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FORMULATION OF A PRELIMINARY ASSESSMENT OF HALOGENATED ORGANIC COMPOUNDS IN MAN AND ENVIRONMENTAL MEDIA

by

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SECTION 1
CONCLUSIONS

During the course of acquiring information for this report, it became apparent that a substantial volume of data existed on the measurements of halogenated hydrocarbons in the environment, their mutagenic and carcinogenic activity and the biological chemistry of these materials. This information has allowed the selection of those substances which are probably most prominent and biologically important for a subsequent epidemiological study. An inadequate amount of information was available for the production and emissions of halogenated hydrocarbons from the industry in the five geographical areas. Without this information, a backward extrapolation between levels in the environment and the incidence of cancer will be very difficult. Furthermore, data were not available on levels in human fluids nor the variance of the halogenated hydrocarbons in biological fluids and tissue. This information is important for statistical analyses and for subsequent correlations.

SECTION 2
RECOMMENDATIONS

Future programs which undertake a comparative analysis between pollutants in the environment and in man should be extended to other chemicals which may be potentially responsible for the increase incidence of cancer in the Continental U.S. It is recommended however that a pilot program be instituted which provides the following information: (1) environmental levels of chemicals in air, water, soil, sediment and the food chain; (2) levels of the pollutants in the human biological fluids and tissue; (3) biological testing of chemicals for carcinogenic and mutagenic activity which is needed for the selection of the more important compounds for epidemiological studies; and (4) production and emission levels for chemicals during the past 10-15 years.

These data are required and are considered as the key ingredients in designing a program which makes an assessment of the organic pollutants in man and environmental media.

SECTION 3
PROGRAM OBJECTIVES

The general broad term thrust of this program is to conduct environmental sampling and related epidemiological studies concerning halogenated organic compounds in five metropolitan locations within the Continental U.S. A comparative analysis is to be made of environmental levels (air, water, soil, sediment and aquatic and terrestrial species) with levels of chemicals found in the endogenous population and cancer mortality rates (in the metropolitan areas). The selected halogenated hydrocarbon chemicals are to be measured in human blood, urine and/or fat tissues.

Under the first phase of this program, identification and quantification of the halogenated hydrocarbons occurring in air, water, etc. are to be performed for the sampling areas selected. The ultimate objective is to acquire information which will allow a statistical correlation of the levels of halogenated organic compounds in the environmental samples with those in human tissue and with the incidence of mortality.

This comprehensive report presents the information which is required for establishing which chemicals are most important for study and establishes those substances which most likely will contribute to a health effect. The report lays the foundation and rational basis for developing a model/hypothesis concerning halogenated hydrocarbons and the incidence of cancer in man; furthermore, the hypothesis is to be tested.

SECTION 4
INTRODUCTION

GENERAL PROGRAM CONCEPT

The general program concept which has been developed attempts to furnish a comprehensive and systematic approach which will make a comparative analysis of selected organic compounds in man and the environmental media. For the purpose of presenting an overview of the concept, Figure 4-1 depicts a flow diagram demonstrating the interlocking relationship between the environment, man and a potential association with the incidence of cancer. This schematic presents a number of prerequisite components of the current program which need examination to demonstrate a potential associational relationship between halogenated hydrocarbons and the incidence of cancer in man. The general program concept has been simplistically divided into three basic levels. The first demonstrates the dosage of man with halogenated hydrocarbons via environmental media such as air, water and food. The second demonstrates the degree of body-burden in man via examination of urine, blood, breath and tissue for these compounds. The last phase of the program attempts to demonstrate an associational relationship (i.e., response) between body-burden and the incidence of cancer.

CONCEPTUAL MODEL

There are essentially three basic elements which must be present in developing this hypothesis: (1) a source of emissions or effluents; (2) a pathway by which a population might be exposed; and (3) a plausible etiological relationship between emissions or effluent and the incidence of disease. These essential ingredients have been incorporated into the model depicted in Figure 4-1.

Beginning with the first level, it is advantageous to have detailed data on specific halogenated hydrocarbons which are emitted from industrial plants and processes. In order to insure that a complete and valid picture

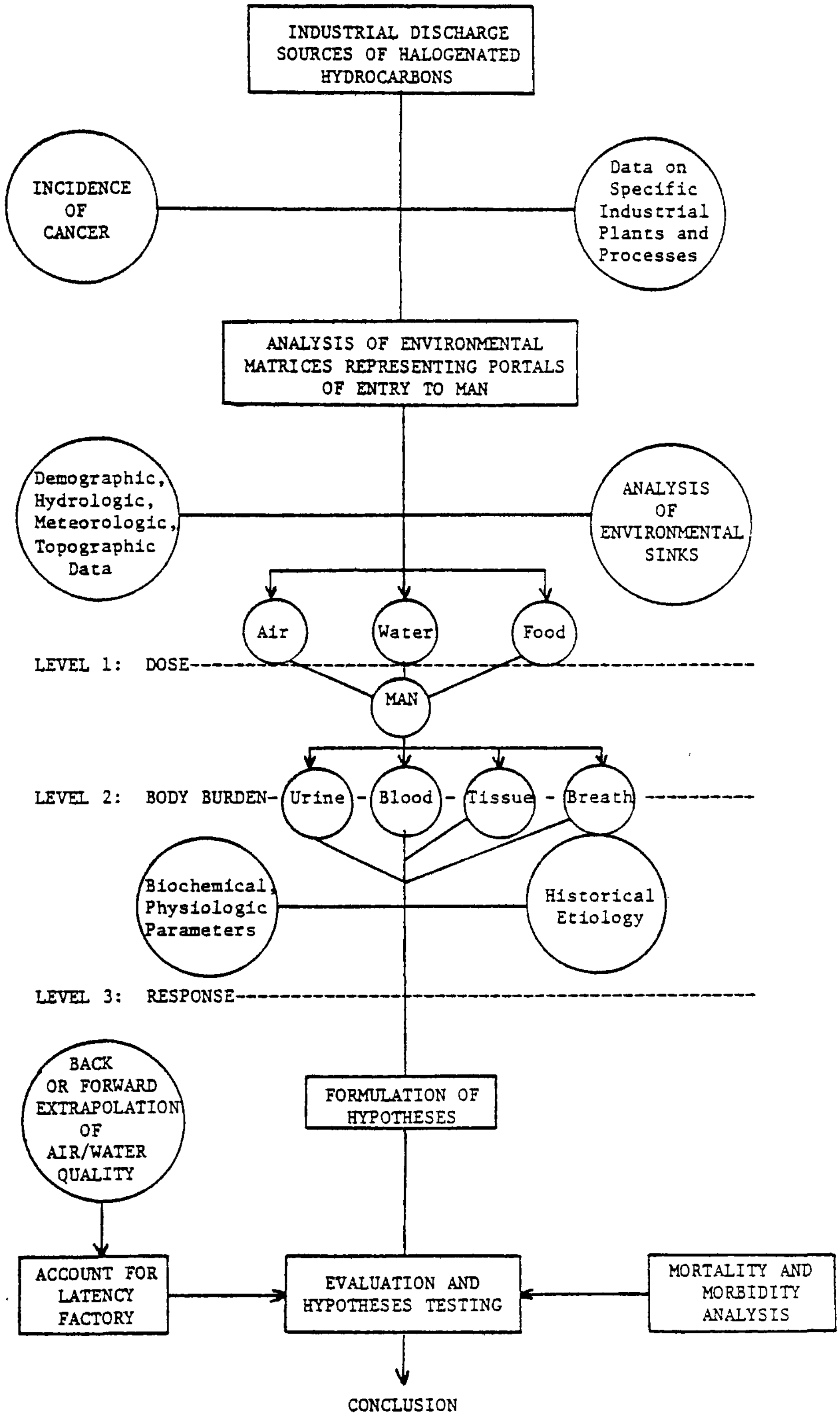

Figure 4-1. Schematic flow diagram demonstrating interlocking relationships between environment, man and association with incidence of cancer.

has been described, this information must be fortified with environmental sampling and analysis. To successfully and representatively analyze environmental matrices which represent portals of entry to man, the hydrologic, meteorologic and topographic characteristics in the geographical area selected for study must be understood. Such information is the basis for a rational sampling regime for the collection and analysis of environmental samples. Environmental sinks need also to be analyzed and the acquisition of data on the types and concentrations of halogenated hydrocarbons which are found in air, water and food helps to establish man's potential dosage. Depicted in Figure 4-2 is a more detailed pertinent relationship between discharge sources, environmental media and man.

To establish a dose (Level 1), body-burden (Level 2) and relationship, it is necessary to acquire appropriate demographic data and to design a human sampling regime which adequately represents the sampled population. For the purpose of developing statistical cell models, detailed demographic data must be obtained concerning each blood and urine sample. To ensure that the proper halogenated hydrocarbons have been selected for study in the blood and urine samples, the biomedical and physiological parameters and information on their historical etiology must be known. Information on the mutagenic and carcinogenic effects of the individual halogenated hydrocarbons should be known in order to assist the selection of a representative number of substances for monitoring and statistical correlation.

Subsequent to the generation of information and completion of the first two levels of the overall program, the final phase will involve the formulation of various hypotheses or models which can then be evaluated and tested. Information on mortality and morbidity as well as regression analysis to account for latency factors can possibly be incorporated into the hypotheses. Whether or not an associational relationship can be ascertained between the halogenated hydrocarbons in the environment, man's exposure to these compounds and the incidence of cancer will depend upon the validity of the model.

A number of important ingredients are envisioned for the successful development and testing of the conceptual model. These are as follows: (1) there exists a statistically significant excess of cancer mortality or

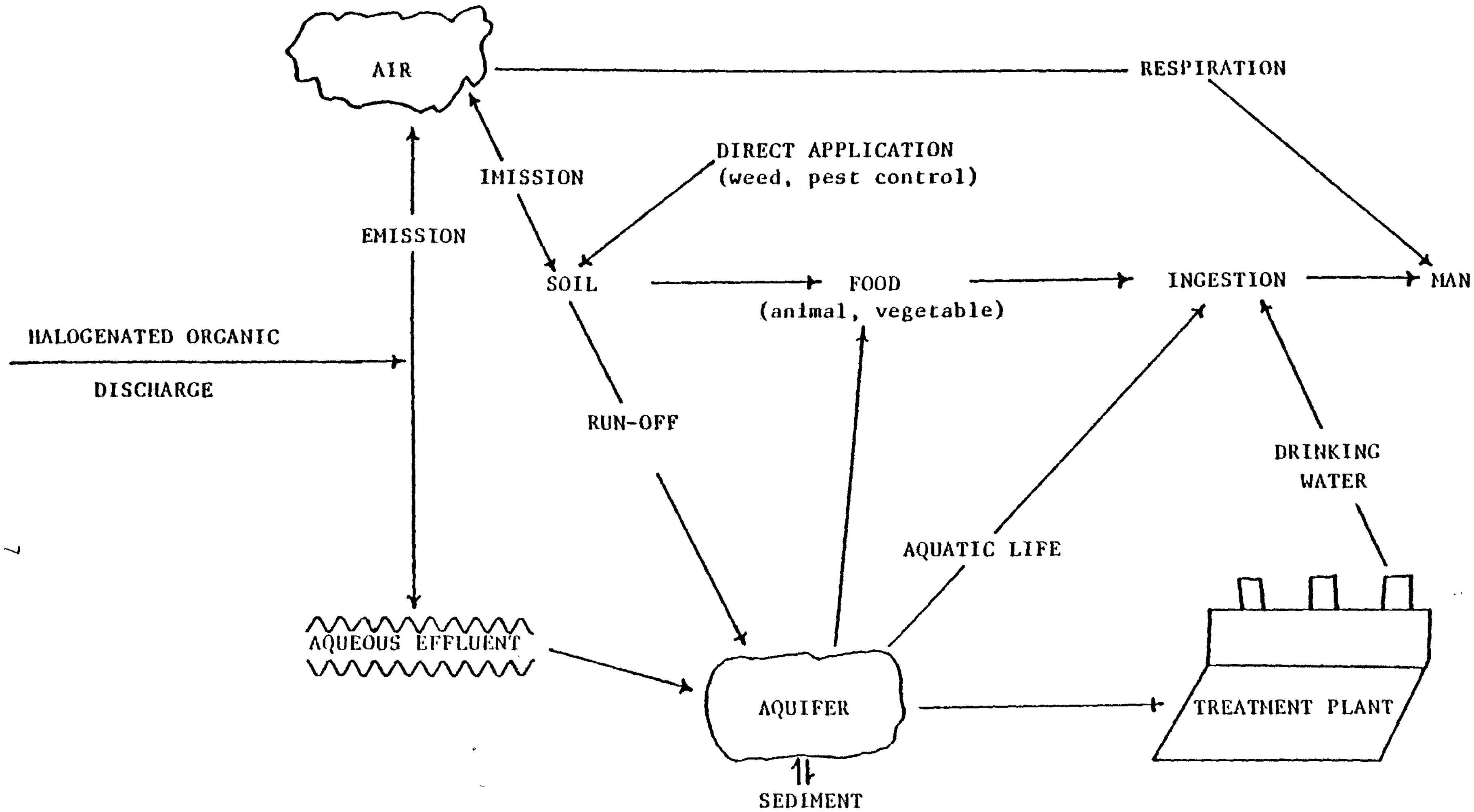

Figure 4-2. Pertinent relationships between discharge sources, environmental media and man.

morbidity in the areas studied as compared to matched controlled areas; (2) medical evidence which documents that the pollutant is capable of causing disease (etiology analysis) can be found; (3) actual measurements which document excessive levels of halogenated hydrocarbons in the area of interest (air, water, and food) can be performed; (4) specific industrial process data which document the industrial activity in a particular geographical area which is acutally producing or has produced the halogenated hydrocarbons can be located; (5) a means by which the pollutant is released from the industry and transported to the population exists; (6) the presence of halogenated substances in human biological fluid and tissue can be demonstrated; and (7) production records which support the contention that the industry was actually involved in the production of halogenated hydrocarbons during the past 10-15 years can be found.

SECTION 5

INCIDENCE OF CANCER IN THE STUDY AREAS

One of the objectives of this study is to compare the environmental levels and body-burden of halogenated organics with cancer mortality rates in the study areas. To this end, the cancer mortality statistics for the United States and the counties comprising the study areas have been compiled (5-1), as shown in Tables 5-1 - 5-6. For the study areas comprising more than one county, an average was calculated for each cancer type. The total deaths in each county were summed to give the total deaths in an area. The death rate for the area was calculated by taking a weighted average of the death rates for each county. The relative rate was calculated in the same manner as for the individual counties: a simple ratio of the county death rate *vs*. the national death rate.

Several of the study areas exhibit high cancer incidence relative to the national averages. Bladder cancer and, to a lesser extent, lung cancer are above average in the Baton Rouge area. All cancers listed, except testicular, are above average in the New Jersey study area. The cancer incidence in this area has been partially linked to the chemical and allied industries located there (5-2).

In the Buffalo-Niagara study area, all cancers except prostate are above the national average. In Greensboro (the control area) only prostate cancer is above the national average. Houston has high rate of malignant neoplasm, especially of the liver, lung and bladder.

The above discussion is intended only as a comparison of the data in Tables 5-1 - 5-6. In no way should it be construed at this point as an association of halogenated organic production and/or pollution with cancer.

Caution must be exercised in use of these data. Very high or very low relative death rates may result when only a few deaths have occurred, without being significant (for example, 3 deaths yielding a death rate of 2.2).

Table 5-1. US AVERAGE CANCER MORTALITY

State and County Code (City)	Cancer Type[a]	Race	Male: Total Deaths Per 20 Years	Male: Death Rate[b]	Male: Relative Rate[c]	Female: Total Death Per 20 Years	Female: Death Rate[b]	Female: Relative Rate[c]
United States	1	White	76,070	5.16	1.00	94,229	5.34	1.00
		Nonwhite	10,021	6.91	1.00	7,261	4.59	1.00
	2	White	571,226	37.98	1.00	108,326	6.29	1.00
		Nonwhite	53,910	36.67	1.00	10,222	6.27	1.00
	3	White	252,763	17.84	1.00	-	-	-
		Nonwhite	35,397	27.39	1.00	-	-	-
	4	White	12,918	.83	1.00	-	-	-
		Nonwhite	504	.30	1.00	-	-	-
	5	White	57,780	3.86	1.00	34,204	1.99	1.00
		Nonwhite	4,072	2.67	1.00	2,429	1.42	1.00
	6	White	98,304	6.78	1.00	43,095	2.39	1.00
		Nonwhite	7,001	5.05	1.00	4,758	3.05	1.00
	All	White	2,572,035	174.04	1.00	2,258,282	130.10	1.00
		Nonwhite	264,108	184.28	1.00	228,561	139.80	1.00

[a] Source: US Cancer Mortality by County 1950-1969, DHEW (NIH) 74-615. Code for Cancer Types: 1 = liver; 2 = trachea, lung, bronchi, etc.; 3 = prostate; 4 = testis; 5 = kidney; 6 = bladder and other urinary organs; All = all malignant neoplasms.

[b] Death rate is the average annual age-adjusted mortality rate per 100,000 calculated for the 20-year period.

[c] Relative Rate is the County death rate divided by the national death rate for a cancer site.

Table 5-2. CANCER MORTALITY FOR BATON ROUGE STUDY AREA

State and County Code (City)	Cancer Type[a]	Race	Sex: Male Total Deaths Per 20 Years	Male Death Rate[b]	Male Relative Rate[c]	Female Total Deaths Per 20 Years	Female Death Rate[b]	Female Relative Rate[c]
22033 E. Baton Rouge, LA	1	White	41	4.9	0.91	39	3.7	0.69
		Nonwhite	22	5.0	0.72	28	5.1	1.11
	2	White	399	44.5	1.17	71	6.3	1.00
		Nonwhite	123	27.3	0.74	29	5.3	0.84
	3	White	106	16.6	0.93	–	–	–
		Nonwhite	106	25.0	0.91	–	–	–
	4	White	11	8.7	0.84	–	–	–
		Nonwhite	2	0.2	0.67	–	–	–
	5	White	29	2.8	0.72	33	3.0	1.51
		Nonwhite	12	2.7	1.01	9	1.5	1.06
	6	White	59	8.0	1.18	24	2.4	1.00
		Nonwhite	35	8.0	1.58	14	2.6	0.85
	All	White	1,509	176.1	1.01	1,300	114.8	0.88
		Nonwhite	790	176.2	0.96	727	130.6	0.93
22047 Iberville, LA	1	White	4	2.7	0.52	3	2.1	0.39
		Nonwhite	16	14.1	2.04	3	2.1	0.46

(continued)

Table 5-2 (cont'd.)

State and County Code (City)	Cancer[a] Type	Race	Sex: Male Total Deaths Per 20 Years	Male Death[b] Rate	Male Relative[c] Rate	Female Total Deaths Per 20 Years	Female Death[b] Rate	Female Relative[c] Rate
Iberville, LA (cont'd.)	2	White	61	46.0	1.21	8	5.7	0.91
		Nonwhite	48	40.1	1.09	8	5.4	0.86
	3	White	21	16.7	0.94	-	-	-
		Nonwhite	35	27.8	1.01	-	-	-
	4	White	2	1.3	1.56	-	-	-
		Nonwhite	0	0	0	-	-	-
	5	White	1	0.9	0.23	1	0.7	0.35
		Nonwhite	3	2.5	0.94	1	0.8	0.56
	6	White	15	11.9	1.76	3	1.9	0.79
		Nonwhite	7	5.7	1.13	10	7.0	2.30
	All	White	230	173.7	1.00	146	102.5	0.79
		Nonwhite	227	189.6	1.03	156	113.1	0.81
22121 W. Baton Rouge, LA	1	White	6	11.2	2.17	2	3.9	0.73
		Nonwhite	4	6.9	1.00	2	3.2	0.70
	2	White	29	54.3	1.43	3	5.7	0.91
		Nonwhite	27	49.2	1.34	6	10.0	1.59
	3	White	3	6.2	0.35	-	-	-
		Nonwhite	13	19.9	0.73	-	-	-

(continued)

Table 5-2 (cont'd.)

State and County Code (City)	Cancer[a] Type	Race	Male: Total Deaths Per 20 Years	Male: Death[b] Rate	Male: Relative[c] Rate	Female: Total Deaths Per 20 Years	Female: Death[b] Rate	Female: Relative[c] Rate
W. Baton Rouge, (cont'd.)	4	White	1	1.3	1.57	–	–	–
		Nonwhite	0	0	0	–	–	–
	5	White	3	5.6	1.45	1	1.8	0.90
		Nonwhite	2	2.9	1.05	0	0	0
	6	White	3	6.3	0.93	3	5.8	2.43
		Nonwhite	3	5.0	0.99	3	4.5	1.48
	All	White	101	191.1	1.10	67	119.0	0.91
		Nonwhite	93	159.3	0.86	89	151.7	1.09
Baton Rouge Area Average (Iberville, W. Baton Rouge, and E. Baton Rouge Parishes)	1	White	51	4.9	0.95	44	3.5	0.66
		Nonwhite	42	6.9	1.11	33	4.3	0.95
	2	White	489	45.2	1.19	82	6.2	0.99
		Nonwhite	198	31.7	0.86	43	5.7	0.91
	3	White	130	16.0	0.90	–	–	–
		Nonwhite	154	25.0	0.91	–	–	–
	4	White	14	0.8	0.93	–	–	–
		Nonwhite	2	0.2	0.67	–	–	–
	5	White	33	2.8	0.71	35	2.7	1.35
		Nonwhite	17	2.7	1.01	10	1.4	0.97

(continued)

Table 5-2 (cont'd.)

