration standard responses and plotting the ratios against the ratio of the calibration-standard concentration (in ppb) to the IS concentration. A least-squares linear-regression routine was applied to the data set to generate the best-fit line for each compound. The equation for that line was then used to determine the concentration of the specific compounds in the tank samples.

**3.2.1 Quantitation of TO-14 Results.** The quantitative analysis results for the TO-14 volatile organic compounds were calculated directly from the calibration curve generated using the IS method described above and in PNL-TVP-03. The conversion from ppmv to mg/m<sup>3</sup> assumes standard temperature and pressure (STP) conditions of 760 torr and 273°K and was calculated directly from the following equation:

$$\text{mg/m}^3 = \frac{\text{ppmv} \times \text{molecular weight of compound}}{22.4 \text{ L/mol}}$$

**3.2.2 Identification and Quantitation of Tentatively Identified Compounds.** The TICs are determined by performing a mass-spectral library search on each integrated peak using the EPA/NIST/WILEY Library, which is a part of the HP 5971 instrument operating system. Chromatographic peaks with an area count greater than, or equal to, one half of the total area count of the chlorobenzene-d<sub>5</sub> IS peak at the 20-ppbv calibration level are tentatively identified and quantitatively estimated. This standard was chosen to determine the integration cutoff as it is in the middle of the chromatographic range, and not in a region affected by coelution of other compounds. The quality of the mass-spectral searches was then reviewed by the principal investigators before the identification was assigned to each chromatographic peak.

The concentration of each TIC was estimated using a relative response factor calculated using a corrected total peak area for the IS chlorobenzene-d<sub>5</sub>. Specifically, the total integrated area for the chlorobenzene-d<sub>5</sub> peak had to be corrected for coeluting compounds before calculating the response factor. The corrected total peak area for the IS was calculated by multiplying the IS quantitation ion by a correction factor based on the ratio of the total integrated peak area to the quantitation ion as measured in blank runs. The corrected peak area was then used to calculate a response factor using the IS concentration in mg/m<sup>3</sup>:

$$\text{Response Factor} = \frac{\text{IS conc. (mg/m}^3\text{)}}{\text{IS peak area}}$$

The calculated response factor was then multiplied by the TIC peak area to give an estimated concentration for that compound. For butane, the total peak area was multiplied by the response factor for chlorobenzene-d<sub>5</sub> to give an estimated concentration of 5.05 mg/m<sup>3</sup>. Internal standards bromochloromethane and difluorobenzene were not used to quantitate the TIC because coeluting compounds appeared to have greatly altered the signal of the quantitation ions for those two ISs.

The ppbv concentrations are calculated concentrations from mg/m<sup>3</sup> and the molecular weight of the analyte.

$$\text{TIC in ppbv} = \frac{\text{TIC (mg/m}^3\text{)} \times 22.4 \text{ L/mol} \times 1000}{\text{TIC g mol wt}}$$

The IS level added to all blank, standard, and sample injections was 18.2 ppbv for bromochloromethane, 20.2 ppbv for 1,4-difluorobenzene, and 18.3 ppbv for chlorobenzene-d<sub>5</sub>. The IS concentrations were converted from ppbv at STP to mg/m<sup>3</sup> using a molecular weight of 129.39 (g/mol) for bromochloromethane, 114.09 for 1,4-difluorobenzene, and 117.6 for chlorobenzene-d<sub>5</sub>.

### 3.4 Analysis Results

The results from the GC/MS analysis of the tank headspace samples are presented in Tables 3.1 and 3.2. A representative total ion chromatograph showing identity of major constituents is given in Figure 3.1.

Table 3.1 lists the quantitative results for compounds listed in Method TO-14. The levels of TO-14 analytes observed in the samples collected from Tank BY-107 were similar to those seen in Tank BY-108. The most predominant TO-14 species seen in this sample were freon-11 (255 ppbv) and toluene (202 ppbv). The other TO-14 compounds seen were at 25 ppbv or less.