State and County Code (City)	Cancer Type[a]	Race	Sex					
			Male			Female		
			Total Deaths Per 20 Years	Death Rate[b]	Relative Rate[c]	Total Deaths Per 20 Years	Death Rate[b]	Relative Rate[c]
Baton Rouge Area Average (cont'd.)	6	White	77	8.5	1.25	30	2.5	1.04
		Nonwhite	45	7.3	1.44	27	3.6	1.18
	All	White	1,840	177.0	1.02	1,513	113.7	0.87
		Nonwhite	1,110	177.2	0.96	927	129.0	0.92

[a]Source: US Cancer Mortality by County 1950-1969, DHEW (NIH) 74-615. Code for Cancer Types: 1 = liver; 2 = trachea, lung, bronchi, etc.; 3 = prostate; 4 = testis; 5 = kidney; 6 = bladder and other urinary organs; All = all malignant neoplasms.

[b]Death Rate is the average annual-adjusted mortality rate per 100,000 calculated for the 20-year period. For average of several counties, the sum of the total deaths divided by death rate for each county was divided by the sum of the total deaths for all counties.

[c]Relative Rate is the County death rate divided by the national death rate for a cancer site.

Table 5-3. CANCER MORTALITY FOR NORTHEAST NEW JERSEY STUDY AREA 1950-1969

State and County Code (City)	Cancer Type[a]	Race	Male: Total Deaths Per 20 Years	Male: Death Rate[b]	Male: Relative Rate[c]	Female: Total Deaths Per 20 Years	Female: Death Rate[b]	Female: Relative Rate[c]
34003 Bergen, NJ (Rutherford)	1	White	365	5.8	1.12	438	5.5	1.03
		Nonwhite	14	9.8	1.42	11	6.8	1.48
	2	White	3,090	46.4	1.22	570	7.0	1.11
		Nonwhite	92	67.3	1.84	20	10.7	1.71
	3	White	1,026	18.6	1.04	–	–	–
		Nonwhite	11	29.6	1.08	–	–	–
	4	White	56	0.8	0.96	–	–	–
		Nonwhite	1	0.5	1.67	–	–	–
	5	White	307	4.6	1.19	197	2.5	1.26
		Nonwhite	1	0.5	0.19	0	0	0
	6	White	531	8.9	1.31	246	3.1	1.30
		Nonwhite	8	6.7	1.33	3	2.0	0.65
	All	White	12,863	202.1	1.16	11,894	148.1	1.14
		Nonwhite	373	281.4	1.53	344	192.2	1.37
34013 Essex, NJ (Newark)	1	White	536	6.7	1.30	551	5.4	1.01
		Nonwhite	69	6.4	0.93	48	3.9	0.86

(continued)

Table 5-3 (cont'd.)

State and County Code (City)	Cancer Type[a]	Race	Sex: Male, Total Deaths Per 20 Years	Male, Death Rate[b]	Male, Relative Rate[c]	Female, Total Deaths Per 20 Years	Female, Death Rate[b]	Female, Relative Rate[c]
Essex, NJ (cont'd.)	2	White	3,697	44.7	1.18	712	7.2	1.14
		Nonwhite	547	48.1	1.31	107	7.6	1.21
	3	White	1,381	19.0	1.07	–	–	–
		Nonwhite	229	27.5	1.00	–	–	–
	4	White	69	0.9	1.08	–	–	–
		Nonwhite	7	0.6	2.00	–	–	–
	5	White	366	4.5	1.17	204	2.1	1.06
		Nonwhite	33	2.9	1.09	30	1.9	1.34
	6	White	829	10.9	1.61	272	2.6	1.09
		Nonwhite	57	5.6	1.11	50	4.3	1.41
	All	White	16,975	215.1	1.24	15,258	154.5	1.19
		Nonwhite	2,385	219.2	1.19	2,155	154.6	1.11
34023 Middlesex, NJ (Edison, Fords)	1	White	199	6.8	1.32	224	6.6	1.24
		Nonwhite	4	3.3	0.48	8	8.7	1.90
	2	White	1,665	54.5	1.43	230	6.6	1.05
		Nonwhite	76	70.7	1.93	11	10.7	1.71
	3	White	455	17.9	1.00	–	–	–
		Nonwhite	27	33.9	1.24	–	–	–

(continued)

Table 5-3 (cont'd.)

State and County Code (City)	Cancer Type[a]	Race	Sex					
			Male			Female		
			Total Deaths Per 20 Years	Death Rate[b]	Relative Rate[c]	Total Deaths Per 20 Years	Death Rate[b]	Relative Rate[c]
Middlesex, NJ (cont'd.)	4	White	24	0.6	0.72	–	–	–
		Nonwhite	1	1.0	3.33	–	–	–
	5	White	149	4.7	1.22	83	2.4	1.21
		Nonwhite	4	4.0	0.15	1	0.9	0.63
	6	White	230	8.4	1.24	92	2.8	1.17
		Nonwhite	10	11.5	2.28	1	1.2	0.39
	All	White	6,556	220.8	1.27	5,251	149.2	1.15
		Nonwhite	282	279.0	1.51	223	208.2	1.49
34031 Passaic, NJ (Clifton, Rutherford)	1	White	227	5.9	1.41	253	5.6	1.05
		Nonwhite	9	7.0	1.01	8	6.2	1.35
	2	White	1,835	46.3	1.22	327	7.2	1.14
		Nonwhite	103	79.2	2.16	15	7.8	1.24
	3	White	591	16.6	0.93	–	–	–
		Nonwhite	36	36.4	1.33	–	–	–
	4	White	35	0.9	1.08	–	–	–
		Nonwhite	2	1.1	3.67	–	–	–
	5	White	178	4.6	1.19	125	2.8	1.41
		Nonwhite	7	4.5	1.69	6	4.3	3.03

(continued)

Table 5-3 (cont'd.)

State and County Code (City)	Cancer[a] Type	Race	Male: Total Deaths Per 20 Years	Male: Death[b] Rate	Male: Relative[c] Rate	Female: Total Deaths Per 20 Years	Female: Death[b] Rate	Female: Relative[c] Rate
34039 Union, NJ (Elizabeth)	1	White	235	5.8	1.12	295	5.8	1.09
		Nonwhite	16	6.1	0.88	23	7.0	1.53
	2	White	1,811	42.0	1.11	354	6.9	1.10
		Nonwhite	123	48.8	1.33	29	10.1	1.61
	3	White	682	19.3	1.08	-	-	-
		Nonwhite	76	39.0	1.42	-	-	-
	4	White	38	0.8	0.96	-	-	-
		Nonwhite	3	0.7	2.33	-	-	-
	5	White	218	5.2	1.35	114	2.3	1.16
		Nonwhite	15	5.3	1.97	9	2.7	1.90
	6	White	369	9.9	1.46	141	2.8	1.17
		Nonwhite	10	4.7	0.93	15	4.8	1.57
	All	White	8,311	203.4	1.17	7,757	151.6	1.17
		Nonwhite	620	252.2	1.37	534	166.3	1.19
NE New Jersey Average (Bergen, Essex, Middlesex, Passaic, Somerset and Union Counties)	1	White	1,616	6.1	1.19	1,821	5.6	1.05
		Nonwhite	112	6.5	0.94	106	5.4	1.17
	2	White	12,634	46.0	1.21	2,306	7.1	1.12
		Nonwhite	960	53.5	1.46	184	8.4	1.33

(continued)

Table 5-3 (cont'd.)

State and County Code (City)	Cancer Type[a]	Race	Sex: Male			Female		
			Total Deaths Per 20 Years	Death Rate[b]	Relative Rate[c]	Total Deaths Per 20 Years	Death Rate[b]	Relative Rate[c]
Passaic, NJ (cont'd.)	6	White	331	9.0	1.33	121	2.7	1.13
		Nonwhite	9	9.7	1.92	9	6.2	2.03
	All	White	7,981	209.5	1.20	6,631	141.8	1.14
		Nonwhite	355	271.5	1.47	302	182.7	1.31
34035 Somerset, NJ (Bound Brook)	1	White	54	4.5	0.87	60	4.7	0.88
		Nonwhite	0	0	0	5	18.6	4.05
	2	White	536	44.2	1.16	113	8.6	1.37
		Nonwhite	19	63.7	1.74	2	8.8	1.40
	3	White	160	15.7	0.88	-	-	-
		Nonwhite	8	30.0	1.10	-	-	-
	4	White	11	0.8	0.96	-	-	-
		Nonwhite	0	0	0	-	-	-
	5	White	53	4.3	1.11	31	2.4	1.21
		Nonwhite	1	1.6	0.60	0	0	0
	6	White	84	7.9	1.17	41	3.0	1.26
		Nonwhite	2	5.6	1.11	0	0	0
	All	White	2,151	182.8	1.05	1,820	135.7	1.04
		Nonwhite	74	226.9	1.23	66	228.5	1.63

(continued)

Table 5-3 (cont'd.)

State and County Code (City)	Cancer Type[a]	Race	Sex: Male Total Deaths Per 20 Years	Male Death Rate[b]	Male Relative Rate[c]	Female Total Deaths Per 20 Years	Female Death Rate[b]	Female Relative Rate[c]
NE New Jersey Average (cont'd.)	3	White	4,295	18.3	1.03	-	-	-
		Nonwhite	387	30.5	1.11	-	-	-
	4	White	233	0.8	0.98	-	-	-
		Nonwhite	14	0.7	2.25	-	-	-
	5	White	1,271	4.7	1.21	754	2.4	1.19
		Nonwhite	62	3.2	1.20	46	2.1	1.50
	6	White	2,374	9.0	1.33	913	2.8	1.17
		Nonwhite	96	6.1	1.21	78	4.2	1.38
	All	White	54,837	208.5	1.20	48,611	150.2	1.15
		Nonwhite	4,089	236.2	1.28	3,624	165.0	1.18

[a]Source: US Cancer Mortality by County 1950-1969, DHEW (NIH) 74-615. Code for Cancer Types: 1 = liver; 2 = trachea, lung, bronchi, etc.; 3 = prostate; 4 = testis; 5 = kidney; 6 = bladder and other urinary organs; All = all malignant neoplasms.

[b]Death Rate is the average annual age-adjusted mortality rate per 100,000 calculated for the 20-year period. For average of several counties, the sum of the total deaths divided by death rate for each county was divided by the sum of the total deaths for all counties.

[c]Relative Rate is the County death rate by the national death rate for a cancer site.

Table 5-4. CANCER MORTALITY FOR THE BUFFALO-NIAGARA, NY STUDY AREA

State and County Code (City)	Cancer Type[a]	Race	Male: Total Deaths Per 20 Years	Male: Death Rate[b]	Male: Relative Rate[c]	Female: Total Deaths Per 20 Years	Female: Death Rate[b]	Female: Relative Rate[c]
36029 Erie, NY (Buffalo)	1	White	530	5.8	1.12	648	5.9	1.10
		Nonwhite	43	9.6	1.39	17	3.4	0.74
	2	White	4,531	47.8	1.26	631	5.8	0.92
		Nonwhite	300	61.5	1.68	42	8.1	1.29
	3	White	1,491	17.8	1.00	–	–	–
		Nonwhite	3	41.6	1.52	–	–	–
	4	White	99	1.0	1.20	–	–	–
		Nonwhite	1	.1	0.33	–	–	–
	5	White	438	4.6	1.19	239	2.2	1.11
		Nonwhite	21	4.2	1.14	14	2.6	1.83
	6	White	874	9.9	1.46	333	3.0	1.26
		Nonwhite	19	3.9	0.77	23	5.2	1.70
	All	White	18,959	207.0	1.19	15,598	142.3	1.09
		Nonwhite	1,087	237.0	1.29	797	161.2	1.15
36063 Niagara, NY (Niagara Falls)	1	White	105	5.3	1.03	130	5.9	1.10
		Nonwhite	4	8.5	1.23	0	0	0
	2	White	922	45.5	1.20	145	6.6	1.05
		Nonwhite	24	51.3	1.40	1	3.2	0.5

(continued)

Table 5-4 (cont'd.)

State and County Code (City)	Cancer Type[a]	Race	Sex: Male Total Deaths Per 20 Years	Male Death Rate[b]	Male Relative Rate[c]	Female Total Deaths Per 20 Years	Female Death Rate[b]	Female Relative Rate[c]
Niagara, NY (cont'd.)	3	White	282	15.6	0.87	-	-	-
		Nonwhite	9	29.1	1.06	-	-	-
	4	White	24	1.1	1.33	-	-	-
		Nonwhite	0	0	0	-	-	-
	5	White	79	4.0	1.04	43	2.0	1.00
		Nonwhite	1	4.1	1.54	2	1.8	1.27
	6	White	155	8.2	1.21	64	2.9	1.21
		Nonwhite	0	0	0	1	2.4	0.8
	All	White	3,635	184.2	1.06	3,008	135.8	1.04
		Nonwhite	76	182.1	0.99	57	143.5	1.03
Buffalo/Niagara Average (Erie and Niagara Counties)	1	White	635	5.7	1.11	778	5.9	1.10
		Nonwhite	47	9.5	1.37	17	3.4	0.74
	2	White	5,453	47.4	1.25	776	5.9	0.94
		Nonwhite	324	60.6	1.65	43	7.8	1.24
	3	White	1,773	17.4	0.98	-	-	-
		Nonwhite	12	31.5	1.15	-	-	-

(continued)

Table 5-4 (cont'd.)

State and County Code (City)	Cancer Type[a]	Race	Sex: Male Total Deaths Per 20 Years	Male Death Rate[b]	Male Relative Rate[c]	Sex: Female Total Deaths Per 20 Years	Female Death Rate[b]	Female Relative Rate[c]
Buffalo/Niagara Average (cont'd.)	4	White	123	1.0	1.23	-	-	-
		Nonwhite	1	0.1	0.3	-	-	-
	5	White	517	4.5	1.17	282	2.2	1.09
		Nonwhite	22	4.2	1.57	16	2.5	1.73
	6	White	1,029	9.6	1.42	397	3.0	1.25
		Nonwhite	19	3.9	0.77	24	5.0	1.63
	All	White	22,594	203.0	1.17	18,606	141.2	1.08
		Nonwhite	1,163	232.4	1.26	854	159.9	1.14

[a] Source: US Cancer Mortality by County 1950-1969, DHEW (NIH) 74-615. Code for Cancer Types: 1 - liver; 2 = trachea, lung, bronchi, etc.; 3 = prostate; 4 = testis; 5 = kidney; 6 = bladder and other urinary organs; All = all malignant neoplasms.

[b] Death Rate is the average annual age-adjusted mortality rate per 100,000 calculated for the 20-year period. For average of several counties, the sum of the total deaths divided by death rate for each county was divided by the sum of the total deaths for all counties.

[c] Relative Rate is the County death rate by the national death rate for a cancer site.

Table 5-5. CANCER MORTALITY FOR GREENSBORO, NC STUDY AREA

State and County Code (City)	Cancer Type[a]	Race	Male: Total Deaths Per 20 Years	Male: Death Rate[b]	Male: Relative Rate[c]	Female: Total Deaths Per 20 Years	Female: Death Rate[b]	Female: Relative Rate[c]
37081 Guilford, NC (Greensboro)	1	White	11	2.9	0.56	17	3.5	0.66
		Nonwhite	5	2.8	0.41	3	1.3	0.3
	2	White	472	33.6	0.88	93	5.2	0.83
		Nonwhite	118	36.1	0.98	21	5.8	0.93
	3	White	216	19.3	1.08	-	-	-
		Nonwhite	92	36.9	1.35	-	-	-
	4	White	10	.5	0.60	-	-	-
		Nonwhite	0	0	0	-	-	-
	5	White	50	3.4	0.88	35	2.0	1.00
		Nonwhite	9	2.9	1.09	3	.6	0.4
	6	White	48	3.8	0.56	39	2.4	1.00
		Nonwhite	25	9.0	1.78	11	2.8	0.92
	All	White	2,018	148.4	0.85	2,004	113.6	0.87
		Nonwhite	618	202.1	1.10	545	140.3	1.00

[a]Source: US Cancer Mortality by County 1950-1969, DHEW (NIH) 74-615. Code for Cancer Types: 1 = liver; 2 = trachea, lung, bronchi, etc.; 3 = prostate; 4 = testis; 5 = kidney; 6 = bladder and other urinary organs; All = all malignant neoplasms.

[b]Death Rate is the average annual age-adjusted mortality rate per 100,000 calculated for the 20-year period. For average of several counties, the sum of the total deaths divided by death rate for each county was divided by the sum of the total deaths for all counties.

[c]Relative Rate is the Coun...

Table 5-6. CANCER MORTALITY FOR THE HOUSTON, TX STUDY AREA

State and County Code (City)	Cancer Type[a]	Race	Sex: Male — Total Deaths Per 20 Years	Male — Death Rate[b]	Male — Relative Rate[c]	Female — Total Deaths Per 20 Years	Female — Death Rate[b]	Female — Relative Rate[c]
48201								
Harris, TX	1	White	391	6.1	1.18	321	4.3	0.80
(Houston)		Nonwhite	160	10.0	1.45	94	5.4	1.18
	2	White	3,684	53.5	1.41	713	8.8	1.40
		Nonwhite	726	44.4	1.21	123	7.0	1.12
	3	White	939	18.9	1.06	–	–	–
		Nonwhite	388	30.1	1.10	–	–	–
	4	White	78	0.8	0.96	–	–	–
		Nonwhite	3	0.2	0.7	–	–	–
	5	White	255	3.7	0.96	165	2.1	1.06
		Nonwhite	64	3.6	1.35	28	1.4	0.99
	6	White	408	7.4	1.09	169	2.3	0.90
		Nonwhite	109	7.4	1.47	53	3.1	1.02
	All	White	12,286	188.5	1.08	10,014	124.2	0.95
		Nonwhite	3,183	203.8	1.11	2,553	139.5	1.00

[a]Source: US Cancer Mortality by County 1950-1969, DHEW (NIH) 74-615. Code for Cancer Types: 1 = liver; 2 = trachea, lung, bronchi, etc.; 3 = prostate; 4 = testis; 5 = kidney; 6 = bladder and other urinary organs; All = all malignant neoplasms.

[b]Death Rate is the average annual age-adjusted morality rate per 100,000 calculated for the 20-year period. For average of several counties, the sum of the total deaths divided by death rate for each county was divided by the sum of the total deaths for all counties.

[c]Relative Rate is the County death rate by the national death rate for a cancer site.

Similarly, for counties and cancers in which several thousand deaths were reported, a small deviation from 100 may be significant. The significance of the data (and therefore the applicability to this project) will be calculated during the data analysis phase.

SECTION 6

POTENTIAL SOURCES OF HALOGENATED HYDROCARBONS

In order to plan the sampling strategy, it is important to know as much as possible about the potential sources of halogenated compounds. To this end, all available resources have been used to obtain data on halogenated organic compound manufacturers, users, and disposal facilities. As discussed below, the information is far from comprehensive. Realizing the limitations of the data, RTI feels it can make an intelligent selection of sampling sites with the data now in hand concerning the potential sources of halogenated hydrocarbons.

MANUFACTURING LOCATIONS

The known halogenated hydrocarbon manufacturing locations are listed in Tables 6-1 - 6-4. No halogenated hydrocarbon manufacturing locations have been found in Greensboro, NC. In addition to the sources of data listed in the footnotes to the tables, data obtained in previous contracts, contacts with EPA, state, and local officials, and chamber of commerce literature have been used to augment and verify the data.

NEW JERSEY AIR EMISSIONS DATA

Airborne plant emission data were obtained from Dr. Jehuda Menczel, Air Facilities Branch, EPA, Region II, New York, for several plants in New Jersey which represent potential study sites. The raw data were evaluated and summarized by RTI:

Pentasote (Passaic) manufactures polyvinyl chloride and was reported to emit 500 tons/year VCM (11/78 = 50 T/yr).

Givaudan (Clifton) had only ethylene dichloride ($\sim$1.2 T/yr) as a significant emission, so it probably does not represent a good study site.

Tenneco (Fords) reportedly emits chlorotoluene, dibromopropanol, and dibromopropylphosphate. Since this is a batch operation, deciphering the emission rates was not possible.

Table 6-1. HALOGENATED HYDROCARBON MANUFACTURING LOCATIONS IDENTIFIED FOR POPULATION DENSITY MAPPING -- NORTHERN NEW JERSEY AREA

Company[a]	Municipality[a]	Compounds Manufactured[a]	Location[b]	Population Map Obtained	Population Radius
Tenneco Chem. Co.	Fords	toxaphene fenac 2,3,6-trichlorobenzoic acid and salts o-chlorotoluene benzyl chloride	40.5166°N, 74.3223°W (40°31'00", 74°19 20")		5
Stauffer	Edison	o-chlorotoluene benzyl chloride	40.4905°N, 74.3873°W (40°29'26", 74°23'14")		5
DuPont	Linden (Tremley Pt.)	methoxychlor chloroneb	40.5959°N, 74.2042°W		5
GAF	Linden	2,4,5-T	40.6137°N, 74.2139°W	X	5
IMC Chem. Co. (Defunct)[c]	Newark	propanil			
Prentiss Drug and Chem. Co.	Newark	lindane methoxychlor chlordane	40.7816°N, 74.1446°W	X	5
Troy Chem. Co.	Newark	chloromethoxypropylmercuric acid	40.7186°N, 74.1440°W	X	5
Standard Chlorine Chem. Co.	Kearney	dichlorobenzene trichlorobenzene	40.7506°N, 74.1068°W	X	5
UOP, Inc.	E. Rutherford	chloro-(p-chlorophenyl)phenylmethane (o-chlorophenyl)acetonitrile chlorodiphenylmethane α-chlorotoluene cinnamoyl chloride propionyl chloride trimedlure o-chlorotoluene (user) benzyl chloride (user)	40.8302°N, 74.0887°W (40°49'49", 74°05'19")	X	5

(continued)

Table 6-1 (cont'd.)