Table 3.2 lists the semi-quantitative results for the TICs. The predominant species observed in this sample were coeluting peaks 1-propene / propane, butane, acetone, pentane, 2-methylpentane, hexane, and butanol. The acetone concentration reported for this sample may be underestimated because the signal for this compound overloaded the GC/MS detector. As in previous tanks, normal paraffin hydrocarbons (NPH) were present in the sample, but did not constitute the major portion of organic components seen. However, it should be noted that because the SUMMA™ canisters were not heated at the time of analysis, the NPH concentrations listed after the retention time of decane may not be a true accounting of all the NPH in the sample. Similarly, polar compounds that may adhere to the inside surface of the canister may also be under represented in this analysis. The total concentration of the TIC compounds was approximately 68.3 mg/m<sup>3</sup>.

## 4.0 Conclusions

The concentrations of selected organic compounds were determined from samples of the tank headspace of Hanford Tank BY-107. Samples for selected inorganic compounds were obtained but not analyzed (Section 2.0). Twelve of the TO-14 analytes and 86 TICs were observed above the detection limit of ca. 10 ppb. The sum of these analytes was approximately 70 mg/m<sup>3</sup> or about 20% the concentration of organic compounds in Tank C-103 (Ligotke et al. 1994) (Huckaby and Story 1994).

## 5.0 References

- Huckaby, J. L. and M. S. Story. 1994. *Vapor Characterization of Tank 241-C-103*, WHC-EP-0780, Westinghouse Hanford Company, Richland, Washington.
- Ligotke, M. W., T. R. Clauss, J. S. Fruchter, R. B. Lucke, D. W. Dennis, G. M. Mong, R. E. Hoheimer, M. McCulloch, M. T. Dana, and S. C. Goheen. 1994. *Aerosol and Vapor Characterization of Tank 241-C-103: Data Report for In Situ OVS Samples Obtained 12/2/93*, PNL-9368, Pacific Northwest Laboratory, Richland, Washington.

## 6.0 Further Reading

McVeety, B., Lucke, R., Fruchter, J., Goheen, S., Hanford Waste Tank BY-107 and BY-108, Preliminary Letter Report DRAFT, 4/94, Pacific Northwest Laboratory, Richland, Washington.

Pacific Northwest Laboratory. Analytical Laboratory Operations Procedure Compendium. Procedures PNL-ALO-212, -226, -271. PNL-MA-599, Richland, Washington.

Pacific Northwest Laboratory. Quality Assurance Manual, Part 2: Good Practices Standard. PNL-MA-70, Part 2, Richland, Washington.

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Pacific Northwest Laboratory. 1994. *Determination of TO-14 Volatile Organic Compounds in Ambient Air Using SUMMA™ Passivated Canister Sampling and Gas Chromatographic-Mass Spectrometry Analysis*, PNL Technical Procedure, PNL-TVP-01 (Rev. 0), Richland, Washington.

Pacific Northwest Laboratory. 1994. *Cleaning SUMMA™ Canisters and the Validation of the Cleaning Process*, PNL Technical Procedure, PNL-TVP-02 (Rev. 0), Richland, Washington.

Pacific Northwest Laboratory. 1994, *Sample Shipping and Receiving Procedure - DRAFT for PNL Waste Tank Samples*, PNL Technical Procedure, PNL-TVP-07 (Rev. 0), Richland, Washington.

**Table 3.1** TO-14 Analysis Results for *In Situ* Sample S4011-SUM.075<sup>(a)</sup>, Collected from Tank BY-107 in SUMMA<sup>TM</sup> Canisters on 3/25/94

TO-14 Analyte	PNL 075 <sup>(b)</sup>	
	(ppbv)	(mg/m <sup>3</sup> ) <sup>(c)</sup>
Dichlorodifluoromethane (FREON-12)	2.44	0.01
Methyl chloride (chloromethane)	23.01	0.05
1,2-Dichloro-1,1,2,2,-tetrafluoroethane (FREON-114)	< 2	< .02
Chloroethene (vinyl chloride)	< 2	< .006
Methyl bromide (bromomethane)	< 2	< .009
Ethyl chloride	2.95	0.01
Trichlorofluoromethane (FREON-11)	254.68	1.56
1,1-Dichloroethene (1,1-dichloroethylene)	< 2	< .009
Dichloromethane (methylene chloride)	1.83	0.01
1,1,2-Trichloro-1,2,2-trifluoroethane (FREON-113)	< 2	< .02
1,1-Dichloroethane	< 2	< .009
Cis-1,2-dichloroethene (cis-1,2-dichloroethylene)	< 2	< .009
Trichloromethane (chloroform)	< 2	< .01
1,2-dichloroethane	< 2	< .009
1,1,1-Trichloroethane	< 2	< .01
Benzene	23.55	0.09
Carbon tetrachloride	< 2	< .01
1,2-Dichloropropane	< 2	< .01
Trichloroethylene	< 2	< .01
Cis 1,3-dichloropropene	< 2	< .01
Trans 1,3-dichloropropene	< 2	< .01
1,1,2-Trichloroethane	< 2	< .01
Methyl benzene (toluene)	202.7	0.83
1,2-Dibromoethane	< 2	< .02
Tetrachloroethene (tetrachloroethylene)	< 2	< .01
Chlorobenzene	< 2	< .01
Ethylbenzene	5.68	0.03
P/m-xylene (1,3-dimethylbenzene)	6.23	0.03
Styrene	< 2	< .01
1,1,2,2-Tetrachloroethane	1.27	0.01
o-Xylene (1,2-dimethylbenzene)	5.45	0.03
1,3,5-Trimethylbenzene	< 2	< .01
1,2,4-Trimethylbenzene	< 2	< .01
Chloromethylbenzene, alpha (benzyl chloride)	< 2	< .01
m-Dichlorobenzene (1,3-dichlorobenzene)	< 2	< .01
p-Dichlorobenzene (1,4-dichlorobenzene)	< 2	< .01
o-Dichlorobenzene (1,2-dichlorobenzene)	< 2	< .01
1,2,4-Trichlorobenzene	< 2	< .02
Hexachloro-1,3-butadiene	2.21	0.03

(a) WHC ID number.

(b) PNL SUMMA<sup>TM</sup> canister number.

(c) Calculated from ppbv using molecular weight of compound, 760 mm torr, and 0°C.

**Table 3.2** Table of Tentatively Identified Compounds and Estimated Concentrations in Tank BY-107 *In Situ* SUMMA™ Canister Sample S4011-SUM-075(a) Collected on 3/25/94

Tentatively Identified Compound <sup>(c)</sup>	Retention Time	PNL 075 <sup>(b)</sup> Concentration (mg/m <sup>3</sup> ) <sup>(d)</sup>
Carbon dioxide	5.79	0.19
Carbon dioxide	6.11	0.92
1-Propene	6.66	3.85
Propane (coeluent)		
Cyclopropane	7.27	0.34
2-Methyl propane	7.53	0.94
C4 Alkene <sup>(e)</sup>	8.01	1.24
Butane	8.20	5.05
Unknown	8.53	0.11
C4 Alkene <sup>(e)</sup>	8.74	0.66
Ethanol	9.53	0.11
2-Pentene	9.73	0.20
C5 Alkene	10.02	0.14
Acetone	10.29	5.37
C5 Alkene <sup>(e)</sup>	10.82	0.82
Pentane	11.24	4.97
1-Pentene	12.03	0.20
Dimethyl butane	12.77	0.08
1-Propanol	13.30	0.07
4-Methyl-1-pentene	13.69	0.44
2-Methylpentane	14.29	3.49
2-Butanone	14.71	0.79
3-Methyl pentane	15.02	0.61
1-Hexene	15.25	0.52
<b>Bromochloromethane (IS)</b>	15.82	
Hexane (coeluent)		2.47
Tetrahydrofuran	16.75	0.24
Methylcyclopentane	17.43	0.44
Butanol	18.32	2.89
<b>1,4-Difluorobenzene (IS)</b>	19.35	
2-Pentanone (coeluent)		1.17
3-Methylhexane	19.88	0.61
Heptane	21.12	1.30
4-methyl-2-pentanone	22.32	0.10
Methylcyclohexane	22.68	0.21
Toluene	24.47	0.53
C8 Alkane <sup>(e)</sup>	24.67	0.15
Octane	26.41	0.53
Siloxane	27.11	0.10
C9 Alkane <sup>(e)</sup>	27.98	0.16
<b>Chlorobenzene-d5 (IS)</b>	28.47	
Trimethylcyclohexane	28.89	0.22
3-Heptanone	29.84	0.34
2-Heptanone	29.96	0.17
C9 Alkane <sup>(e)</sup>	30.14	0.14
2-butoxy ethanol	30.99	0.22
Nonane	31.42	0.46
Unknown mixture	32.40	0.10
2-Octanone	33.17	0.44