Company[a]	Municipality[a]	Compounds Manufactured[a]	Location[b]	Population Map Obtained	Population Radius
American Cyanamid	Bound Brook	chloroform (user) ethylene dichloride (user) chlorobenzene (user) trichlorobenzene (user)	40.5576°N, 74.5538°W (40°33'27"N, 74°33'14"W)		
Merck	Rahway	chloroform (user) methylene chloride (user)	40.6119°N, 74.2719°W (40°36'43"N, 74°16'19"W)		5
White Chem. Co.	Bayonne	62 HHC's listed including: acid chlorides alkyl chlorides alkyl bromides and fire retardants	40.6520°N, 74.1125°W	X	5
W. A. Cleary Corp.	Somerset	MCPP (mecroprop)			
Givaudan	Clifton	hexachlorophene	40.8312°N, 74.1297°W	X	5
Cosan Chem. Co.	Clifton	"halogenated organics"	40.8322°N, 74.1053°W		5
Blue Spruce Co.	Bound Brook	propanil 3,4-dichloroaniline 1,2-dichloro-4-nitrobenzene			
Hercules, Inc.	Parlin	chlorinated paraffins			
ICI United States, Inc.	Bayonne	chlorinated paraffins			
Chevron	S. Plainfield	naled			
KinBuc Dump (closed)	Edison		40.4958°N, 74.3834°W		

(continued)

Table 6-1 (cont'd.)

Company[a]	Municipality[a]	Compounds Manufactured[a]	Location[b]	Population Map Obtained	Population Radius
Halocarbon Products Corp.	Hackensack	bromotrifluoroethylene chlorodifluoroacetic acid chlorotrifluoroethylene tetrachlorohexafluorobutane trichloroheptafluorobutane trifluoroacetic acid trifluoroacetic anhydride trifluoroethanol trifluoropropane trifluoropropene			

[a]Sources of data include: 1. 1977 Directory of Chemical Producers - USA, Chemical Information Services, Stanford Research Institute, Menlo Park, CA 94025.
2. Personal communication, D. K. Oestreich, EPA, IERL, RTP, NC 27711.

[b]Locations obtained from plant sites on USGS 7 1/2 minute quadrange maps. Plants located through prior RTI experience or contacts with local officials.

[c]Source: A. Thornton, NJ Board of Air Pollution.

Table 6-2. HALOGENATED HYDROCARBON MANUFACTURING LOCATIONS IDENTIFIED FOR POPULATION DENSITY MAPPING -- BATON ROUGE AREA

Company[a]	Municipality[a]	Compounds Manufactured[a]	Location	Population Map Obtained	Population Radius
Ciba-Geigy	St. Gabriel	hexachlorobutadiene[c] chlorodimeform atrazine simazine	30.440°N, 91.0968°W	X	10
Ethyl	Baton Rouge	trichloroethylene (50) 1,1,1-trichloroethane (40) 1,2-dichloroethane (330) tetrachloroethylene (50) vinyl chloride (330)	30.4968°N, 91.1814°W (30°29'48", 91°19'53")	X	5
Allied, North	Baton Rouge	1,2-dichloroethane (300)	30.4954°N, 91.1881°W	X	5
Allied, South	Baton Rouge	vinyl chloride (300)	39.4742°N, 91.1870°W (30°28'27", 91°11'13")	X	5
Hercules	Plaquemine	dialifor	30.2679°N, 90.5315°W	X	10
Dow	Plaquemine	1,2-dichloroethane (450) tetrachloroethylene (150) vinylidine chloride vinyl chloride (450) 1,2,3-trichloropropene 1,2-dichloropropane methylene chloride	30.3179°N, 91.2324°W	X	10

[a]Sources of data include: 1. 1977 Directory of Chemical Producers - USA, Chemical Information Services, Stanford Research Institute, Menlo Park, CA 94025.
2. Personal communication, D. K. Oestreich, EPA, IERL, RTP, NC 27711.

[b]Locations obtained from plant sites on USGS 7 1/2 minute quadrange maps. Plants located through prior RTI experience or contacts with local officials.

[c]Midwest Research Institute, "Sampling and Analysis of Selected Toxic Substances, Task B. Hexachlorobutadiene" EPA 560/6-76-015, June 1976.

Table 6-3. HALOGENATED HYDROCARBON MANUFACTURING LOCATIONS IDENTIFIED FOR POPULATION DENSITY MAPPING -- BUFFALO/NIAGARA AREA

Company[a]	Municipality[a]	Compounds Manufactured[a]	Location[b]	Population Map Obtained	Population Radius
Occidental Petroleum Corp., Hooker Chem. subsid.	Niagara Falls	o-chlorotoluene p-chlorotoluene 1,2,4-trichlorobenzene 1,2,3-trichlorobenzene pentachlorobenzene lindane BHC dienochlor mirex endosulfan glytac (EGT) o-chlorobenzaldehyde p-chlorobenzaldehyde o-chlorobenzoic acid m-chlorobenzoyl chloride o-, m-, p-chloro-α,α,α-trifluoro-toluene 2,4-dichlorobenzotrifluoride 2,4-dichlorobenzotrichloride 2,4-dichlorotoluene hexachlorocyclopentadiene isophthaloyl chloride terephthaloyl chloride α,α,α-trichlorotoluene α,α,α-trifluorotoluene chlorotrifluoroethylene, poly-merized 1,4,5,6,7,7-hexachloro-5-nor-bornene-2,3-dicarboxylic acid	43.0790°N, 79 0106°W	X	3
ICC Industries, Inc. Solvent Chem. Corp., subsid.	Niagara Falls	chlorobenzene o-, m-, p-dichlorobenzene trichlorobenzene	43.0800°N, 79.0232°W	X	3

Table 6-3 (cont'd.)

Company[a]	Municipality[a]	Compounds Manufactured[a]	Location	Population Map Obtained	Population Radius
Goodyear Tire and Rubber Co., Chemicals Div.	Niagara Falls	polyvinyl chloride resins	43.0859°N, 79.0023°W (43°05'09", 79°00'08")		5
Old Love Canal[c]	Niagara Falls	c	43.0776°N, 78.9499°W (43°04'39", 78°57'00")		5
S Area Dump[d]	Niagara Falls	c	43.0762°W, 79.0064°W (43.04'34", 79°00'23")		
102nd St. Dump[d]	Niagara Falls	c	43.0732°N, 78.9481°W (43°04'24", 78°56'53")		
Hyde Park Dump[d]	Niagara Falls	c	43.1323°N, 79.0393°W (43°07'56", 79°02'21")		
Buffalo Color Corp. (formerly Allied Chemical Co.	Buffalo	dyes	42.8699°N, 78.8437°W (42°52'12"N, 78°50'37"W)		3
DuPont, Plastics Products and Resins Department	Buffalo	fluorocarbon resins	42.9642°N, 78.9177°W		5

[a]Sources of data include: 1. 1977 Directory of Chemical Producers - USA, Chemical Information Services, Stanford Research Institute, Menlo Park, CA 94025.
2. Personal communication, D. K. Oestreich, EPA, IERL, RTP, NC 27711.

[b]Locations obtained from plant sites on USGS 7 1/2 minute quadrangle maps. Plants located through prior RTI experience or contacts with local officials.

[c]Industrial Waste Disposal Area.

[d]Source: Assessment of the Extent of Environmental Problems Posed by Hooker Chemical Dumps in Niagara Falls, New York and Estimated Cleanup Costs by F. C. Haut, Assoc., New York, December 11, 1978.

Table 6-4. HALOGENATED HYDROCARBON MANUFACTURING LOCATIONS IDENTIFIED FOR POPULATION DENSITY MAPPING -- HOUSTON AREA

Company[a]	Municipality[a]	Compounds Manufactured[a,b]	Location[c]	Population Map Obtained	Population Radius
Ethyl Corp.	Pasadena	vinyl chloride 1,2-dichloroethane chloroethane	29.7405°N, 95.1694°W	X	5
Shell Chem. Co.	Deer Park	vinyl chloride epichlorohydrin ethylene dichloride 3-chloropropene chloroethane 1,3-dichloropropene 1,2-dichloropropane 1,2,3-trichloropropane	29.7149°N, 95.1235°W (29°42'54", 95°07'25")	X	5
Diamond Shamrock	Deer Park	1,2-dichloroethane trichloroethylene tetrachloroethylene	29.7296°N, 95.1109°W	X	5
Pearsall Chem. Corp.	LaPorte	chlorinated paraffins (20)			
Chemetron	LaPorte	phosgene chloroformate esters			
Mobay Chem. Corp.	Cedar Bayou	phosgene			
Upjohn	LaPorte	phosgene	29.7196°N, 95.0870"W	X	5
Rollins Environ-mental	Deer Park	d	29.7305°N, 95.0952°W	X	5
DuPont	LaPorte	bromacil diuron linuron maneb monuron siduron terbacil neburon	29.7001°N, 95.0366°W	X	5

(continued)

Table 6-4 (cont'd.)

Company[a]	Municipality[a]	Compounds Manufactured[a,b]	Location[c]	Population Map Obtained	Population Radius
Union Carbide	Texas City	1,2-dichloroethane (150) 1,1,2-trichloroethane	29.3722°N, 94.9444°W (29.22'20", 94°51'40")	X	3
Petrotex	Houston	1,4-dichlorobut-2-ene 3,4-dichlorobut-1-ene	29.7010°N, 95.2564°W (29°42'04", 95°15'23")	X	3
Gulf Chemical	Texas City		29.3569°N, 94.9417°W	X	3

[a]Sources of data include: 1. 1977 Directory of Chemical Producers - USA, Chemical Information Services, Stanford Research Institute, Menlo Park, CA 94025.
2. Personal communication, D. K. Oestreich, EPA, IERL, RTP, NC 27711.

[b]Numbers in parenthesis are annual production capacity - millions of pounds.

[c]Locations obtained from plant sites on USGS 7 1/2 minute quadrange maps. Plants located through prior RTI experience or contacts with local officials.

[d]Waste disposal facility.

Hoffman LaRoche (Nutley) uses a large volume of solvents such as methylene chloride and halogenated intermediates. The emissions profile here is similar to that of Merck, so it was not included as a preliminary site.

Merck (Rahway) was reported to have low level emissions of some chlorinated aromatics and other halogenated intermediates. However, two solvents, chloroform (10.7 T/yr) and methylene chloride (742 T/yr), were reported to be emitted in large quantities.

Ciba-Geigy (Summit) reportedly has only very low emissions of some organic intermediates. Thus, it is an unsuitable site.

Toms River Chemical (Toms River) was reported to emit a variety of chlorinated aromatics at low levels as well as epichlorohydrin (5635.36 lb/yr). These emissions are significant, but discussions with Region II personnel indicated that there is no human population near the plant site, so this site does not appear to be suitable for this study.

American Cyanamid (Bound Brook) was reported to emit a variety of halogenated organics, most notably chloroform (35 T/yr), ethylene dichloride (24 T/yr), chlorobenzene (16 T/yr), and trichlorobenzenes (8.4 T/yr). These high levels, coupled with reportedly (Region II personnel) high nearby population, make this a prime candidate as a study site.

Chevron (S. Plainfield) is merely a pesticide formulator. Their emissions are reportedly confined to particulate and petroleum fraction solvents. This site does not appear to be suitable for this study.

OTHER POTENTIAL EMISSION SOURCES

In addition to the manufacturing facilities listed in Tables 6-1 - 6-4 and the other miscellaneous sources discussed above, there are a number of other important sources of halogenated organics. Dry cleaners use halogenated solvents (generally trichloroethylene or 1,1,1-trichloroethane) in their processes and may be suspected of high emissions due to poor controls and practice. This source is especially important in that dry cleaning establishments are often located in or near residential areas. Information about dry cleaning activities in the sampling sites should be collected during field activities. Various industries use halogenated solvents for degreasing metal parts and similar uses. Information on these users and potential emissions does not appear to be available. A wide range of other industries could use (and emit) halogenated solvents, including pharmaceutical formulators, manufacturers of synthetic organic chemicals, cleaning product manufacturers, flavor and fragrance industries, textile processing plants, spice extractors, rubber industry, and polymers. The emissions from these industries, as discussed for some potential New Jersey sampling sites (vida supra), can be significant. However, information on the users and, more importantly, their emissions is lacking.

The population at the study sites is also potentially exposed to a variety of pesticides (herbicides, fungicides, fumigants, insecticides, etc.) applied indoors and outdoors in residences, commercial establishments, and at work. There is no way to anticipate these sources. Potential exposure from these sources may be determined only from the study questionnaire administered during field sampling.

In addition to industrial use, transfer and disposal could potentially emit significant amounts of halogenated organics. The known industrial waste disposal sites have been included in Tables 6-1 - 6-4.

Finally, domestic uses of halogenated organics in cleaning, hobbies, etc., must be recognized. The levels of exposure will be ascertained from the study questionnaire during field sampling.

SECTION 7

MEASUREMENT OF HALOGENATED HYDROCARBONS IN THE ENVIRONMENT

INTRODUCTION

Figure 4-1 presented the general scheme of this research program. In order to determine which halogenated hydrocarbons might contribute to a health impact on the human population, it has been necessary to acquire information concerning the potential sources of halogenated hydrocarbons as well as to provide some measurements of the environment. It is the intent of this section to provide information which has been acquired under this as well as other research programs on measured levels of halogenated hydrocarbons. These data are needed not only to ascertain which halogenated hydrocarbons are most important for study, based on their prevalence and magnitude of occurrence, but to assist in selecting the sites within the five geographical areas for comparison.

The information presented in this section was obtained by consulting the open literature, and by conducting a pilot study. Primary emphasis was given to ambient air and drinking water as part of the environmental samples acquired and analyzed under this program while the levels of halogenated organic compounds found in other environmental media were obtained through consulting previously reported information.

HALOGENATED ORGANICS IN FOOD AND HUMAN TISSUE IN THE UNITED STATES FOOD

Table 7-1 presents the level of halogenated organic compounds which have been found in food in the United States. The predominant halogenated hydrocarbons are DDT, DDE, DDD, and PCB's in fish and shell fish. Average concentrations were 2-400 ppb for DDD, DDE, and DDT. Somewhat lower PCB concentrations have been reported. Many other halogenated hydrocarbons (pesticides) have also been detected in food but only at trace levels. Thus it appears the most important compounds which should be considered for monitoring under phase II might be DDT, DDE, DDD, and PCB's in food.

Table 7-1. LEVELS OF HALOGENATED ORGANIC COMPOUNDS FOUND IN FOOD IN THE UNITED STATES

Chemical	Food Type	Conc. Mean[a] (ppb)	Conc. range[b] (ppb)	Number of Determinations	Location[c]	Reference
DDE	seal fat	105		1	Hooper Bay, AK	7.1
	sea duck meat	4		1	Hooper Bay, AK	7.1
	bivalves	510	410-570	34	N.W. Atlantic	7.2
	crustacea	840	670-920	47	N.W. Atlantic	7.2
	benthic fish	450	270-700	84	N.W. Atlantic	7.2
	pelagic fish	450	290-650	96	N.W. Atlantic	7.2
	sugar beet pulp	<10	N.D.[e]-160	114		7.3
	dairy products	2	T-12	30		7.4
	potatoes	1	T-5	30		7.4
	leafy vegetables	1	T-6	30		7.4
	root vegetables	1	N.D.-14	30		7.4
	garden fruits	T		30		7.4
	oils, fats, shortening	T	T-12	30		7.4
DDD	bivalves	360	280-480	34	N.W. Atlantic	7.2
	crustacea	120	40-330	47	N.W. Atlantic	7.2
	benthic fish	140	50-250	84	N.W. Atlantic	7.2
	pelagic fish	170	110-240	96	N.W. Atlantic	7.2
DDT	seal fat	19		1	Hooper Bay, AK	7.1
	bivalves	130	110-170	34	N.W. Atlantic	7.2
	crustacea	40	N.D.-80	47	N.W. Atlantic	7.2
	benthic fish	410	250-590	84	N.W. Atlantic	7.2
	pelagic fish	380	190-550	96	N.W. Atlantic	7.2
	sugarbeet pulp	<10	N.D.-50	114		7.3
	dairy products	T		30		7.4
	meat, fish, poultry	6	T-15	30		7.4
	potatoes	T	T-15	30		7.4
	leafy vegetables	T		30		7.4
	root vegetables	6		30		7.4
	garden fruits	T		30		7.4
	oils, fats, shortening	T		30		7.4
	sugars and adjuncts	T		30		7.4

(continued)

Table 7-1 (cont'd.)

Chemical	Food Type	Conc. Mean[a] (ppb)	Conc. range[b] (ppb)	Number of Determinations	Location[c]	Reference
PCB's	bivalves	16	2-51	34	N.W. Atlantic	7.2
	crustacea	46	14-70	47	N.W. Atlantic	7.2
	benthic fish	61	6-600	84	N.W. Atlantic	7.2
	pelagic fish	700	46-9700	96	N.W. Atlantic	7.2
	dairy products	T		30		7.4
	meat, fish poultry	T		30		7.4
	potatoes	T		30		7.4
	oils, fats, shortening	T		30		7.4
Toxaphene	sugarbeet pulp	<30	N.D.-340	114		7.3
Perthane	leafy vegetables	44		30		7.4
	fruits	2	13-20	30		7.4
Pentachlorophenol	gelatin	26	N.D.-6.4	4		7.5
	dairy products	T	T-10	30		7.4
	leguminous vegetables	10		30		7.4
	sugars and adjuncts	3	1-20	30		7.4
Dieldrin	sugar beet pulp	<10	N.D.-10	114		7.3
	dairy products	2	T-5	30		7.4
	meat, fish, poultry	4	1-10	30		7.4
	potatoes	1	T-7	30		7.4
	leafy vegetables	T		30		7.4
	leguminous vegetables	T		30		7.4
	garden fruits	3	T-12	30		7.4
	fruits	T		30		7.4
	oils, fats, shortening	T	T-4	30		7.4
	oysters	7		30		7.4
Dicofol	fruits	2	T-44	30		7.4
Endosulfan	potatoes	1	T-15	30		7.4
	leafy vegetables	19	T-439	30		7.4
	garden fruits	T	T-2	30		7.4
	fruits	T	T-7	30		7.4

(continued)

Table 7-1 (cont'd.)

Chemical	Food Type	Conc. Mean[a] (ppb)	Conc. range[b] (ppb)	Number of Determinations	Location[c]	Reference
Lindane	dairy products	T	T-.6	30		7.4
	meat, fish, poultry	T	T-3	30		7.4
	potatoes	1		30		7.4
	garden fruits	6		30		7.4
	sugars and adjuncts	T	T-2	30		7.4
Aldrin	garden fruits	T[d]		30		7.4
Endrin	potatoes	T		30		7.4
	oysters	T			Louisiana	7.6
Heptachlor epoxide	dairy products	T	T-2	30		7.4
	meat, fish, poultry	T	T-2	30		7.4
	potatoes	T		30		7.4
BHC	dairy products	1	T-4	30		7.4
	meat, fish, poultry	T	T-3	30		7.4
	garden fruits	T	1-2	30		7.4
	oils, fats, shortening	T	T-5	30		7.4
	sugars and adjuncts	T	T-5	30		7.4
Chlordane	garden fruits	T		30		7.4
Methoxychlor	dairy products	T	T-2	30		7.4
Pentachloroaniline	oils, fats, shortening	3	3-32	30		7.4
TDE	dairy products	T	T-1	30		7.4
	meat, fish, poultry	2	T-11	30		7.4
	potatoes	T		30		7.4
	leafy vegetables	T		30		7.4
	leguminous vegetables	T		30		7.4
	garden fruits	1	T-9	30		7.4
	oils, fats, shortening	1	T-21	30		7.4
	sugars and adjuncts	T		30		7.4

(continued)

Table 7-1 (cont'd.)

Chemical	Food Type	Conc. Mean[a] (ppb)	Conc. range[b] (ppb)	Number of Determinations	Location[c]	Reference
1,2,4,5-Tetrachloro-3-nitrobenzene	meat, fish, poultry	1.1		30		7.4
	grain and cereal	5		30		7.4
	potatoes	7	32-173	30		7.4
	garden fruits	5		30		7.4
	fruits	1		30		7.4
	oils, fats, shortening	T		30		7.4
Hexachlorobenzene	dairy products	.6		30		7.4
	meat, fish, poultry	1	T-41	30		7.4
	root vegetables	T		30		7.4
	oils, fats, shortening	1	T-6	30		7.4
Phosalone	fruits	T		30		7.4
Polychlorodibenzo-p-dioxin	gelatin	.9	N.D.-30	7		7.5
Ronnel	fruits	T		30		7.4
Strobane	leguminous vegetables	T		30		7.4
Pentachloronitrobenzene	oils, fats, shortening	T	T-2	30		7.4
Octachlorodibenzofuran	gelatin	<.4		1		7.5
Heptachlorodibenzofuran	gelatin	<.4		1		7.5

[a]As presented in primary reference.

[b]Minimum and maximum values reported in primary references.

[c]General U.S. unless otherwise indicated.

[d]Trace concentration.

[e]Not detected.