Table 3.2 Contd

Tentatively Identified Compound <sup>(c)</sup>	Retention Time	PNL 075 <sup>(b)</sup>	Concentration (mg/m <sup>3</sup> ) <sup>(d)</sup>
Trimethylcyclohexane	33.42		0.12
C10 Alkane <sup>(e)</sup>	34.41		0.08
C9 Ketone <sup>(e)</sup>	34.83		0.10
Trimethylcyclohexane	35.04		0.15
C10 Alkene <sup>(e)</sup>	35.88		0.07
Decane	36.08		0.37
C10 Alkene <sup>(e)</sup>	36.69		0.08
C10 Alkane <sup>(e)</sup>	37.21		0.20
C4 cyclohexane <sup>(e)</sup>	37.99		0.06
C11 Alkane <sup>(e)</sup>	38.11		0.20
C5 Cyclohexane <sup>(e)</sup>	39.18		0.07
Decahydronaphthalene	39.71		0.11
Unknown	40.22		0.10
Undecane	40.40		0.70
C5 Alkene <sup>(e)</sup>	40.99		0.16
C5 Alkane <sup>(e)</sup>	41.22		0.11
C5 Alkane <sup>(e)</sup>	41.66		0.18
Methyldecahydronaphthalene	41.89		0.09
C5 Cyclohexane <sup>(e)</sup>	42.11		0.20
C5 Alkane <sup>(e)</sup>	42.47		0.23
C5 Alkane <sup>(e)</sup>	42.67		0.21
Methyldecahydronaphthalene	42.87		0.28
C5 Alkane <sup>(e)</sup>	43.04		0.23
Unknown	43.35		0.15
Unknown	44.18		0.16
Dodecane	44.43		2.01
C13 Alkane <sup>(e)</sup>	45.05		1.46
C13 Alkene <sup>(e)</sup>	46.49		0.74
C2-Decahydronaphthalene <sup>(e)</sup>	46.73		0.21
C14 Alkane <sup>(e)</sup>	46.88		0.33
C14 Alkane <sup>(e)</sup>	47.30		1.96
Tridecane	48.17		2.89
C14 Alkene <sup>(e)</sup>	48.63		0.37
C14 Alkane <sup>(e)</sup>	48.93		0.45
C3-Decahydronaphthalene <sup>(e)</sup>	49.50		0.08
Unknown	50.30		0.40
C14 Alkane <sup>(e)</sup>	50.50		0.32
C14 Alkane <sup>(e)</sup>	50.74		0.17
C14 Alkane <sup>(e)</sup>	51.04		1.99
Tetradecane	51.67		1.60
Unknown	51.88		0.21
C15 Alkane <sup>(e)</sup>	53.86		0.57
Pentadecane	54.94		0.14