Emphasis probably should be given to fish and shellfish since they represent potential biomagnification in the food chain.

Serum/Blood

The levels of halogenated organic compounds in human serum, plasma and blood in the United States are given in Table 7-2. Again, as in food, the predominant pesticides observed were p,p'-DDD, o,p'-DDE, p,p'-DDE, DDE, o,p'DDT, p,p'-DDT, and DDT. Furthermore, β-BHC and dieldrin levels were significant. In general, the mean concentrations of pesticides were less than 50 ppb. Also, higher concentrations of the pesticides are found in blood than in plasma and serum.

Milk

A number of determinations on the levels of halogenated organic compounds in human milk have been made and are listed in Table 7-3. The general trends are similar to those observed in human serum. The concentrations of pesticides in milk fat were found to be considerably higher than in milk and often mean concentrations of greater than 100 ppb were observed.

Tissue

Table 7-4 presents the levels of halogenated organic compounds found in human tissue in the United States. Again, pesticides have been studied and the general trend is for higher concentrations to be observed in adipose tissue (fat) as compared to other human tissues. Relatively high concentrations of β-BHC, p,p'-DDE, DDE and p,p'-DDT have been measured. The concentrations in adipose tissue are, in general, an order of magnitude greater than in any case of the other types of human tissue.

Very high concentrations of some pesticides are observed in adipose tissue with levels exceeding 1 ppm. For the observations reported, the DDE levels were the highest reaching 7 ppm (mean concentration) with a range from 440 ppb to 56 ppm.

As in the case of fish and shellfish, bioaccumulation also occurs in human adipose tissue. Thus, fat appears to be the most significant tissue to study in this program since it serves as a sink for halogenated hydrocarbons and possibly represents a means of backward extrapolation of human exposure to halogenated hydrocarbons.

Table 7-2. LEVELS OF HALOGENATED ORGANIC COMPOUNDS IN HUMAN SERUM, PLASMA AND BLOOD IN THE UNITED STATES

Compound	Sample Matrix	Mean (ppb)	Range (ppb)	Number of Determinations	Location	Reference
α-BHC	Serum	<0.1	0-15	1000	ID	7.7, 7.8
β-BHC	Male blood	6.0	1.3-20.3	10	US	7.9
	Female blood	2.2	0.3- 3.5	10	US	7.9
	Serum	0.1	0-15		ID	7.8
	Blood	1.4	S.D.= 0.46	?	FL	7.10
γ-BHC	Male blood	1.5	0.5- 8.0	10	US	7.9
	Female blood	1.4	0.7- 1.0	10	US	7.9
Total BHC	Female plasma	3.4	1.4- 9.6	10	US	7.9
	Female serum	1.6	0-10.2	28	TX	7.7
	Female serum	1.7	0- 2.9	7	Houston, TX	7.7
p,p'-DDD	Male blood	18.9	5.7-44.8	10	US	7.9
	Female blood	7.9	3.2-15.0	10	US	7.9
	Female blood	<0.1	<0.1	10	US	7.9
	Serum	0.2	0-27	1000	ID	7.8
o,p'-DDE	Male blood	2.2	<0.3- 8.5	10	US	7.9
	Female blood	1.0	<0.3- 2.5	10	US	7.9
	Female plasma	<0.1	<0.1	10	US	7.9
p,p'-DDE	Male blood	17.8	6.2-36.7	10	US	7.9
	Female blood	8.8	6.8-10.7	10	US	7.9
	Serum	11	5 -22	38	Hooper Bay, AK	7.8
	Female plasma	13	5 -20.3	10	US	7.9
	Female serum	39.5	6.1-114	28	TX	7.7
	Female serum	40.6	13.2-60.5	7	Houston, TX	7.7
	Serum	17.6	-	970	UT	7.13
	Serum	22	0-383	782	ID	7.8
	Blood	15.7	S.D.= 6.5	?	FL	7.10

(continued)

Table 7-2 (cont'd.)

Compound	Sample Matrix	Mean (ppb)	Range (ppb)	Number of Determinations	Location	Reference
DDE	Blood	29.1	-	37	Tucson, AR	7.14
	Plasma, white children	24.6	-	96	SC	7.15
	Plasma, black children	55.2	-	96	SC	7.15
	Plasma, white adults	28.5	-	-	SC	7.12,7.15
	Plasma, black adults	122	-	-	SC	7.12,7.15
	Serum	15.7	-	-	FL	7.12
	Serum	13	-	-	ID	7.12
	Serum, children	13.4	-	-	UT	7.12
	Serum, adults	20.9	-	-	UT	7.12
	Blood	11.3	2 -54	119	Miami, FL	7.13,7.16
o,p'-DDT	Male blood	8.2	1.4-33.6	10	US	7.9
	Female blood	3.3	1.6- 6.5	10	US	7.9
	Female plasma	0.7	0.1- 1.1	10	US	7.11
p,p'-DDT	Male blood	24.8	6.8-84.4	10	US	7.9
	Female blood	13.1	5.7-19	10	US	7.9
	Female plasma	5.3	2.6- 9.5	10	US	7.11
	Serum	3.8	-	970	UT	7.13
	Serum	4.2	0-42	978	ID	7.8
	Blood	4.18	S.D.- 1.83	?	FL	7.10
DDT	Blood	8.4	-	372	Tucson, AR	7.14
	Serum	<2	<2- 3	378	Hooper Bay, AK	7.12
	Serum, white children	6.6	-	96	SC	7.15
	Serum, black children	18.5	-	96	SC	7.15
	Serum, white adults	11.2	-	-	SC	7.12,7.15
	Serum, black adults	26.3	-	-	SC	7.12,7.15
	Serum	4.2	-	-	FL	7.12
	Serum	3	-	-	ID	7.12
	Serum, children	3.6	-	-	UT	7.12
	Serum, adults	6.6	-	-	UT	7.12
	Blood	<7.0	-	119	Miami, FL	7.13,7.16

(continued)

Table 7-2 (cont'd.)

Compound	Sample Matrix	Mean (ppb)	Range (ppb)	Number of Determinations	Location	Reference
Total DDT equiv.	Female plasma	20.0	6.8-29.5	10	US	7.11
Dieldrin	Male blood	5.5	1.0-12.9	10	US	7.9
	Female blood	1.8	0.6- 4.5	10	US	7.9
	Female plasma	0.3	0.1- 1.2	10	US	7.11
	Female serum	1.2	0- 6.0	28	TX	7.7
	Female serum	1.5	1.3- 6.0	7	Houston, TX	7.7
	Serum	0.9	-	970	UT	7.13
	Serum	0.4	0-25	1000	ID	7.8
	Blood	1.49	S.D.- 1.00	?	FL	7.10
Heptachlor Epoxide	Male blood	2.3	<0.3-12.0	10	US	7.9
	Female blood	2.2	0.5- 5.1	10	US	7.9
	Female plasma	0.6	0.3- 1.0	10	US	7.11
	Serum	<0.1	0- 5	1000	ID	7.8
PCB's	Plasma (refuse workers)	2.6	ND-14.1	37	US	7.10
	Plasma (controls)	3.7	ND-20.2	54	US	7.10

NOTES:

BHC = benzenehexachloride (hexachlorocyclohexane)
DDD = 2,2-bis(chlorophenyl)-1,1-dichloroethane
DDE = 1,1-dichloro-2,2-bis(chlorophenyl)ethylene
DDT = 1,1,1-trichloro-2,2-bis(chlorophenyl)ethane
Total DDT equiv. = Sum of all DDT-related peaks calculated as if all were DDT
PCB's = Polychlorinated biphenyls. Quantitation generally based on comparison to an Aroclor mixture
T = Trace
ND = Not detected
NQ = Not quantitated

Table 7-3. LEVELS OF HALOGENATED ORGANIC COMPOUNDS IN HUMAN MILK IN THE UNITED STATES

Compound	Sample Matrix	Mean (ppb)	Range (ppb)	Number of Determinations	Location	Reference
β-BHC	Milk	0.5	T- 10	57	AR, MS	7.17
	Milk	-	T- 38	40	CO	7.18
γ-BHC	Milk fat	83	30 - 270	53	PA	7.19
Total BHC	Milk	6.5	0.1- 20.2	14+	US	7.11
	Milk	7.7	0- 37.0	28	TX	7.7
	Milk	6.2	3.6- 9.0	7	Houston, TX	7.7
p,p'-DDD	Milk	4.7	<0.1- 14	14+	US	7.11
	Milk fat	10.8	ND- 30	53	PA	7.19
	Milk	-	T- 5	40	CO	7.18
o,p'-DDE	Milk	1.0	<0.1- 2.8	14+	US	7.11
p,p'-DDE	Milk	227	10 -1720	57	AR, MS	7.17
	Milk	29	5.2- 981	14+	US	7.11
	Milk	84.1	13.4- 236	28	TX	7.11
	Milk	92.4	16.7- 138	7	Houston, TX	7.7
	Milk fat	1766	790 -4350	53	PA	7.19
	Milk	-	79 - 336	40	CO	7.18
DDE	Milk	194	74 - 314	30+	AZ	7.20
	Milk	60	20 - 90	4	Chicago, IL	7.21
	Milk	30	<10 - 140	5	WA	7.21
	Milk	30	-	1	Phoenix, AZ	7.21
	Milk	100	70 - 120	**	US	7.21

(continued)

Table 7-3 (cont'd.)

Compound	Sample Matrix	Mean (ppb)	Range (ppb)	Number of Determinations	Location	Reference
o,p'-DDT	Milk	92	10 - 840	57	AR, MS	7.17
	Milk	25	0.1- 10.8	14^+	US	7.11
	Milk	10	5 - 36	30^+	AZ	7.20
	Milk	-	T - 13	40	CO	7.18
p,p'-DDT	Milk	29	7.8- 89	14^+	US	7.11
	Milk	114	9 - 383	30^+	AZ	7.20
	Milk fat	513	90 -2120	53	PA	7.19
	Milk	-	7 - 109	40	CO	7.18
DDT	Milk	100	80 - 130	4	Chicago, IL	7.21
	Milk	60	<10 - 220	5	WA	7.21
	Milk	60	-	1	Phoenix, AZ	7.21
	Milk	70	50 - 90	**	US	7.18
	Milk	-	10 - 110	40	CO	7.22
	Milk	130	0- 770	32	DC	
						7.17
Total DDT equiv.	Milk	334	20 -2760	57	AR, MS	7.11
	Milk	70.5	40.4- 156	14^+	US	7.23
	Milk	100	S.D.- 100	14	Long Island, NY	7.23
	Milk	170	S.D.- 130	20	Rochester, NY	7.23
	Milk	180	S.D.- 100	19	Chicago, IL	7.23
	Milk	220	S.D.- 170	27	Lexington, KY	7.23
	Milk	170	S.D.- 150	34	Nashville, TN	7.23
	Milk	150	S.D.- 80	6	Memphis, TN	7.23
	Milk	180	S.D.- 120	18	Los Angeles, CA	7.23
	Milk (black)	447	59 -1899	38	MS, AK	7.24
	Milk (white)	75	15 - 133	14	Nashville, TN	7.24
	Milk	323	185 - 721	7	MS, AK	7.24
	Milk	130	0- 770	32	DC	7.22
	Milk	370	0- 370	6	CA	7.25

(continued)

Table 7-3 (cont'd.)

Compound	Sample Matrix	Mean (ppb)	Range (ppb)	Number of Determinations	Location	Reference
Dieldrin	Milk	-	T - 50	57	AR, MS	7.17
	Milk	6.2	2.9- 14.6	14+	US	7.7
	Milk	3.3	0- 21	28	TX	7.7
	Milk	7.5	1.9- 21	7	Houston, TX	7.7
	Milk	-	T - 11	40	CO	7.18
Heptachlor Epoxide	Milk	4	T - 30	57	AR, MS	7.17
	Milk	1.7	<0.1- 4.4	14	US	7.11
	Milk fat	160	40 -460	53	PA	7.19
	Milk	-	T - 5	40	CO	7.18
_t_-Nonachlor	Milk	1	T - 10	57	AR, MS	7.17
Oxychlordane	Milk	5	T - 20	57	AR, MS	7.17
PCB's	Milk	T	T - T	57	AR, MS	7.17
	Milk	~10	<40 -100	39	CO	7.26
	Milk	-	40 -100	40	CO	7.18

NOTES:

BHC = benzenehexachloride (hexachlorocyclohexane)
DDD = 2,2-bis(chlorophenyl)-1,1-dichloroethane
DDE = 1,1-dichloro-2,2-bis(chlorophenyl)ethylene
DDT = 1,1,1-trichloro-2,2-bis(chlorophenyl)ethane
Total DDT equiv. = sum of all DDT-related peaks calculated as if all were DDT
PCB's = polychlorinated biphenyls. Quantitation generally based on comparison to an Aroclor mixture
T = trace
ND = not detected
NQ = not quantitated
+ = 5 women. Separate determinations make total of 14 samples
** = unspecified pool or donors in Denver and other US areas
* = 6 positive values out of unreported number of samples analyzed

Table 7-4. LEVELS OF HALOGENATED ORGANIC COMPOUNDS IN HUMAN TISSUE IN THE UNITED STATES

Compound	Sample Matrix	Mean (ppb)	Range (ppb)	Number of Determinations	Location	Reference
α-BHC	Fat	<30.0	-	25	New Orleans, LA	7.27
β-BHC	Fat	600	30-2,430	25	New Orleans, LA	7.27
Total BHC	Fat	480	0-12,300	994	Chicago, IL	7.28
DDD	Perirenal fat	11	-	30	Honolulu, HA	7.29
	Mesenteric fat	47	-	29	Honolulu, HA	7.29
	Panniculus fat	18	-	30	Honolulu, HA	7.29
	Bone marrow	76	-	19	Honolulu, HA	7.29
	Tracheobronchial lymph nodes	10	-	11	Honolulu, HA	7.29
	Adrenal	57	-	18	Honolulu, HA	7.29
	Kidney	2	-	38	Honolulu, HA	7.29
	Liver	33	-	42	Honolulu, HA	7.29
	Brain	2	-	32	Honolulu, HA	7.29
	Gonad	2	-	36	Honolulu, HA	7.29
	Lung	0.9	-	25	Honolulu, HA	7.29
	Spleen	3	-	27	Honolulu, HA	7.29
p,p'-DDD	Fat	450	90-990	25	New Orleans, LA	7.27
o,p'-DDE	Fat	290	50-530	40	New Orleans, LA	7.27
p,p'-DDE	Adipose	5,000	-	103	UT	7.13
	Adipose	2,400	-	959	Chicago, IL	7.30
	Fat	6,850	560- 21,170	25	New Orelans, LA	7.27

(continued)

Table 7-4 (cont'd.)

Compound	Sample Matrix	Mean (ppb)	Range (ppb)	Number of Determinations	Location	Reference
DDE	Adipose	5,790	–	5	Phoenix, AZ	7.14
	Adipose	4,580	–	70	Tucson, AZ	7.14
	Liver	432	–	70	Tucson, AZ	7.14
	Kidney	133	–	66	Tucson, AZ	7.14
	Brain	84	–	52	Tucson, AZ	7.14
	Perirenal fat	4,640	–	30	Honolulu, HA	7.29
	Mesenteric fat	4,400	–	29	Honolulu, HA	7.29
	Panniculus fat	4,480	–	30	Honolulu, HA	7.29
	Bone marrow	2,080	–	19	Honolulu, HA	7.29
	Tracheobronchial lymph nodes	1,380	–	11	Honolulu, HA	7.29
	Adrenal	875	–	18	Honolulu, HA	7.29
	Kidney	209	–	38	Honolulu, HA	7.29
	Liver	200	–	42	Honolulu, HA	7.29
	Brain	83	–	32	Honolulu, HA	7.29
	Gonad	69	–	36	Honolulu, HA	7.29
	Lung	59	–	25	Honolulu, HA	7.29
	Spleen	31	–	27	Honolulu, HA	7.29
	Fat	7,000	0-56,100	994	Chicago, IL	7.28
	Adipose	7,000	440-23,400	159	Miami, FL	7.13,7.16
o,p'-DDT	Fat	60	<10-670	25	New Orleans, LA	7.27
p,p'-DDT	Fat	1,730	150-5,990	25	New Orleans, LA	7.27
DDT	Adipose	2,050	–	5	Phoenix AZ	7.14
	Adipose	1,540	–	70	Tucson, AZ	7.14
	Liver	101	–	70	Tucson, AZ	7.14
	Kidney	30	–	66	Tucson, AZ	7.14
	Brain	22	–	52	Tucson, AZ	7.14
	Perirenal fat	1,330	–	30	Honolulu, HA	7.29
	Mesenteric fat	1,350	–	29	Honolulu, HA	7.29
	Panniculus fat	1,160	–	30	Honolulu, HA	7.29

(continued)

Table 7-4 (cont'd.)

Compound	Sample Matrix	Mean (ppb)	Range (ppb)	Number of Determinations	Location	Reference
DDT (continued)	Bone marrow	411	-	19	New Orleans, LA	7.29
	Tracheobronchial lymph nodes	892	-	11	New Orleans, LA	7.29
	Adrenal	125	-	18	New Orleans, LA	7.29
	Kidney	83	-	38	New Orleans, LA	7.29
	Liver	47	-	42	New Orleans, LA	7.29
	Brain	10	-	32	New Orleans, LA	7.29
	Gonad	15	-	36	New Orleans, LA	7.29
	Lung	14	-	25	New Orleans, LA	7.29
	Spleen	11	-	27	New Orleans, LA	7.29
	Fat	2,600	0-19,000	994	Chicago, IL	7.28
	Adipose	4,300	490-32,800	159	Miami, FL	7.13,7.16
	Fat	5,300	0-34,000	75	CA	7.22
Dieldrin	Adipose	210	-	5	AR, MS	7.17
	Adipose	140	-	70	Tucson, AZ	7.14
	Hair	∿1	<10-10	9	Raleigh, NC	7.31
	Adipose	170	-	103	UT	7.8
	Perirenal fat	30	-	30	Honolulu, HA	7.29
	Mesenteric fat	63	-	29	Honolulu, HA	7.29
	Tracheobronchial lymph nodes	19	-	19	Honolulu, HA	7.29
	Adrenal	6	-	11	Honolulu, HA	7.29
	Kidney	5.6	-	18	Honolulu, HA	7.29
	Liver	3.7	-	38	Honolulu, HA	7.29
	Brain	3.1	-	42	Honolulu, HA	7.29
	Gonad	2.1	-	32	Honolulu, HA	7.29
	Lung	2.2	-	36	Honolulu, HA	7.29
	Spleen	2.1	-	25	Honolulu, HA	7.29
	Fat	140	<10-1,390	221	Chicago, IL	7.28
	Adipose	220	<50-770	146	Miami, FL	7.32
	Adipose	290	30-1,150	25	New Orleans, LA	7.27
Endrin	Fat	ND	-	221	Chicago, IL	7.28
	Fat	<30	-	25	New Orleans, LA	7.27

(continued)

Table 7-4 (cont'd.)

Compound	Sample Matrix	Mean (ppb)	Range (ppb)	Number of Determinations	Location	Reference
Heptachlor Epoxide	Perirenal fat	22	-	30	Honolulu, HA	7.29
	Mesenteric fat	32	-	29	Honolulu, HA	7.29
	Panniculus fat	27	-	30	Honolulu, HA	7.29
	Bone marrow	4	-	19	Honolulu, HA	7.29
	Tracheobronchial lymph nodes	0.1	-	11	Honolulu, HA	7.29
	Adrenal	1.2	-	18	Honolulu, HA	7.29
	Kidney	0.9	-	38	Honolulu, HA	7.29
	Liver	1.9	-	4	Honolulu, HA	7.29
	Brain	0.2	-	32	Honolulu, HA	7.29
	Gonad	0.1	-	36	Honolulu, HA	7.29
	Lung	0.3	-	25	Honolulu, HA	7.29
	Spleen	T	-	27	Honolulu, HA	7.29
	Fat	160	<10-750	505	Chicago, IL	7.28
	Fat	240	30-1,450	25	New Orleans, LA	7.27
Mirex	Adipose	2,500	160-5,940	6*	US	7.33
t-Nonachlor	Adipose	40	-	5 (comp)	MA	7.34
	Adipose	60	-	11	TX	7.34
PCB's	Hair	270	ND-760	9	Raleigh, NC	7.31
	Adipose	470,000	204,000-600,000	2	US	7.35
	Adipose	∿1,000	-	637	US	7.36
	Adipose	100,000	-	1	MI	7.37
	Adipose	∿1,000	-	196	US	7.37
	Hair	ND	-	91	US	7.10

NOTES:

BHC = benzenehexachloride (hexachlorocyclohexane)
DDD = 2,2-bis(chlorophenyl)-1,1-dichloroethane
DDE = 1,1-dichloro-2,2-bis(chlorophenyl)ethylene
DDT = 1,1,1-trichloro-2,2-bis(chlorophenyl)ethane
Total DDT equiv. = sum of all DDT-related peaks calculated as if all were DDT
PCB's = polychlorinated biphenyls. Quantitation generally based on comparison to an Arochlor mixture.
T = trace
ND = not detected
NQ = not quantitated
* = 6 positive values out of unreported number of samples analyzed

HALOGENATED HYDROCARBONS IN ENVIRONMENT OF NIAGARA FALLS/BUFFALO, NY AREA

Ambient Air

The occurrence of halogenated hydrocarbons in the vapor phase of ambient air was tabulated using information from other research programs as well as environmental monitoring conducted under Phase I of this contract. The sampling locations for the Niagara Falls and Buffalo areas, sampling protocols and detailed information on the levels of halogenated hydrocarbons are given in Appendix A. Table 7-5 summarizes this information. Listed is the concentration range for the halogenated hydrocarbons which were detected in the ambient air samples taken from this area, as well as the frequency of detection and number of determinations. Their percent occurrence in ambient air was also calculated. It is evident that a number of halogenated hydrocarbons are occurring with a high frequency at levels above 1000 ng/m^3. Also, a number of halogenated hydrocarbons appear to be site-specific for this area since these substances were not identified in ambient air in other geographical areas. This factor will be further dicussed in the summary section of this chapter.

Drinking Water

Appendix A presents detailed information on sampling and analysis and the data obtained for the concentrations of purgeable halogenated organics in drinking water from Niagara and Buffalo, NY. Table 7-6 summarizes the estimated levels of these compounds. Many of the halogenated hydrocarbons found in ambient air are also present in the drinking water from this area. Table 7-7 presents additional information on halogenated organics and water which has been reported in the literature.

Human Breath

As part of the pilot study, limited sampling and analysis was conducted in the human population in order to estimate the levels of halogenated organics. Samples were taken from individuals living in the "Old Love" Canal area to determine the extent of human contamination. Appendix A presents the sampling protocols for the human body-burden study.

Table 7-8 lists a summary of the estimated levels of halogenated organics in human breath for the Niagara Falls, NY area.

Table 7-5. SUMMARY OF ESTIMATED LEVELS OF VAPOR-PHASE HALOGENATED ORGANICS IN AMBIENT AIR IN NIAGARA FALLS, NY

Chemical	Conc. Range (ng/m^3)	Frequency Detected	No. of Determinations	Percent Occurrence
chloroform	1,050-105,461	9	9	100
tetrachloroethylene	122-14,000	9	9	100
carbon tetrachloride	T-3,692	8	9	89
1,1,1-trichloroethane	1,444-5,444	8	9	89
chlorotoluene isomers	T-12,274	12	15	80
dichlorobenzene isomers	T-444	7	9	78
dichlorotoluene isomers	T-648	10	15	67
trichlorobenzene isomers	T-4,346	10	15	67
trichlorotoluene isomers	T-568	10	15	67
chlorobenzene	T-119	5	9	55
chloronaphthalene isomers	T	5	9	55
tetrachlorobenzene isomers	T-451	8	15	53
1,2-dibromoethane	T	4	9	44
1,3-hexachlorobutadiene	T-389	6	15	40
dichlorobenzaldehyde isomer	T	3	9	33
tetrachlorotoluene isomers	T	3	9	33
1,2-dichloroethylene	T	3	9	33
1,2-dichloroethane	T	2	8	25
trichloroethylene	285-611	2	9	22
1,2-dichloropropane	T	2	9	22
chlorobenzotrifluoride isomers	410-19,586	3	15	20

(continued)

Table 7-5 (cont'd.)

Chemical	Conc. Range (ng/m^3)	Frequency Detected	No. of Determinations	Percent Occurrence
dichlorobenzotrifluoride	193	1	6	17
bromotoluene isomer	T	1	9	11
bromochlorotoluene isomer	T	1	9	11
pentachlorobenzene	17	1	15	7
1,1-dichloroethane	ND	0	9	0
chlorobenzaldehyde	ND[a]	0	9	0
chlorobenzodichlorofluoride isomer	ND[a]	0	9	0
1,2-bis-(trifluoromethyl)benzene	ND[a]	0	9	0

[a]Previously identified in household basements in "Old Love" Canal, see reference 7.60.

Table 7-6. SUMMARY OF ESTIMATED LEVELS OF PURGEABLE HALOGENATED ORGANICS IN DRINKING WATER FROM NIAGARA AND BUFFALO, NY

Chemical	Conc. Range (ng/ℓ)	Frequency Detected	No. of Determinations	Percent Occurrence
bromodichloromethane	1,758-10,375	15	15	100
tetrachloroethylene	350-2,875	15	15	100
1,1,1-trichloroethylene	8-417	15	15	100
chlorobenzene	8-58	15	15	100
_m_-dichlorobenzene	8-700	15	15	100
chloroform	4,433-39,625	14	15	93
carbon tetrachloride	16-192	14	15	93
bromoform	16-60	13	15	87
chlorodibromomethane	75-6,767	13	15	87
trichloroethylene	8-253	13	15	87
trichlorobenzene isomers	325-542	11	15	73
tetrachlorobenzene isomers	125-1,958	8	15	53
1,3-hexachlorobutadiene	T-167	6	14	43
_o_-dichlorobenzene	56-125	5	15	33
chlorotoluene isomers	T	2	15	13
1,2-dichloropropane	T	1	14	7

Table 7-7. LEVELS OF HALOGENATED ORGANICS FOUND IN WATER IN THE BUFFALO/NIAGARA AREA

Chemical	Conc. Range[b] (μg/ℓ)	Conc. Mean[c] (μg/ℓ)	Number of Determinations	References	Production Data (million lb./yr.)
Methylene Chloride		5	1	7.38	
Chloroform		3.1	3	7.39	
Dibromochloromethane		0.6	2	7.39	
Bromodichloromethane		0.5	2	7.39	
PCB's		0.0705	2	7.40	
DDE		0.0203	2	7.40,7.41	
Dieldrin		0.0043	3	7.40	
DDD		0.0040	2	7.40	
DDT		0.0035	2	7.40	
p-Dichlorobenzene					ICC Indust., Inc., Niagara Falls, (7), Solvent Chem. Corp., Niagara Falls (10).
Chlorobenzene					[e]ICC Indust., Inc., Niagara Falls (0.02); Solvent Chem., Corp., Inc., Niagara Falls; Occidental Petroleum Corp., Niagara Falls (0.015)
Chlorotoluene					o- and p- isomers: Hooker Chem. Corp., Niagara Falls

(continued)

Table 7-7 (cont'd.)

Chemical	Conc. Range[b] (μg/ℓ)	Conc. Mean[c] (μg/ℓ)	Number of Determinations	References	Production Data (million lb./yr.)
1,2,4-Trichlorobenzene					[e]Solvent Chem. Corp., Niagara Falls (1.5); Occidental Petroleum Corp., Niagara Falls (2).
Pentachlorobenzene					[e]Occidental Petroleum Corp., Niagara Falls.
1,2,4-Trichlorobenzene					[e]Occidental Petroleum Corp., Niagara Falls.
Phosgene					Van De Mark Chem., Co., Inc., Lockport, NY (8).

[a]Buffalo/Niagara area includes sites in/at Niagara River, Lake Ontario-olcott, Marrero, Buffalo, Dunkirk, Niagara.

[b]Conc. range omitted where none was cited, or where individual pieces of data were not given, or where a range cited in one reference was exceeded by a value reported in another reference in which no range was given.

[c]Conc. mean is the arithmetic average of concentration data, with the following limitations imposed by the nature of the reporting:

(1) where no quantification was performed the occurrence of a chemical was in no way included in calculating the mean.

(2) where only one concentration was reported for an unspecified number of determination <(n) and/or samples, that concentration was included in the calculation as if only one determination had been performed.

(3) where several concentrations were reported, each was included individually in the calculation of the mean.

(4) where an average value and the number of determinations <(n) performed were given, but individual values were not given, the average value was included n times in the calculation of the mean.

(continued)

Table 7-7 (cont'd.)

[d]Number of determinations was calculated by adding, where given:

(1) the number of individual determinations performed (case C.3 and C.4 above).

(2) 1 (one) for average values given where no number of determinations was given (case C.2 above).

[e]Unpublished data, Tracor Jitco, Inc., 1776 East Jefferson St., Rockville, MD 20852

Table 7-8. SUMMARY OF ESTIMATED LEVELS OF HALOGENATED ORGANICS IN HUMAN BREATH IN NIAGARA FALLS, NY

Chemical	Conc. Range (ng/m^3)	Frequency Detected	No. of Determinations	Percent Occurrence
chloroform	3,896-94,510	9	9	100
1,1,1-trichloroethane	T-394	9	9	100
tetrachloroethylene	658-1,753	9	9	100
carbon tetrachloride	T-796	8	9	89
dichlorobenzene isomers	T-5,294	7	9	78
1,2-dichloroethane	T-243	4	9	44
chlorobenzotrifluoride isomers	T-852	5	9	55
1,1-dichloroethane	T	1	9	11
trichloroethylene	T	3	9	33
chlorobenzene	T	1	9	11
chlorotoluene isomers	261-338	2	9	22
dichlorotoluene isomers	1,220	1	9	11
chloronaphthalene isomer	T	1	9	11
bromotoluene isomers	T	1	9	11
trichlorobenzene isomers	T-88	2	9	22
tetrachlorobenzene isomers	27-180	2	9	22
pentachlorobenzene	73	1	9	11
1,3-hexachlorobutadiene	T	1	9	11

Human Blood

In addition to human breath, blood samples were also acquired from the same individuals in the "Old Love" Canal area. The purgeable halogenated organics were quantified in the blood samples and these data are shown in Table 7-9. The concentrations of many of the halogenated hydrocarbons exceeded 1 ppb levels.

Table 7-10 presents the pesticides which were measured in the same human blood samples. Virtually every sample contained p,p'-DDE while a few samples may have contained heptachlor.

Human Urine

Table 7-11 gives the levels of purgeable halogenated organics occurring in human urine from the inhabitants of the "Old Love" Canal in Niagara Falls, NY. Many of the chemicals which were detected in breath and blood were also detected in urine of these individuals.

HALOGENATED HYDROCARBONS IN ENVIRONMENT OF NEW JERSEY AREA

Ambient Air

The sampling protocols and locations of sampling for ambient air in the New Jersey area which was conducted under the pilot study of this program, as well as under other research programs, are presented in Appendix A. Detailed data are also given in Appendix A.

Table 7-12 presents a summary of the estimated levels of vapor phase halogenated organics in the New Jersey area. Many of the halogenated hydrocarbon levels exceeded the ppb level and represented the highest values observed in the ubiquitous category when compared to the other five geographical areas. The ubiquitous compounds were detected at high frequencies.

Drinking Water

Table 7-13 presents the levels of purgeable halogenated organics which were found in New Jersey drinking water samples. The levels of these compounds were also relatively high as compared to water in other geographical areas. Furthermore, they occurred at a high frequency rate.

Table 7-14 presents the levels of halogenated organics found in water in the New Jersey area which was information acquired from other research

Table 7-9. SUMMARY OF ESTIMATED LEVELS OF PURGEABLE HALOGENATED ORGANICS IN HUMAN BLOOD SAMPLES IN NIAGARA FALLS, NY

Chemical	Conc. Range (ng/ℓ)	Frequency Detected	No. of Determinations	Percent Occurrence
chloroform	1,100-20,100	9	9	100
1,1,1-trichloroethane	250-2,000	9	9	100
tetrachloroethylene	22-255,550	9	9	100
_m_-dichlorobenzene	600-67,700	9	9	100
carbon tetrachloride	40-140	8	9	89
trichloroethylene	100-2,550	6	9	67
chlorobenzene	50-16,800	8	9	89
_o_-dichlorobenzene	150-350	5	9	55
bromodichloromethane	14,250	1	9	11
tetrachlorobenzene	2,600	1	9	11

Table 7-10. HALOGENATED EXTRACTABLE (SEMI-VOLATILES) IN HUMAN BLOOD[a]

Sample	Compounds, ng/l (ppt) Whole Blood								
	Trifluralin	α-BHC	Heptachlor	Heptachlor Epoxide	Endosulfan	Dieldrin	p,p'-DDE	p,p'-DDT	Mirex
1	-	-	1610	-	-	-	3035	-	-
2	-	-	-	-	-	-	2990	-	-
3	-	-	-	-	-	-	2040	-	-
4	-	-	1070	-	-	-	925	-	-
5	-	-	1335	-	-	-	800[b]	-	-
6	-	-	-	-	-	-	935	-	-
8	-	-	-	630[c]	-	-	1440	-	-
9	-	-	-	-	-	-	800	-	-
10	-	-	-	-	-	-	1370[b]	-	-

[a] 20 ml whole blood diluted to 50 ml with distilled water. Control: 0.52 μg α-BHC. 35.2 ± 4.4% recovery (two injections of both standard and extract). Chromatography Cleanup: 0.18 μg α-BHC. 99.8 ± 15.4% recovery from Florisil (two injections of both std. and extract). Sensitivity: 5-205 ng/ℓ. - = not detected.

[b] Compound discovered after Florisil cleanup. Interferences due to peak overlap, low sensitivity, etc.

[c] Unconfirmed. Large peak overlap.

Table 7-11. SUMMARY OF ESTIMATED LEVELS OF PURGEABLE HALOGENATED ORGANICS IN HUMAN URINE FROM NIAGARA FALLS, NY

Chemical	Conc. Range (ng/ℓ	Frequency Detected	No. of Determinations	Percent Occurrence
chloroform	858-1,460	9	9	100
tetrachloroethylene	120-550	9	9	100
chlorobenzene	50-117	6	9	67
carbon tetrachloride	42-150	9	9	100
1,1,1-trichloroethane	92-183	4	4	100
trichloroethylene	42-400	9	9	100
m-dichlorobenzene	36-39,160	6	9	67
o-dichlorobenzene	108-725	3	4	75
1,2-dichloroethane	50-75	2	9	22
chlorotoluene isomer	T	1	9	11
bromotoluene isomer	T	1	9	11

Table 7-12. SUMMARY OF ESTIMATED LEVELS OF VAPOR-PHASE HALOGENATED ORGANICS IN THE NEW JERSEY AREA

Chemical	Concentration Range (ng/m^3)	Frequency Detected	Number of Determinations	Percent Occurrence
tetrachloroethylene	T-394,000	85	86	99
trichloroethylene	T-173,886	86	87	99
chlorobenzene	T-6,072	85	86	99
m-dichlorobenzene	T-3,392	90	93	97
1,1,1-trichloroethane	T-111,167	83	86	96
1,2-dichloroethane	T-139,121	75	93	81
o-dichlorobenzene	T-12,433	84	93	90
chloroform	T-98,625	78	87	90
carbon tetrachloride	T-42,378	83	93	89
vinyl chloride	T-3,132	15	36	42
trichlorobenzene	33-1,160	27	96	28
1,2-dichloroethylene	T-5,263	4	16	25
1,1,2-trichloroethane	294-17,571	7	36	19
1,1,2,2-tetrachloroethane	T-2,872	4	26	15
1,1-dichloroethane	T-342	10	66	15

Table 7-13. SUMMARY OF ESTIMATED LEVELS OF PURGEABLE HALOGENATED ORGANICS IN NEW JERSEY DRINKING WATER

Chemical	Concentration Range (ng/ℓ)	Frequency Detected	Number of Determinations	Percent Occurrence
1,1,1-trichloroethane	64-2,667	22	22	100
carbon tetrachloride	77-575	22	22	100
trichloroethylene	757-18,017	22	22	100
tetrachloroethylene	86-1,183	22	22	100
bromodichloromethane	624-146,150	22	22	100
chlorodibromomethane	274-92,592	22	22	100
chlorobenzene	T-75	20	22	91
m-dichlorobenzene	T-25	20	22	91
o-dichlorobenzene	17-50	12	22	55
1,1-dichlorobenzene	105-142	3	22	14
trichlorobenzene isomers	50	1	22	5

Table 7-14. LEVELS OF HALOGENATED ORGANICS FOUND IN WATER IN THE NEW JERSEY AREA

Chemical	Conc. Range (μg/ℓ)	Conc. Mean (μg/ℓ)	Number of Determinations	References	Production Data (million lb/yr)
Dichlorobenzene		209	6	7.38	Standard Chlorine Chem. Co., Inc., Kearny [o-isomer (16); o-isomer (n.d.).]
Trichloroethane		42.0	11	7.38,7.39,7.43	
Dieldrin	29.0 - 4.0	19.7	4	7.38	
Chloroform		14.5	5,6	7.42	
Chloronitrobenzene		10.7	3	7.38	
Trichloroethylene		7.0	33	7.38,7.39,7.43	
Dichloroethane		5.0	27	7.38,7.44,7.45	
Methyl Trichlorophenoxyacetate		5.0	1	7.38	
Bromodichloroethane		5.0	2	7.38	
Bromodichloromethane	16.0 - n.d.	3.7	16	7.38,7.39,7.45	
Tetrachloroethylene		3.6	23	7.38	
Methyl Dichlorophenoxyacetate		3.5	2	7.38	
Dibromochloromethane		3.3	9	7.38,7.39,7.43,7.45	
Bromopropylbenzene		3.0	1	7.38	
Bromobenzene		3.0	1	7.38	
Methylene Chloride		2.5	8	7.38	
Tetrachloroethane		2.5	13		
Methyl-2-(4-Chlorophenoxy)butanoate		2.0	1		
Bromochloroethane		2.0	2		
Dichloroethylene		1.8	5		
Bromochloropropane		1.5	2	7.38	
Pentachloroanisole		1.3	4	7.38	
Dichloropropane		1.3	4	7.38	

(continued)

Chemical	Conc. Range (µg/ℓ)	Conc. Mean (µg/ℓ)	Number of Determination	References	Production Data (million lb/yr)
Hexachloroethane		1.0	1	7.38	
Trichloroanisole		1.0	2	7.38	
Chlorobenzene		1.0	1	7.38	
Dichloroiodomethane		1.0	1	7.38	
Carbon Tetrachloride	<2.0 - n.d.	1.0	6	7.38,7.39,7.43 7.44,7.45	
Hexachlorobutadiene		0.7	3	7.38,7.46	
Bromoform		0.6	8	7.38,7.39,7.45	
p-Chlorotoluene					Tenneco, Inc., Fords
o-Chlorotoluene					Tenneco, Inc., Fords (9); Monsanto, Bridgeport (80); Stauffer Chem. Co., Edison (11); used by UOP, Inc., East Rutherford (5).
Benzyl Chloride					Monsanto, Bridgeport (80); Stauffer Chem. Co., Edison (11); Tenneco, Inc., Fords (9), used by UOP, Inc., East Rutherford (5).
Phosgene					E.I. duPont de Nemours, Deepwater Point (135).

[a]New Jersey includes sites in/at Reedy Island, Turnpike Bridge, Passaic River mouth, Port Elizabeth, Bayonne, Linden, St. John, Delaware Memorial Bridge, Marcus Hook, Paulsboro, Navy Yard, Tremley, Newark, Narrows, Lower Bay, Hudson River mouth, Fort Lee, Little Falls, Ben Franklin Bridge, Raritan Bay, Perth Amboy, Sewaren, Tufts, Passaic County, Bristol, Torresdale, Phillipsburg, Haworth, Clifton, Rahway, Colonic, Delaware River mouth, Frenchtown, Elisabethtown, Essex County, Kingstown, Shrewsbury, Woodbridge, Suffolk City, Toms River, and Easton, PA.

[b]Conc. range omitted where none was cited, or where individual pieces of data were not given, or where a range cited in one reference was exceeded by a value reported in another reference in which no range was given.

[c]Conc. mean is the arithmetic average of concentration data, with the following limitations imposed by the nature of the reporting:

1. where no quantification was performed, the occurrence of a chemical was in no way included in calculating the mean.
2. where only one concentration was reported for an unspecified number of determinations <(n) and/or samples, that concentration was included in the calculation as if only one determination had been performed.
3. where several concentrations were reported, each was included individually in the calculation of the mean.
4. where an average value and the number of determination <(n) performed were given, but individual values were not given, the average value was included n times in the calculation of the mean.

[d]Number of determinations was calculated by adding, where given:

1) the number of individual determinations performed (case C3 and C4 above).
2) 1 (one) for average values given where no number of determinations was given. (case C2 above).

programs. These data are comparable to those presented in the previous table.

Table 7-15 presents the analysis of extractable halogenated hydrocarbons in tap water from northern New Jersey. These water samples are the same as those presented in Table 7-13. In contrast to the data in Table 7-13 for purgeable halogenated hydrocarbons, essentially none of the pesticides were detected in these drinking water samples.

HALOGENATED HYDROCARBONS IN ENVIRONMENT OF BATON ROUGE, LA AND VICINITY

Ambient Air

Appendix A presents the sampling protocol and locations, as well as the detailed information on the levels of vapor-phase halogenated organics in ambient air from Baton Rouge, LA. Table 7-16 presents a summary of these estimated levels. Substantial quantities of the ubiquitous compounds were observed, as well as the presence of a new set of site specific pollutants which were not detected in samples from other geographical areas. Twenty-nine vapor-phase halogenated organics were identified and measured.

Drinking Water

Table 7-17 presents a summary of the levels of purgeable halogenated hydrocarbons found at the Jefferson Parish water plant. Table 7-18 presents additional information for halogenated hydrocarbons in tap water from Jefferson Parish. Finally, Table 7-19 presents the data for the New Orleans/Baton Rouge, LA area. In general, the purgeable compounds appear to be at rather elevated levels while the pesticides are not detectable.

HALOGENATED HYDROCARBONS IN ENVIRONMENT AT HOUSTON, TX AND VICINITY

Ambient Air

The sampling protocol and locations as well as the detailed information on the vapor phase halogenated organics in ambient air for Houston, TX and vicinity are given in Appendix A. Table 7-20 presents a summary of the estimated levels of these compounds. The ubiquitous compounds comprise the substances occurring at the highest frequency rate and highest concentration values. A series of site-specific pollutants is also present which represents essentially the production, storage, or usage of these compounds in this area. Data for 30 halogenated hydrocarbons are presented in this table.