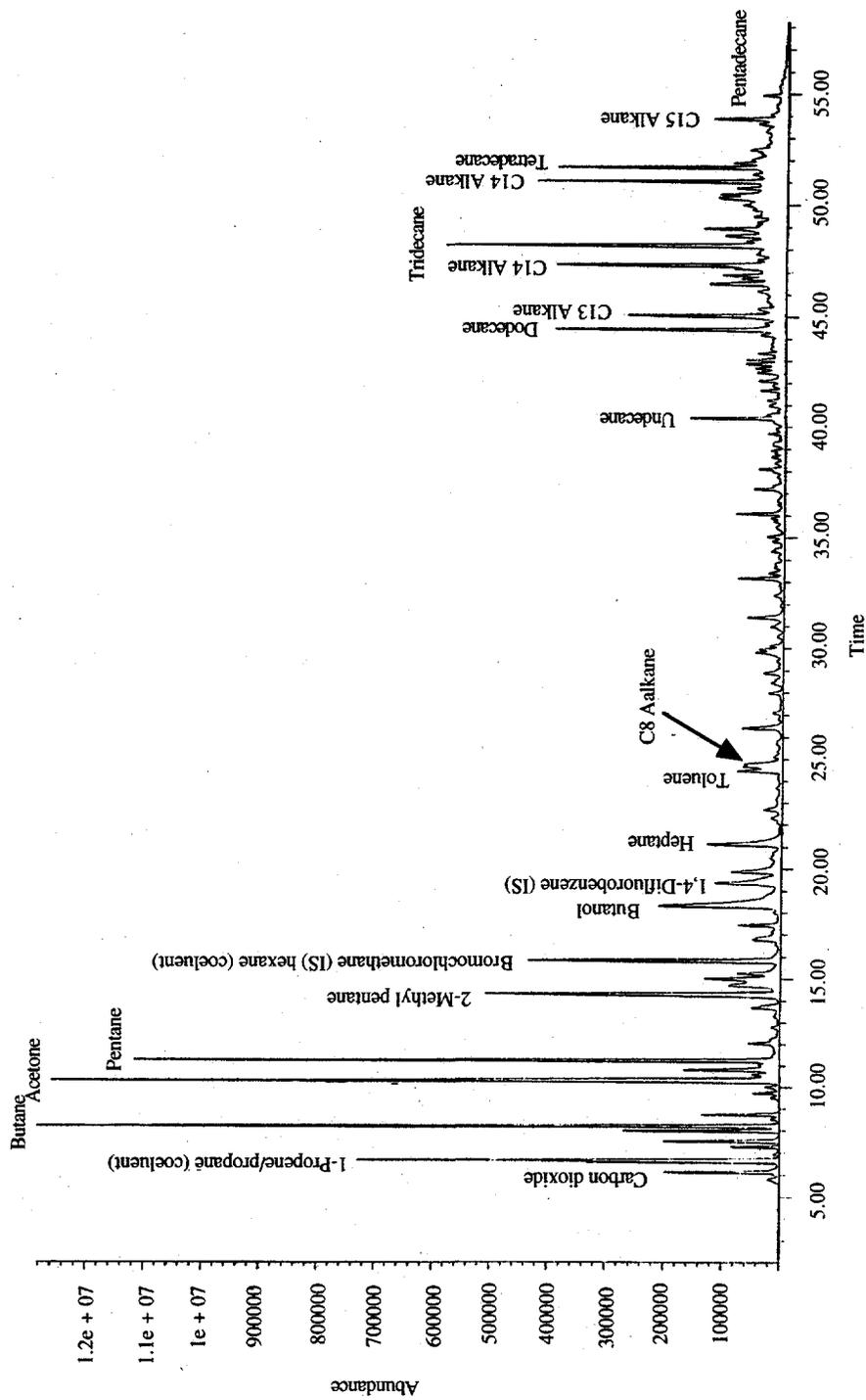
(a) WHC sample number.

(b) PNL SUMMA™ canister number.

(c) Obtained by mass-spectral interpretation and comparison with the EPA/NIST/WILEY Library.

(d) Semi-quantitative estimate calculated using concentration of the chlorobenzene-d<sub>5</sub> IS.

(e) Other structural isomers should be considered.



**Figure 3.1** GC/MS Chromatogram of Hanford Waste Tank BY-107 *In Situ* SUMMA™ Canister Vapor Sample S4011-SUM-075 Collected on 3/25/94

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