Table 7-15. QUANTITATIVE ANALYSIS OF EXTRACTABLE SEMI-VOLATILE HHC'S IN TAP WATER IN NORTHERN NEW JERSEY[a]

Site	Period	Location	Compound (ng/ℓ, ppt)							
			Trifluralin	α-BHC	Heptachlor	Heptachlor Epoxide	Endosulfan	p,p'-DDE	Dieldrin	p,p'-DDT
1	2	5	-	-	-	-	-	-	-	-
2	3	6	-	-	-	-	-	-	-	-
2	4	2	-	-	-	-	-	-	-	-
3	6	4	-	-	-	-	-	-	-	-
3	6	5	-	-	-	-	-	-	-	-
3	6	6	-	-	-	-	-	-	-	-
3	7	2	-	-	-	-	-	-	-	-
3	7	3	-	-	-	-	-	-	-	-
3	7	7	-	-	-	-	-	-	-	-
3	8	1	-	-	-	-	-	-	-	-
4	8	2	-	-	-	-	-	-	-	-
4	8	3	-	-	-	-	-	-	-	-
4	8	4	-	-	7	-	-	-	-	-
4	8	5	-	-	-	-	-	-	-	-
4	8	6	-	-	-	-	-	-	-	-
4	8	7	-	-	-	-	-	-	-	-
5	10	2	-	-	-	-	-	-	-	-
5	10	4	-	-	-	-	-	-	-	-
5	10	5	-	-	-	-	-	-	-	-
5	10	6	-	-	-	-	-	-	-	-
5	10	7	-	-	-	-	-	-	-	-
5	11	1	-	-	20	-	-	-	-	-

[a]Sample size = 120 ml; Detection limit $\cong$ 5-25 ng/ℓ

See Tables 7-37, 7-38, 7-40, 7-41 and 7-42

Table 7-16. SUMMARY OF ESTIMATED LEVELS OF VAPOR-PHASE HALOGENATED ORGANICS IN BATON ROUGE, LA AREA[a]

Chemical	Concentration Range (ng/m^3)	Frequency Detected	Number of Determinations	Percent Occurrence
chloroform	181-11,742	42	43	98
tetrachloroethylene	7-1,224	40	43	93
carbon tetrachloride	T-10,100	37	43	86
1,2-dichloroethane	9-10,341	36	43	84
1,1,1-trichloroethane	T-8,760	33	43	77
trichloroethylene	T	3	4	75
_o_-dichlorobenzene	T	3	4	75
_m_-dichlorobenzene	T	3	4	75
chloroethane	1,378	19	30	63
vinyl chloride	T-1,334	9	16	56
chloroacetylene	T-58	5	12	42
1,2-dichloropropane	T-3,999	15	39	38
1,1,2-trichloroethane	36-9,611	13	43	30
1,1-dichloroethane	T-500	12	43	28
tetrachlorobutadiene	T-139	3	11	27
tetrachloropropane isomer	13-242	3	11	27
bis(2-chloroisopropyl)ether	T-363	3	11	27
chlorobenzene	T-900	10	43	23
hexachloro-1,3-butadiene	18-37	2	11	18
1,3-dichloropropene	T-10	2	11	18
trichloropropane	T-24	2	11	18
1,1,2,2-tetrachloroethane	T-1,573	7	43	16
vinylidene chloride	T-990	6	44	14
dichloropropene	106-261	2	11	18
pentachloroethane	T-13	2	15	13
hexachloroethane	T	2	15	13
pentachlorobutadiene	T	1	11	9
chlorotoluene	35	1	11	9
trichlorobenzene isomers	ND	0	4	0

[a]See reference 7.61 and 7.62

Table 7-17. SUMMARY OF PURGEABLE HALOGENATED HYDROCARBON LEVELS FOUND AT JEFFERSON PARISH WATER PLANT, 2/7/77 - 8/5/77

	Detection Limit (μg/ℓ)	River[a]				Sand Filter[a]			
		Number of Times Found[b]	Mean[c] (μg/ℓ)	Low Value[d] (μg/ℓ)	High Value (μg/ℓ)	Number[b] of Times Found	Mean[c] (μg/ℓ)	Low Value[d] (μg/ℓ)	High Value (μg/ℓ)
_t_-1,2-dichloroethylene	.2	0	–	–	–	0	–	–	–
dichloromethane	–	52	2.581	0.4	15.8	51	3.848	0.3	18.1
bromoethane	.3	0	–	–	–	0	–	–	–
carbon tetrachloride	1.0	12	0.69	0.7	11.2	8	0.395	0.8	8.0
chloroform	.3	52	1.245	0.2	2.5	52	10.008	1.8	46.0
bromochloromethane	.7	0	–	–	–	1	0.010	0.5	0.5
trichloroethylene	.6	24	0.20	0.1	1.4	15	0.087	0.2	0.5
dichlorobromomethane	1.3	1	0.0242	1.3	1.3	18	0.990	0.5	6.2
1,2-dichloroethane	.5	52	8.680	1.1	32.3	52	8.014	1.1	23.7
dibromochloromethane	2.5	16	1.86	1.4	13.4	19	1.63	0.2	12.8
1,1,2-trichloroethane	1	13	0.237	0.2	2.1	18	0.223	0.3	1.6
chlorobenzene	.15	5	0.062	0.1	1.5	4	0.027	0.1	0.8
bromoform	10.0	0	–	–	–	0	–	–	–
_m_-dichlorobenzene	.5	1	0.037	1.9	1.9	2	0.039	0.1	1.9

[a] River = untreated Mississippi River water. Sand Filter = water entering distribution system.

[b] Number of items given compound found at level greater than detection limit.

[c] Arithmetic mean for 52 samples, with zero used as value for concentrations below the detection limit.

[d] Some values reported below detection limit.

Table 7-18. SUMMARY OF PURGEABLE HALOGENATED HYDROCARBON LEVELS FOUND IN TAP WATER IN JEFFERSON PARISH[a]

Compound	Number of Times Found[b]	Mean[c] (μg/ℓ)	Low Value (μg/ℓ)	High Value (μg/ℓ)
1,2-dichloroethylene	1	0.0007	-	0.1
dichloromethane	117	0.13	-	1.1
bromoethane	0	-	-	-
carbon tetrachloride	145	0.20	0.03	2.5
chloroform	145	6.06	0.9	86.1
bromochloromethane	5	0.089	-	7.5
trichloroethylene	92	0.19	-	1.6
dichlorobromomethane	141	1.74	-	14.0
1,2-dichloroethane	145	2.16	0.6	8.1
dibromochloromethane	63	0.20	-	3.5
1,1,2-trichloroethane	87	0.12	-	2.4
chlorobenzene	0	-	-	-
bromoform	0	-	-	-
dichlorobenzene	0	-	-	-
tetrachloroethylene	114	0.14	-	1.1

[a] Source: Private communication, N. V. Brodtmann, Jr.; Jefferson Parish Department of Water, Jefferson, LA, May 1978.

[b] Number of times given compound found out of 145 samples.

[c] Arithmetic mean for 145 samples, with zero used as value for concentrations below the detection limit.

Table 7-19. LEVELS OF HALOGENATED ORGANICS FOUND IN WATER IN THE NEW ORLEANS/BATON ROUGE AREA

Chemical	Conc. Range[b] (μg/ℓ)	Conc. Mean[c] (μg/ℓ)	Number of Determinations[d]	References	Production Data (million lb./yr.)
trichloroethylene	5227-n.d.	96	66	7.38,7.47, 7.48,7.49	Ethyl Corp., Baton Rouge (50); Occidental Petroleum Corp., Taft (40)
chloroform	394-0.2	20	73	7.38,7.47, 7.48,7.49, 7.45,7.51	
bromobenzene		13	1	7.38,7.54	
trichloroethane	334-0.235	10.6	68	7.47,7.48 7.49,7.52	1,1,1-trichloroethane; Vulcan Materials Co., Geismar (65); Ethyl Corp., Baton Rouge (40)
dichloroethane	32.3-n.d.	7.7	61	7.38,7.45 7.47,7.52	1,2-dichloroethane: Allied Chem. Corp., Baton Rouge (300); Borden, Inc., Geismar (300); Dow Chem., Plaquemine (450); Ethyl Corp., Baton Rouge (330); Monochem, Inc., Geismar (300); Shell Chem. Corp., Norco (700)
carbon tetrachloride	193-<.1	7.1	67	7.47,7.48 7.49,7.51, 7.52	
dichlorobenzene	15-n.d.	4.2	>55	7.38,7.47, 7.52	
atrazine		4.2	4	7.38,7.52	
dichloroethylene		4	1	7.38	
methylene chloride	15.8-0.34	2.6	53	7.47,7.51, 7.52	Dow Chem., Plaquemine (190); Vulcan Materials Co., Geismar (80)
chlorodibromomethane	15.0-n.d.	3.5	58	7.38,7.45, 7.47,7.52, 7.55	
alachlor (2-Cl homolog)	2.9-1.9	2.3	3	7.52	
bromodichloromethane		2.2	60	7.38,7.45 7.47,7.51 7.52,7.55	
tetrachloroethylene	7-0.2	1.9	6	7.38,7.52	Ethyl Corp., Baton Rouge (50); Vulcan Materials Co., Geismar (150); Dow Chem., Plaquemine (150); Occidental Petroleum Corp., Taft (50)

(continued)

Table 7-19 (cont'd.)

Chemical	Conc. Range[b] (µg/ℓ)	Conc. Mean[c] (µg/ℓ)	Number of Determinations[d]	References	Production Data (million lb./yr.)
hexachloroethane	4.3-0.19	1.6	3	7.52	
dichloroiodomethane	1.6-1.1	1.3	3	7.52	
hexachlorobutadiene	4.7-n.d.	1.2	16	7.52,7.53	
dibromochloromethane		1.0	1	7.51	
chloral		1.0	9	7.55	
alachlor (1-Cl homolog)	1.7-0.5	0.88	3	7.52	
deethylatrazine	0.80-0.75	0.78	3	7.52	
trichloropropane		0.4	10	7.38,7.52	
dibromodichloroethane	0.63-n.d.	0.32	3	7.52	
chlorobenzene		0.30	53	7.47,7.51	
bromoform	0.57-n.d.	0.25	4	7.45,7.52	
cyanazine	0.35-0.21	0.29	3	7.52	
vinylidene chloride		0.2	2	7.56	Dow Chem., Plaquemine
bis(2-chloroisopropyl)ether	0.18-0.03	0.10	3	7.52	
bis(2-chloroethyl)ether	0.16-0.04	0.11	3	7.52	
simazine		<0.1	3	7.52	
propazine		<0.1	3	7.52	
tetrachloroethane	0.11-n.d.	0.04	3	7.52	
heptachloronorbornene	0.07-0.04	0.06	6	7.52	
dieldrin	0.07-n.d.	0.02	9	7.42,7.52	
butachlor	0.06-0.05	0.05	3	7.52	

(continued)

Table 7-19 (cont'd.)

Chemical	Conc. Range[b] (μg/ℓ)	Conc. Mean[c] (μg/ℓ)	Number of Determinations[d]	References	Production Data (million lb./yr.)
DDE	0.05-n.d.	0.03	3	7.52	
chlordane	<0.1-n.d.	<0.03	3	7.52	
pentachlorophenyl methyl ether	<0.1-n.d.	<0.03	3	7.52	
pentachloroethane	<0.1-n.d.	<0.03	3	7.52	
DDT		0.010	1	7.42	
endrin	0.008-0.004	0.006	3	7.52	
PCB's		0.0017	1	7.40	
chloronitrobenzene	n.d.	n.d.	>3	7.54,7.52	
bromochlorobenzene	n.q.			7.54	
trichlorotrifluoroethane	n.q.			7.51	
dichloropropane	n.q.		1	7.56	
bis(chloromethyl)ether	n.q.			7.54	
aldrin	n.q.		32	7.57	
chloromethane	n.q.			7.54	
chloropyridine	n.q.			7.54	
lindane	n.q.		1	7.57	
benzene hexachloride	n.q.			7.57	
vinyl chloride	n.q.			7.58	Allied Chem. Corp., Baton Rouge (300); Borden, Inc., Geismar (300); Dow Chem., Plaquemine (450); Ethyl Corp., Baton Rouge (330); Monochem., Inc., Geismar (300); Shell Chem. Corp., Norco (700).
dichloroacetylene	n.q.			7.54	

(continued)

Table 7-19 (cont'd.)

Chemical	Conc. Range[b] (μg/ℓ)	Conc. Mean[c] (μg/ℓ)	Number of Determinations[d]	References	Production Data (million lb./yr.)
dibromobenzene	n.q.			7.54	
dichlorobutene	n.q.			7.54	
hexachlorobenzene	n.q.			7.54	
cyanogen chloride	n.q.			7.54	
hexachlorocyclohexane					Shell Chem. Co., Norco (60).

[a]Baton Rouge/New Orleans area includes sites in New Orleans, Luling, Jefferson Parish, Carrollton, Terrebonne Parish, Morgan City, Lafayette, Head of Passes, Port Sulphur, Lutcher, Plaquemine, Geismar, Hahnville, Baton Rouge, Mississippi River, Baton Rouge - Port Sulphur transect.

[b]Conc. range omitted where none was cited, where individual data were not given, or where range cited in one reference was exceeded by a value reported in another reference in which no range was given.

[c]Conc. mean is the average of concentration data, with the following limitations:
- (1) where no quantitation was performed, the occurrence of a chemical was not included in calculating the mean
- (2) where only one concentration was reported for an unspecified number of determinations and/or samples, that concentration was included in the calculation as if only one determination had been performed
- (3) where several concentrations were reported, each was included individually in the calculation of the mean
- (4) where an average value and the number of determinations were given, but not individual values, the average value was included (n) times in the calculation of the mean

[d]Number of determinations calculated by adding:
- (1) the number of individual determinations performed (case C,3 and C,4 above)
- (2) 1 (one) for average values where number of determinations was unavailable.

n.d. = not detected
n.q. = not quantitated

Table 7-20. SUMMARY OF ESTIMATED LEVELS OF VAPOR-PHASE HALOGENATED ORGANICS IN AMBIENT AIR IN HOUSTON, TX AND VICINITY[a]

Chemical	Concentration Range (ng/m^3)	Frequency Detected	Number of Determinations	Percent Occurrence
carbon tetrachloride	T-11,538	30	30	100
chloroform	T-53,846	29	30	97
_m_-dichlorobenzene	T	12	13	92
tetrachloroethylene	T-2,019	26	30	87
1,1,1-trichloroethane	T-27,700	25	30	83
1,2-dichloroethane	T-66,300	22	30	73
chlorobenzene	T-125	9	13	69
trichloroethylene	T-5,071	20	30	67
_o_-dichlorobenzene	T	6	13	46
hexachloro-1,3-butadiene	T-2,066	7	17	41
trichlorobenzene isomers	T	4	13	31
dichloropropane isomer	T-2,586	5	17	29
dichloropropene isomers	T-1,293	4	17	24
bis(2-chloroisopropyl)ether	T-333	3	17	18
chloroprene	266-4,000	2	17	12
vinylidine chloride	T-531	3	25	12
dibromoethane	T-158	2	17	12
dichlorobutane isomers	52-700	2	17	12
dichlorobutene isomers	T-262	2	17	12
pentachlorobutadiene isomers	T-100	2	17	12
1,1,2-trichloroethane	3,334-6,700	3	30	10
1,1,2,2-tetrachloroethane	19-33	2	30	7
1,2-dibromopropane	T	1	17	6
1,2,3-trichloropropane	298	1	17	6
tetrachlorobutadiene isomer	T	1	17	6
trichloropropene isomers	T	1	17	6
1,1-dichloroethane	555	1	30	3
1,1,1,2-tetrachloroethane	21	1	30	3
pentachloroethane	3,984	1	30	3
vinyl chloride	T	1	30	3

[a]See reference 7.60, 7.61, 7.62.

Drinking Water

Table 7-21 summarizes the halogenated organics found in drinking water in the Houston, TX area. Many of the compounds occur at the ppb level.

Human Breath

Table 7-22 provides information on the concentration of halogenated hydrocarbons which was detected in 10 expired air samples from male volunteers at the Brooke Air Force Base in Texas.

Table 7-21. LEVELS OF HALOGENATED ORGANICS FOUND IN WATER IN THE HOUSTON AREA

Chemical	Conc. Range[b] (µg/ℓ)	Conc. Mean[c] (µg/ℓ)	Number of Determinations[d]	References	Production Data (million lb./yr.)
Trichlorobutane		185	1	7.38	
Trichloropentene		92	1	7.38	
Trichloroethylene	197-0.9	54	18	7.38,7.48 7.49	Diamond Shamrock, Deer Park (90), Dow Chem., Freeport (150)
Trichloroethane	119-0.1	24	14	7.48,7.49	1,1,1-Trichloroethane: Dow Chem., Freeport (450), 1,1,2-Trichloroethane: Dow Chem., Freeport (n.a.)
Dichlorobenzene		21	1	7.38	
Bis(chloroisopropyl)ether		19	1	7.59	
Trichlorohexane		16	2	7.38	
Carbon Tetrachloride		13	15	7.38,7.48, 7.49	
Chloroform	82-<.1	8.9	20	7.38,7.48 7.49,7.50	
Tetrachloroethylene		8	4	7.38	Diamond Shamrock, Deer Park (160); Dow Chem., Freeport (120)
Dichlorobutane		8	2	7.38	
Dichloroheptane		4	1	7.38	
Chloroprene dimer		2	2	7.38	
Pentachloroanisole		2	2	7.38	
Bis(chloroethyl)ether		1.4	1	7.59	
Dichloroethane		1.3	3	7.38	1,2-Dichloroethane: Diamond Shamrock, Deer Park (550); Dow Chem., Freeport (1600) and Oyster Creek (1100); Ethyl Corp., Pasadena (260); Shell Chem. Co., Deer Park (1200)
Hexachlorobutadiene	2.0-n.d.	~1	1	7.46	
Trichloropropane		1	1	7.38	
Bromoform	n.d.			7.50	
Chlorophenol	n.d.			7.59	

(continued)

Table 7-21 (cont'd.)

Chemical	Conc. Range[b] (µg/ℓ)	Conc. Mean[c] (µg/ℓ)	Determinations[d]	Reference	Production Data (million lb./yr.)
Dichlorodibromomethane	n.d.			7.50	
Dichlorotoluene	n.d.			7.50	
1,2-Dichloropropane					Dow Chem., Freeport (25).
Vinyl Chloride					Dow Chem., Freeport (200) and Oyster Creek (700); Ethyl Corp., Pasadena (150); Shell Chem. Co., Deer Park (840).
Methylene Chloride					Dow Chem., Freeport (200).
1-Chloro-2, 3-Epoxypropane (Epichlorohydrin)					Dow Chem., Freeport (250); Shell Chem. Co., Deer Park (140).

[a]Houston area includes sites in Morgan Point, Deer Park, Lynch, Bayou, Freeport, North Shaver, Turning, Pelican, Texas Bayou, Houston, Red Fish, Port Neches.

[b]Conc. range omitted where none was cited, or where individual pieces of data were not given, or when a range cited in one reference was exceeded by a value reported in another reference in which no range was given.

[c]Conc. mean is the arithmetic average of concentration data, with the following limitations imposed by the nature of the reporting:

(1) where no quantification was performed the occurrence of a chemical was in no way included in calculating the mean;
(2) where only one concentration was reported for an unspecified number of determinations <(n) and/or samples, that concentration was included in the calculation as if only one determination had been performed;
(3) where several concentrations were reported, each was included individually in the calculation of the mean;
(4) where an average value and the number of determinations <(n) performed were given, but individual values were not given, the average value was included n times in the calculation of the mean.

[d]Numbe. of determinations was calculated by adding, where given:

(1) the number of individual determinations performed (case C3 and C4 above).
(2) 1 (one) for average values given where no number of determinations was given. (case C2 above).

Table 7-22. HALOGENATED HYDROCARBONS DETECTED IN TEN EXPIRED AIR SAMPLES FROM MALE VOLUNTEERS AT BROOKS AFB, TX [a]

Compound	Mean (μg/hr)	Range of Positives (μg/hr)	Number of Positives
1,1,1-trifluorotrichloroethane	71.4	2.6-580	6
methylene chloride	44.0	0.12-340	5
dimethyldifluorosilane	24.1	1.2-140	10
1,1,1-trichloroethane	16.9	0.034-140	4
dichlorobenzene	3.2	0.001- 26	7
chloroform	1.3	T-11	5
vinylidine chloride	1.3	13	1
trimethylfluorosilane	0.52	5.2	1
trichloroethylene	0.43	T-3.9	4
tetrachloroethane	0.20	.022-2.0	2
1,2-dichloroethane	0.08	T-0.80	2
vinyl chloride	0.073	T-.73	3
fluorochloroethylene	0.054	0.54	1
dichlorofluoromethane	0.020	0.062-0.14	2
trichlorofluoromethane	0.008	0.007-0.041	4
dichlorodifluoroethylene	0.0068	0.002-0.029	4
chlorobenzene	0.002	0.002	1
1,1-dichloroethane	T	T	1

[a]Eight Volunteers; one was sampled three times.

[b]Arithmetic mean with non-detected samples counted as zero.

Source: J. P. Conklo, A. J. Cump, and B. E. Welch, "Trace Composition of Human Respiratory Gases," Arch. Environ. Health, 30, 290-295 (1975).

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SECTION 8

MUTAGENIC/CARCINOGENIC ACTIVITY OF HALOGENATED COMPOUNDS

A summary of mutagenicity and carcinogenicity data for halogenated organic compounds to be studied is listed in Table 8-1. This summary is useful not only for quickly assessing the mutagenicity/carcinogenicity of the study compounds but also for determining where there is insufficient data which NCI may be able to supply.

The summary presented in Table 8-1 must be viewed with some caution. The inaccuracies of the tests and their interpretations are well-known. The definition of a significant positive result varies from test-to-test and among investigators. Some of the results summarized in Table 8-1 were not evaluated in the original citation--the data were presented with no interpretation--and the evaluation was made by RTI personnel. The experimental quality (controls, etc.) of some of the citations is also subject to question. In addition, some of the older references may have produced negative results due to poor testing sensitivity.

Table 8-1. SUMMARY OF MUTAGENICITY AND CARCINOGENICITY DATA ON HALOGENATED COMPOUNDS.

Class	Chemical Name	NCI Test Status	Carcino-genicity	Terato-genicity	MUTAGENICITY									References
					Bacteria[1]	Yeast[2]	Fungi[3]	Fruit Fly[4]	Mammalian Cells	Human Cells	Dominant Lethal (Mice)	Host Mediated	Other	
Industrial	dichloromethane	CBT, CBT	–	–	+,?		+	–						2,4,13,21
Chemicals	dibromomethane				+		–							2
	chloroform	+	±	–	+		–							3,4,21
	tribromomethane		+		+									4,13
	carbon tetrachloride		+		±									12,13,21
	dibromodichloromethane	CBT												
	vinyl chloride		+		+									12,13,21
	vinylidine chloride		+		+									12,18,19,21
	1,2-dichloroethane	+			+		+	+						2,21
	1,2-dibromoethane	+	+		+									12
	trichloroethylene	± CBT (4)	±	–	+									1,6-8,21
	1,1,1-trichloroethane	?, CBT												
	1,1,2-trichloroethane		+(?)											13,26
	tetrachloroethylene	+, ?, CBT	–	–	+									4,10,21
	1,1,2,2-tetrachloroethane	+												4
	dichloropropane				–		–							1,2
	2-chlorobutadiene (chloroprene)		?		+ ?									12,21
	1,4-dichloro-2-butene				+									21
	hexachloro-1,3-butadiene		–		SFT									4,21
	chlorobenzene	CBT					–							3
	bromobenzene				–									12
	o-dichlorobenzene	CBT			SFT		+							3,21
	m-dichlorobenzene				SFT		+							3,21
	p-dichlorobenzene	CBT	+(?)				+							13
	o-chloroaniline						+							3
	m-chloroaniline						+							3
	p-chloroaniline						+							3
	benzyl chloride		?		+									12,21
	PCB (Aroclor)		–		+									13,20,21

Table 8-1 (cont'd.)

Class	Chemical Name	NCI Test Status	Carcino-genicity	Terato-genicity	MUTAGENICITY Bacteria[1]	Yeast[2]	Fungi[3]	Fruit Fly[4]	Mammalian Cells	Human Cells	Dominant Lethal (Mice)	Host Mediated	Other	References
Insecticides	Dieldrin	± (tech.) – (purif.)	+	+	±				–		–	–		5,11,12,13
	DDE	±	+		–									12
	DDT	–	±	–					+		+		–	11,13
	Aldrin	+ (tech.)	+	+										11,13
	Heptachlor	+	+											11,13
	o,p'-DDD	NR	+(?)											13
	p,p'-DDD		+											13
	Heptachlor epoxide		+											10
Herbicides	Atrazine		?			+			+				+	11,13
Metabolites	chloroacetaldehyde				+									15
	chloroethanol				+									15
	trichloroacetic acid				–		–							2
	3-chloro-o-cresol				–									16
	4-chloro-o-cresol				–									16
	5-chloro-o-cresol				–									16
	5-chloro-3-methyleatechol				–									16
	3,4-dichlorocatechol				–									16
	3,5-dichlorocatechol				–									16
	3,6-dichlorocatechol				–									16
	3,4,5-trichlorocatechol				–									16
	2,3-dichlorophenol				–									16
	2,4-dichlorophenol		+		–									7,13
	2,5-dichlorophenol				–									16
	2,6-dichlorophenol				–									16
	3,4-dichlorophenol				–									16
	3,5-dichlorophenol				–									16

(Continued)

Table 8-1 (cont'd.)

Class	Chemical Name	NCI Test Status	Carcino-genicity	Terato-genicity	MUTAGENICITY									References
					Bacteria[1]	Yeast[2]	Fungi[3]	Fruit Fly[4]	Mammalian Cells	Human Cells	Dominant Lethal (Mice)	Host Mediated	Other	
Metabolites (cont'd.)	2,3,5-trichlorophenol				-									16
	2,3,6-trichlorophenol				-									16
	2,4,5-trichlorophenol				-									16
	2,4,6-trichlorophenol				-									16
	2,3,4,6-tetrachlorophenol				-									16
	chloroacetic acid		-		-									12,17

+ Reported positive.
- Reported negative.
1 "Bacteria" includes: Salmonella typhimurium, Escherichia coli, Bacillus subtilis, Klebsciella pneumoniac.
2 Saccharomyces cerevisiae.
3 Neurospora crassa, Aspergillus nidulans.
4 Drosphila melanogaster.
NCI Data based on Technical Reports and "Chemicals on Standard Protocol", NCI Carcinogenesis Testing Program, February 1, 1979.
NR No Report, insufficient data.
CBT Currently being tested.
SFT Scheduled for Test.

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SECTION 9

BIOLOGICAL CHEMISTRY OF HALOGENATED HYDROCARBONS

The biological chemistry of the halogenated hydrocarbons is central to this research project. In order to make any correlation among the environmental levels, body-burden, and disease incidence, the uptake, metabolism, and excretion of halogenated hydrocarbons must be considered. To this end, the literature on uptake, metabolism, and excretion has been reviewed and is summarized in this report.

In addition, the potential use of indirect indications of cancer was investigated. A number of biological indicators were considered, including plasma alkaline phosphatase, serum glutamic-oxaloacetic transaminase (SGOT), γ-glutamyl transpeptidase, ornithine carbamyl transferase, serum aryl hydrocarbon hydroxylase, and alphafetoprotein. Unfortunately, only the Carcinoembryonic Assay presented any realistic hope of providing data relevant to this program. Other assays were insensitive, too complex for the available level of effort, or did not have a large data base with which to compare the results of this study.

The summary of the halogenated hydrocarbon metabolism literature and a discussion of CEA, including background and pretest results, are presented below. The deficiencies of the available scientific data and methodology are acknowledged: lack of data on uptake from environmental levels, lack of metabolism data for some compounds, lack of excretion kinetics for many compounds, and lack of more definitive biochemical assays to augment chemical analyses. However, it is felt that the available data and techniques will be invaluable to this study.

METABOLISM OF HALOGENATED HYDROCARBONS

The biological chemistry of the study compounds is important for several reasons: if compounds are readily metabolized, the metabolites may be the analytes of interest for biological fluids. In addition, the mutagenicity/carcinogenicity of the metabolites must be known. In order to assess the body-burden, the residence time in the body must be known. The half-life of the halogenated organics under study varies from a few hours (e.g., methylene chloride) to several years (e.g., pesticides). The route of excretion is important to determine which biological samples are most important (breath, blood, urine, or tissue).

In an effort to resolve these issues, a summary of the known biological chemistry of the halogenated organics under study has been prepared and is presented in Appendix B. The major portion of this summary, Table B-1, was taken from "Metabolism Summaries of Selected Halogenated Organic Compounds in Man and Environmental Media, A Literature Survey" by R. Huffman, C. Latanich, T. Collins and J. Caldwell which was prepared by Tracor Jitco for Dr. Joseph Breen, Survey and Analysis Division, Office of Program Interpretation and Information, Office of Toxic Substances, EPA, under Contract No. 68-02-4116, Task 19. The data presented in Table B-1 were specially formatted by Tracor Jitco personnel for this study. These summaries are the result of an intensive effort to comprehensively review the literature for these compounds.

The metabolism of the pesticides to be studied is summarized in Table B-2. Data on the kinetics of these metabolism/elimination reactions were found only for dieldrin in pigeons and atrazine in pigs. It may be assumed that for DDT, DDE, and heptachlor, the half-life of the pesticide or its major metabolite is very long (several years) in humans.

POTENTIAL UTILITY OF RADIOIMMUNOASSAY--CARCINOEMBRYONIC ANTIGEN

In the search for diagnostic tools for the early detection of cancer, many biochemical markers have been examined. Few biochemical markers are altered until extensive tumor growth has occurred. The unique exception to this is the carcinoembryonic antigen (CEA). It is a small protein present in the developing embryo and some cancers. Plasma levels of CEA have been used to monitor the clinical progress of some tumors. Its use as a diagnostic tool has been impaired by high numbers of false positive and false negative results. In addition, there is conflicting opinion on the threshold value for a positive finding. In spite of these drawbacks, the determination of CEA is valuable since elevated levels of CEA have been the only predictive biochemical marker for cancer. Elevated serum levels have been found in patients with no clinical evidence of carcinoma who later developed carcinomas A rise in CEA frequently precedes tumor recurrence after surgery, chemotherapy or radiation treatment.

For the purposes of this study the question of whether a particular individual does or does not have cancer is not as important as the incidence of cancer in different populations. A considerable body of data exists on CEA blood levels in various populations and can be used to evaluate the populations in this study.

Historical Data Base for the Correlation of CEA and Disease State and Smoking

Normal healthy subjects with no smoking history were examined for their CEA titres using a radioimmunoassay (RIA) procedure according to Hansen (1). These results are summarized in Table 9-1. Approximately equal numbers of male and female subjects were represented among the 1425 individuals studied. Another group of 2107 subjects with no known disease was evaluated for CEA levels. These results are summarized in Table 9-2. Some malignant and non-malignant disease states influence the levels of CEA. For example, the levels in 2033 patients with clinically diagnosed malignant disease are given in Table 9-3. The levels for non-malignant conditions are given in Table 9-4.

All of the data presented in Tables 9-1 through 9-4 were derived using the Hansen method (1). Other RIA methods have been used and are listed with their unique characteristics in Table 9-5. Due to the commercial availability of the Hansen RIA procedure as a kit and the large population data base, this is the method of choice.

Urinary CEA levels have been determined and a correlation with certain diseases exists. Table 9-6 shows some of these results. It may be useful to determine CEA in urine even though the results are somewhat ambiguous due to the elevation of CEA by urinary infections.

Table 9-1. CEA TITRES IN HEALTHY NON-SMOKING* SUBJECTS

Age	No. of Subjects	Percentage of Subjects Having CEA Levels in Each Range				
		0.0-2.5 ng/ml	2.6-50.0 ng/ml	5.1-10.0 ng/ml	10.1-20.0 ng/ml	>20 ng/ml
<20	224	94.6	4.5	0.9	0.0	0.0
21-30	506	92.1	7.3	0.6	0.0	0.0
31-40	248	88.7	10.5	0.8	0.0	0.0
41-50	202	80.2	19.3	0.5	0.0	0.0
51-60	111	77.5	17.1	5.4	0.0	0.0
61-70	99	85.9	10.1	3.0	1.0	0.0
<70	35	85.7	11.4	2.9	0.0	0.0
All ages	1425	88.5	10.2	1.2	0.1	0.0

*Reference 1.

Table 9-2. CEA TITRES IN HEALTHY SUBJECTS - SMOKERS, NON-SMOKERS AND PREGNANT FEMALES*

Subject Type	No.	Percentage of Subjects Having CEA Levels in Each Range			
		0.0 - 2.5 ng/ml	2.6 - 5.0 ng/ml	5.1 - 10.0 ng/ml	>10.0 ng/ml
Non-smokers	892	97.0	2.8	0.2	0.0
Presently smoking	620	81.0	15.0	3.1	0.9
Former smokers	235	93.2	5.1	0.8	0.8
Pregnant females	360	96.1	3.0	0.8	0.0

*Reference 1

Table 9-3. CEA TITRES IN PATIENTS WITH CLINICALLY SUSPECTED MALIGNANT DISEASE*

Disease (site)	No. of Subjects	Percentage of Patients Having CEA Levels in Each Range			
		0.0 - 2.5 ng/ml	2.6 - 5.0 ng/ml	5.1 - 10.0 ng/ml	>10 ng/ml
Carcinomas					
colorectum	544	28	23	14	35
lung	181	24	25	25	26
pancreas	55	9	31	25	35
stomach	79	39	32	10	19
breast	125	53	20	13	14
other+	343	51	28	12	9
Non-carcinoma malignant disease					
malignant lymphoma	72	65	24	11	0
sarcoma	38	69	26	5	0
acute and chronic leukemia	40	63	25	7	5
other=	78	50	41	8	1
Non-malignant disease					
normal	62	81	16	3	0
benign tumor	143	82	12	6	0
hyperplasia	45	79	17	4	0
other@	231	86	11	3	0

*Reference 1

+Prostate, head, neck, ovary, cervix.

=Multiple myeloma, astrocystoma, mesothelioma and neuroblastoma.

@Crolin's disease, fibrocystic disease, colitis, pancreatitis.

Table 9-4. CEA TITRES IN 3340 PATIENTS WITH NON-MALIGNANT DISORDERS*

		Percentage of Patients Having CEA Levels in Each Range (ng/ml)			
Disorder	No. of Patients	0.0 - 2.5	2.6 - 5.0	5.1 - 10.0	10.0
pulmonary emphysema	49	43	37	16	4
alcoholic cirrhosis	120	30	44	24	2
ulcerative colitis	146	69	18	8	5
regional ileitis	97	60	27	11	2
granulomatous colitis	59	53	27	15	5
gastric ulcer	94	55	29	15	1
duodenal ulcer	166	70	22	6	2
rectal polyps	90	81	15	3	1
diverticulitis	84	73	20	5	2
breast disease (benign)	115	85	11	4	0
osteoarthritis	112	70	24	5	1
myasthenia gravis	183	82	17	1	0
bronchitis	61	67	25	7	1
obesity	55	69	28	3	0
hernia	103	77	22	1	0
diabetes	230	62	34	3	1
heart condition	289	61	32	5	2
hypertension	156	72	26	2	0

(continued)

Table 9-4 (cont'd.)

Disorder	No. of Patients	Percentage of Patients Having CEA Levels in Each Range (ng/ml)			
		0.0 - 2.5	2.6 - 5.0	5.1 - 10.0	10.0
Crohn's disease	29	86	12	2	0
hemorrhoids	49	67	28	4	1
diverticulosis	58	59	38	3	0
pancreatitis	95	47	31	18	4
hypothyroidism	47	68	28	4	0
kidney transplant	45	44	39	12	5
anemia	70	57	34	8	1
cholelithiases	54	82	17	1	0
cholecystitis	39	77	17	5	1
alcohol addiction	37	35	40	13	12
pneumonia	28	54	42	4	1
tuberculosis	30	63	35	2	0
hepatitis	69	70	29	1	0
other disorders	481	67	28	5	0

*Reference 1.

Table 9-5. COMPARISON OF RIA METHODS FOR CEA

Method (References)	Preliminary Extraction	Method of Separating CEA from CEA - anti CEA	Lapsed Time for assay (Days)	Upper Limit of "normal"	Population assayed
Hansen (1)	1.0 M $HClO_4$	zirconylphosphate gel	2	2.5 ng/ml	>10,000
Thomson (2)	1.0 $HClO_4$	50% $(NH_4)_2SO_4$	5	2.5 ng/ml	$\sim$100
Egan (3)	none	second antibody	2	16 ng/ml	unknown
McPherson (4)	none	solid phase	5	2.5 ng/ml	unknown
Coller (5)	none	radioimmunoelectrophoresis	0.083	not quantitative	unknown
MacSween (6)	none	second antibody	2	5.0 ng/ml	unknown
Go (7)	none	zirconylphosphate gel	2	2.0 ng/ml	unknown

Table 9-6. URINARY CEA LEVELS IN HEALTHY SUBJECTS AND SEVERAL DISORDERS*

Health Status	Sex	No. of Subjects in Each Range (ng/ml)				Positive+ To Total
		<35	35-60	61-100	>100	
Normal controls	M	42	3	1	1	5/47
	F	30	8	4	6	6/48
Carcinoma of the bladder:	M	16	5	6	20	31/47
	F	2	2	0	9	9/13
1) Treated with no evidence of recurrence of tumor	M	32	1	0	1	2/37
	F	9	1	0	0	0/10
2) with secondary infection	M	2	2	0	13	5/17
	F	0	0	0	3	3/3
Non-urethelial malignant tumors	M	16	0	0	0	0/16
	F	5	3	1	2	2/11
Benign disease	M	6	1	0	0	1/7
	F	3	0	1	1	1/5
Urinary infection	M	0	0	0	5	5/5
	F	0	1	0	3	3/4

*Reference 8.

+The threshold for positive CEA in urine was 35 ng/ml for men and 100 ng/ml for women.

Carcinoembryonic Antigen (CEA) Analysis on Residents of the Old Love Canal Area of Niagara Falls, NY -- A Pilot Study

Blood samples from the nine participants in the pilot study at "Old Love" Canal, Niagara Falls, NY were analyzed for carcinoembryonic antigen (CEA) by the procedure specified for the CEA-Roche Kit (Roche Diagnostics, Nutley, NJ). Briefly, the elements of this procedure are described below.

Collection of Samples

The blood samples were collected in 10 ml Vacutainer tubes containing EDTA and potassium sorbate (#4759 Vacutainer, Becton Dickinson and Company). The samples were centrifuged immediately for 30 min in a clinical centrifuge, and the plasma was withdrawn and placed in labelled containers. These samples were refrigerated until they were returned to the laboratory where they were frozen until analyzed.

Indirect Assay for CEA

Perchloric Acid Extraction--Duplicate aliquots of each plasma sample (0.5 ml) were diluted with 2 ml of 0.85% NaCl and mixed. 2.5 ml of perchloric acid (1.2 *M*) was added to each tube and mixed. The samples were then centrifuged for 20 min at 1000 x g and the supernatants decanted into dialysis bags. The bags were labelled and securely fastened before dialysis against water (250 ml/bag) with 4 changes of water and a minimum of 3 hr between changes with thorough mixing maintained throughout the dialysis. A final dialysis was performed against 0.01 *M* ammonium acetate (pH 6.5 $\pm$ 0.2). The extracts were then assayed by the radioimmunoassay (RIA) procedure.

RIA Procedure--Standards were prepared by adding 5 ml of the EDTA buffer (provided in the kit) to each of 5 pairs of labelled tubes. Aliquots of the CEA standard were added to each to provide duplicate standards with 0, 1.25, 3.125, 6.25 and 12.5 ng CEA per sample. The contents of each dialysis bag were placed in labelled tubes and treated exactly like the standards above. CEA antiserum (25 µl) was added to each tube (in small batches to facilitate accurate timing) and mixed. The tubes were incubated at 45°C for 30 min and removed. Twenty-five µl of ^{125}I-CEA was added, mixed, and incubated as above for 30 min. 2.5 ml Z-gel (Zirconyl phosphate gel provided in the kit) was added, rapidly mixed, and centrifuged at 1000 x g for 5 min.

The supernatants were decanted. The Z-gel was further washed with 5 ml of 0.1 M ammonium acetate by mixing, centrifuging and decanting the supernatant. The remaining Z-gel was counted in a gamma scintillation spectrometer. A calibration curve was constructed from the standards and used to estimate the sample concentrations.

Results and Discussion

The results of the analysis of the 9 participants in the pilot study are given in Table 9-7. The CEA-Roche procedure indicates standard deviations are roughly $\pm$ 0.5 ng/ml in the 0 to 5 ng/ml range.

CEA levels are not considered elevated until they exceed 2.5 ng/ml by this procedure. Three individuals from "Old Love" Canal fall into that category. In a normal healthy population of non-smokers the predicted frequency of elevated CEA is 3 in 100 and 19 per 100 for smokers. Of the 9 participants in this study, 5 were smokers. By using a weighted average incidence of elevated CEA levels for smokers and non-smokers, the 3 elevated CEA levels in this pilot study was of borderline significance (barely significant at the 90% confidence level). This is a very small population to attempt to analyze statistically; however, it does demonstrate the approach.

Table 9-7. PLASMA CEA LEVELS IN THE "OLD LOVE" CANAL STUDY

Sample No.	Mean ng/ml	Standard Error* ng/ml
1	1.40	0.46
2	2.58+	--
3	1.98	0.21
4	1.18	0.21
5	3.02#	0.69
6	2.29	0.27
8	1.11	0.66
9	1.91	0.30
10	2.74#	0.50

*The standard error was computed from $(s^2_{standards} + s^2_{samples})n^{1/2}$.

#Initial assay resulted in loss of one sample. A separate assay was made after the expiration date of the Kit.

+Initial assay resulted in loss of one sample and insufficient plasma remained for a repeat.

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SECTION 10

DEMOGRAPHIC AND METEOROLOGICAL CHARACTERISTICS OF SEVERAL POTENTIAL STUDY SITES

To assist in both the site selection and data interpretation, demographic and meteorological data have been collected for the potential study sites. The data collected include: wind roses, population density maps, USGS topographic maps, other local maps, aerial photographs, and water sources. In addition, RTI has all of the US Census data, in both hard copy and computer tapes, which may be accessed if necessary.

HISTORIC METEOROLOGICAL DATA (WIND ROSES)

Wind data for the study areas were obtained from the National Oceanographic and Atmospheric Administration (NOAA), Asheville, NC and converted to wind roses. The wind roses, shown in Appendix C, will be invaluable for planning sampling strategies and for estimating population exposures.

MAPS

Topographic maps (7-1/2 minute) were obtained for all of the potential study sites. These maps are useful for obtaining plant coordinates for population mapping and aerial photographs, roughly determining the population near the potential sites, determining the topography, and selecting sampling locations.

Maps from other sources (commercial, state, local government, chamber of commerce, banks, etc.) have been collected as available. These maps are generally more up-to-date and often give pertinent information such as plant names and street names which are not always given on the USGS maps.

POPULATION DENSITY MAPPING FOR STUDY AREAS

Arrangements were made with the Bureau of the Census through the Project Officer to obtain population density maps for the plant sites of interest to this study. The population density maps for the study areas are shown in Appendix D. The population density maps provide information pertinent not only to selection of sampling locations but also for the epidemiological studies later in this program.

The exact locations for the plants at the study sites were determined by discussion with EPA personnel, state and local officials, and RTI personnel who have been to the areas. The plants were then located on USGS 7-1/2" quadrangle maps and the longitude and latitude calculated. Table 6-1 lists the plants of interest, their locations, compounds produced, and the population radius selected for mapping. Some plant coordinates are missing, where the plant could not be pinpointed on a map. These locations will be filled in following the first trip to an area.

AERIAL PHOTOGRAPHY

Aerial (or satellite) photographs of selected plant sites were obtained by the Project Officer, J. Breen, from EPA-EMSL, Remote Sensing Division-Las Vegas. The photographs are extremely helpful, in conjunction with the maps, for determining industrial vs. residential areas. In addition, such factors as tree cover are obtainable. For the maps thus far obtained, overlays have been constructed showing the plants, points of interest, and, where applicable, previous sampling locations.

As an example, parts of two aerial photographs for Baton Rouge, LA have been reproduced here. The photographs are shown in Figure 10-1 and 10-3. It should be noted that the photograph received from the EPA was in color (infrared). The overlays for the areas shown in Figure 10-1 and 10-3 are reproduced in Figures 10-2 and 10-4, respectively. Not only are the plants of interest to this study (Allied North, Allied South and Ethyl) shown, but also several other nearby industries.

Additional aerial photographs are being prepared and will be treated in a similar manner when received.

WATER SOURCES

The water companies serving the sampling sites in New Jersey are listed in Table 10-1. Similar data will be obtained for the other areas as the study progresses.

The Niagara Falls water treatment plant is located immediately to the East of the Hooker chemical complex. The water intakes are about 400 m out

Figure 10-1. Aerial photograph (black and white copy of color print) of Allied North and surrounding area, Baton Rouge, LA. Scale of original is 1:12,000. Size of original is 46 x 46 cm.

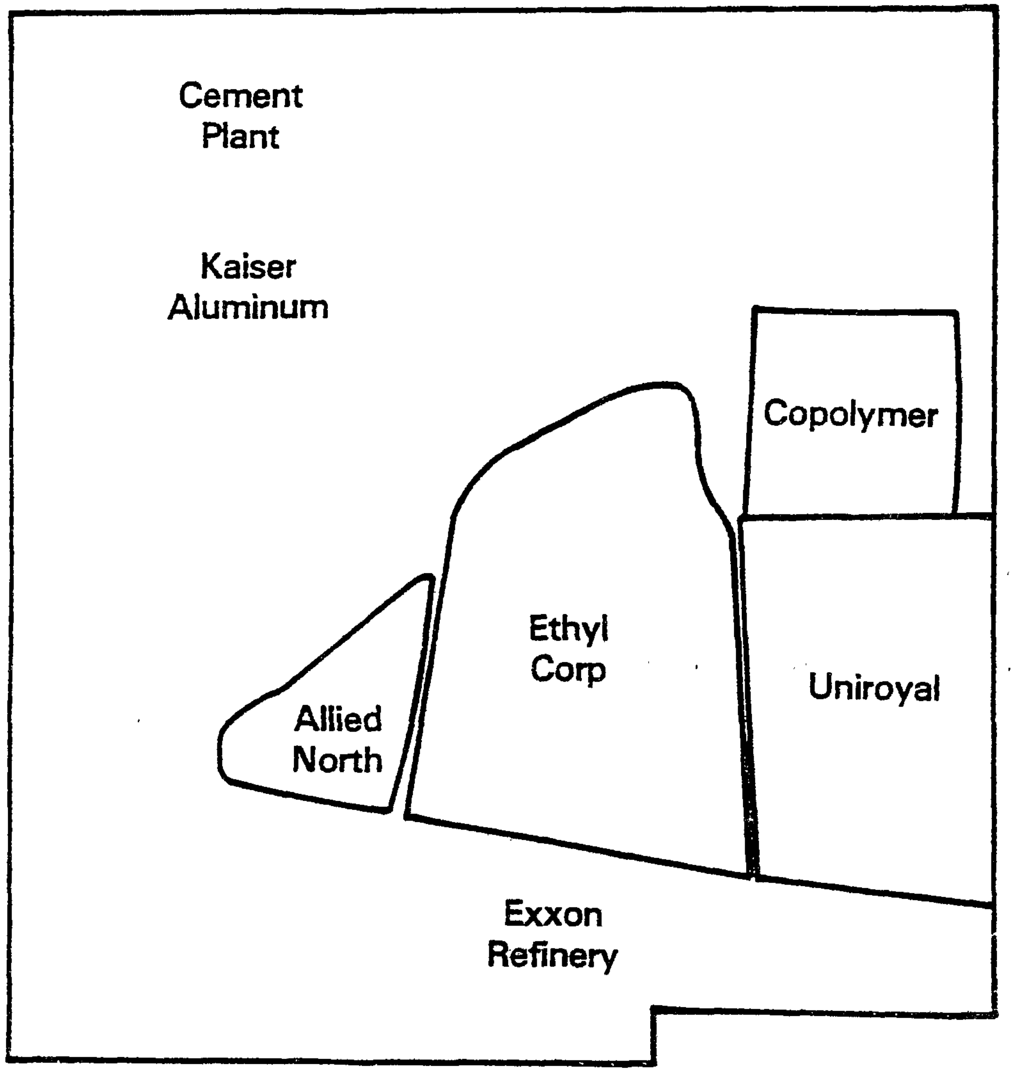


Figure 10-2. Reproduction of transparent overlay for Figure 10-1 showing rough outlines of plant sites.

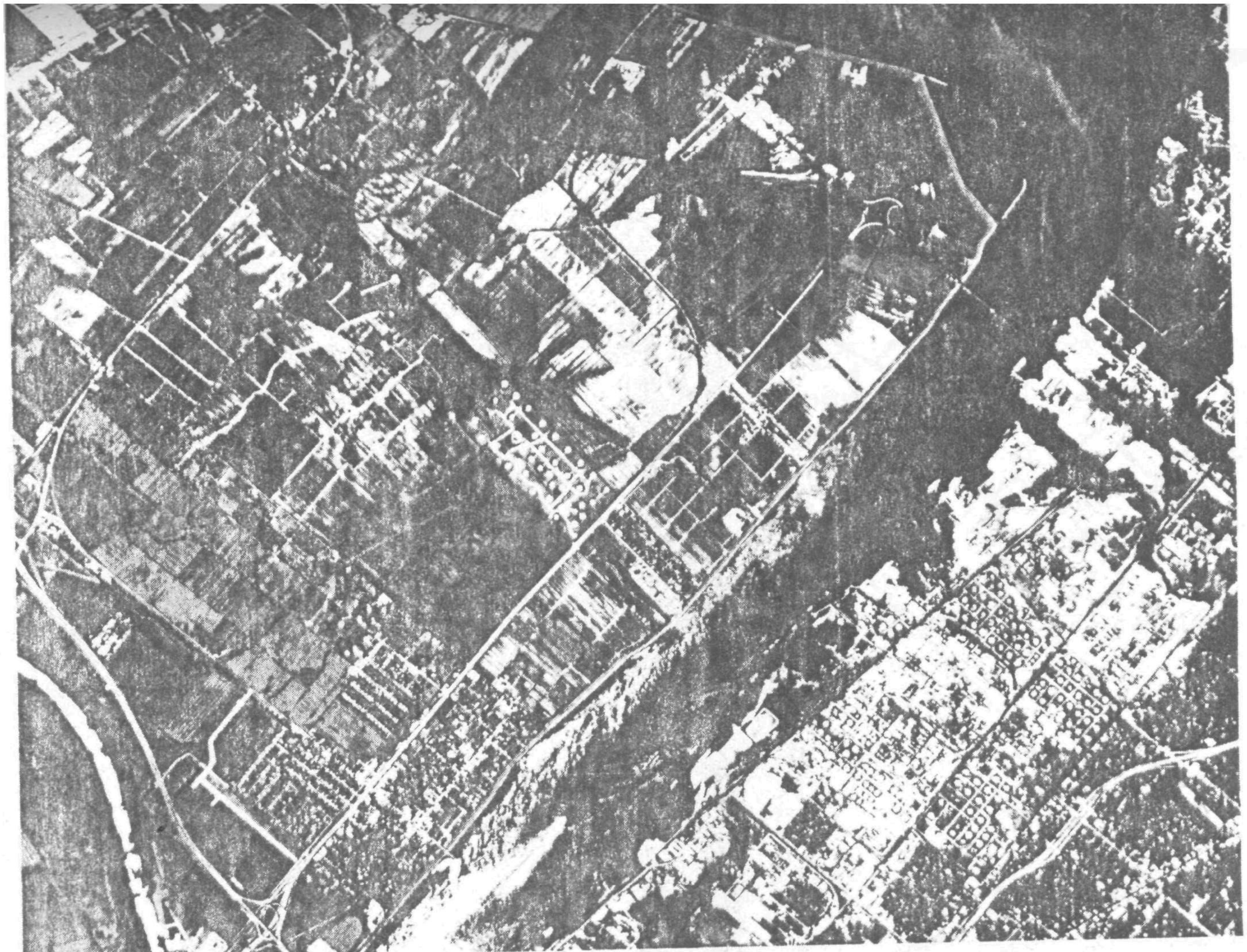


Figure 10-3. Infrared aerial photograph (black and white copy of color print) of Allied North, Allied South, Ethyl, and surrounding area, Baton Rouge, LA. Scale of original is 1:24,000. Size of original is 50 x 60 cm; area shown is is 32.5 x 50 cm.

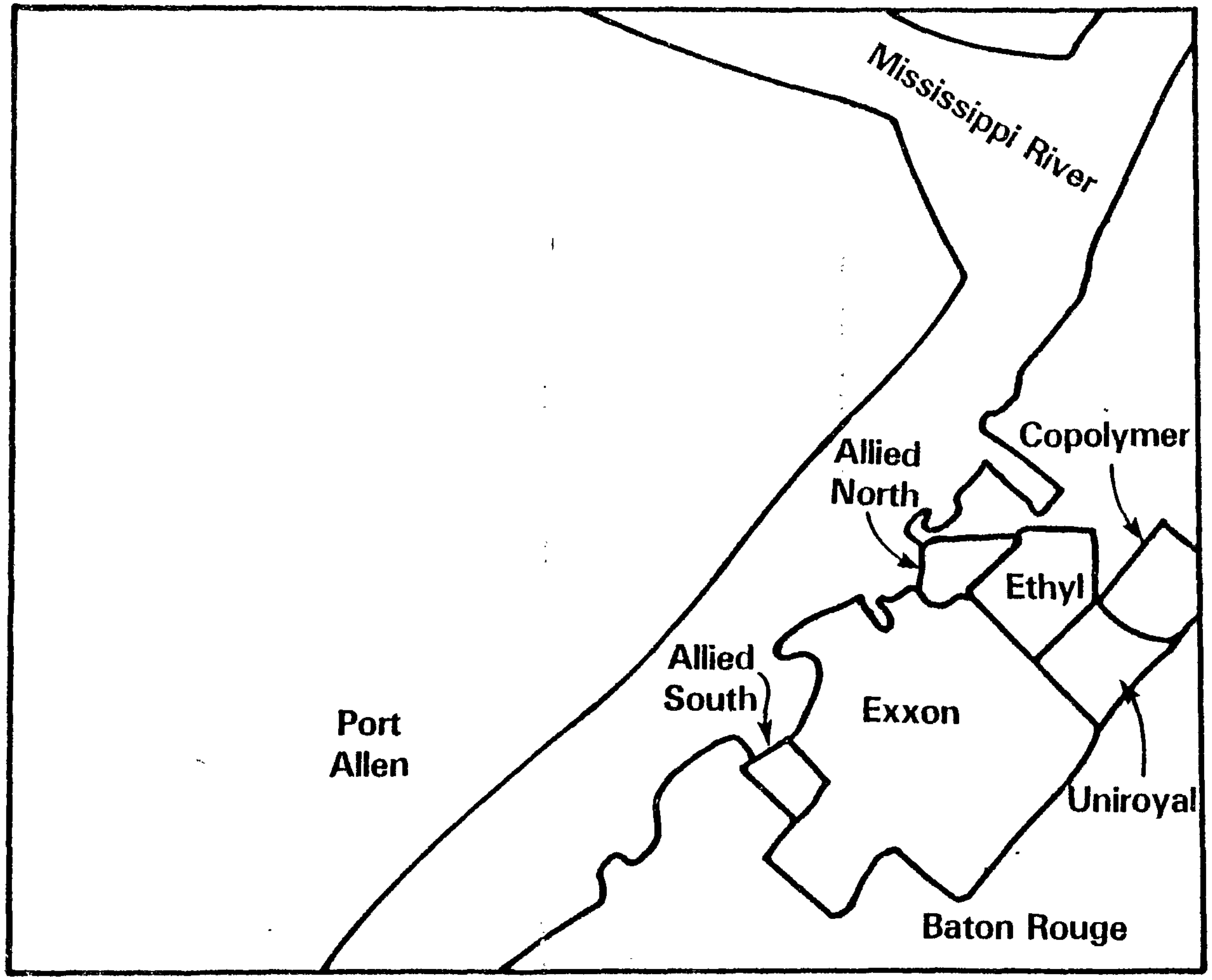


Figure 10-4. Reproduction of transparent overlay for Figure 10-3 showing rough outlines of plant sites and other major features.

Table 10-1. WATER COMPANIES SERVING THE SAMPLING SITES IN NEW JERSEY

Municipality	Water Company	Phone No.	Contact
Edison Metuchen Fords Hopelawn	Middlesex Water Co. 1 Woodbridge Center	634-1500	Mr. Bastian Mr. Mullen
Perth Amboy	Perth Amboy Water Co. 590 Smith St. Perth Amboy	826-0290	Mr. Langenohl
South Amboy Jct.	South Amboy Water Co.		
Sayreville	Sayreville Water Co.	727-0171	Mr. Piatek
Milltown	Milltown Water Co.		
New Brunswick	New Brunswick Water Co. 76 Bayard	745-5061	Don Carey
Bound Brook	Elizabethtown Water Co.	354-4444	Mr. Caden
Rutherford E. Rutherford Carlstadt Woodridge Moonachie Secaucus	Hackensack Water Co.	863-0500	Don Hoven

Source: Harry Smith, USEPA, Region II, New York from the treatment plant in the Niagara River. This treatment plant serves the entire city.

RECONNAISSANCE OF THE NEW JERSEY STUDY AREA

On July 13, 1978, Dr. M. D. Erickson of RTI drove through some of the potential study sites in northern New Jersey. Upon inspection, many potential sites could be eliminated for one reason or another.

Tenneco.--Tenneco, Ashland, and Hatco/Grace are located near the Raritan River on bottomland. Ashland manufactures alkyl cresols; Hatco/-Grace manufactures plasticizers (phthalates and adipates); the town of Fords represents a moderate study population and is generally considered downwind from Tenneco although an elevated freeway (New Jersey 440) may interfere with the air flow to the population area. Nevertheless, this site may be acceptable for purposes of this program.

Tremley Point (DuPont, GAF, American Cyanamid).--Tremley Point is a massive, sprawling industrial park. Because many large, non-halogenated-hydrocarbon-producing industries are located in this area (for example, Exxon Bayway Refinery), because the population in Linden is somewhat removed (>3 kilometers) and population densities to the north and east lie in New York (Staten Island) outside of the study area, and because GAF is currently not operating (according to Dr. Menczel of Region II), this site appears to be somewhat less than ideal as a suitable study site for this program.

Prentiss Drug and Chemical and Troy Chemical.--These companies are located near Wilson Avenue in Newark. The area is an old, decaying industrial park. The nearby population is primarily located upwind (to the west), although a sparse population to the north may be downwind during some of the time according to our meteorological data. The site is further complicated by other industries in the nearby area and heavy traffic on the skyway and turnpikes near Doremus Avenue. This does not appear to be a suitable site for this program.

White Chemical Company.--This company is located just east of the residential neighborhoods of Bayonne at the beginning of a sprawling industrial area on Constable Hook. The prevailing winds of this area result in the Hudson River being downwind; the population to the south (about 1 kilometer) is on Staten Island, NY which may be considered outside the study area. A large amount of non-halogenated industry is in the vicinity. Thus the site may be unsuitable for study.

UOP.--UOP is located along a four-lane artery (New Jersey 17) in East Rutherford. To the east are the Meadowlands and Sports Complex. To the west beginning within three blocks is a dense housing area. Thus the predominant downwind locations are unpopulated. In addition, Region II personnel have advised RTI that the Rutherford area is highly sensitized because of the recent discovery of a high incidence of childhood leukemia and Hodgkin's disease. This site has been under intensive study by the State, EPA, CDC and others.

Givaudan and Cosan.--In Clifton, NJ these two companies are about three blocks apart and are in a nearly ideal setting. The population surrounds the companies on all four sides, both close and at a distance. A minimum of non-halogenated hydrocarbon industry is present. Minwax Plant #2, Passaic Adhesive Chemical Company, and Rubber and Latex Company are all very small nearby plants. Cosan Chemical Company is a very small operation. Givaudan is, however, a very large complex of buildings, both manufacturing and office, with an estimated 500-1000 people working at the time the site visit was made. The volume of HHC's produced and used is probably very low and requires further investigation to justify the selection of this site.

Standard Chlorine Chemical Company.--This company is located in the Meadowlands at least 2 kilometers from any significant population. Despite the fact that they produce large quantities of chlorinated benzenes (75, 75 and 18 million pounds per year capacities for mono-, di-, and 1,2,4-trichlorobenzene, respectively, according to 1977 Directory of Chemical Producers - USA, Chemical Information Services, SRI International, Menlo Park, CA, 94025) the population is rather distant. The concentrations of HHC's probably decrease to very low levels before reaching the communities and thus human exposure would be extremely small. However, further consideration needs to be given to this site.

SECTION 11

SITES AND HALOGENATED HYDROCARBONS SELECTED FOR A COMPARATIVE ANALYSIS BETWEEN MAN AND THE ENVIRONMENT

This section utilizes the information in the previous Sections 5-10 in selecting the sites and halogenated hydrocarbons for monitoring in the environment to make a comparative analysis between man and the environment. In keeping with the acquisition of information according to the schematic shown in Figure 4-1, this section attempts to focus on the study design proposed for the program based on the uncovered information. Discussed here are the events which lead to the halogenated hydrocarbons to be monitored in the selected geographical areas in the respective environmental media in an attempt to demonstrate their dosage to man with the subsequent monitoring of the human sample to establish a human body-burden.

SUMMARY OF MOST PREVALENT HALOGENATED HYDROCARBONS

Vapor-Phase

The vapor-phase halogenated hydrocarbons which occurred at the higher concentrations in air and water were ranked and are listed in Tables 11-1 - 11-4. The compounds were divided into two groups, those which are considered to be ubiquitous, i.e. occurring at all of the geographical areas and different primarily only in concentration and those which are considered to be areas specific. A comparison of the halogenated hydrocarbons listed in Tables 11-1 - 11-4 reveals a particularly interesting trend. For the most part, those which are considered major compounds and ubiquitous in air are also commonly found in water.

Of the many compounds which were identified and measured and reported in Section 7, the most prevalent ones were selected for representation in these tables. Attention was given primarily to the mean concentration at which these compounds occurred and their mutagenic, carcinogenic or toxicity data.

Table 11-1. PREVALENT HALOGENATED COMPOUNDS IN AMBIENT AIR AND WATER OF NIAGARA FALLS AND BUFFALO, NY

	Occurrence			
Medium	Ubiquitous	Mean Conc.	Area Specific	Mean Conc.
Air	chloroform	89,000 ng/m^3	chlorobenzotrifluoride isomers	11,400 ng/m^3
	tetrachloroethylene	6,800	chlorotoluene isomers	6,800
	1,1,1-trichloroethane	3,600	trichlorobenzene isomers	2,300
	trichloroethylene	540	trichlorotoluene isomers	320
	carbon tetrachloride	1,700	1,3-hexachlorobutadiene	250
			dichlorotoluene isomers	310
			dichlorobenzotrifluoride	193
Water	bromodichloromethane	8.3 μg/ℓ	tetrachlorobenzene isomers	1.5 μg/ℓ
	chloroform	3.1	trichlorobenzene isomers	0.5
	tetrachloroethylene	2.0	1,3-hexachlorobutadiene	0.07
	chlorodibromomethane	2.0	bromoform	0.05
	m-dichlorobenzene	0.4		
	1,1,1-trichloroethane	0.3		
	carbon tetrachloride			

Table 11-2. PREVALENT HALOGENATED COMPOUNDS IN AMBIENT AIR AND WATER OF RAHWAY/WOODBRIDGE, BOUNDBROOK AND PASSAIC, NJ

	Occurrence			
Medium	Ubiquitous	Mean Conc.	Area Specific	Mean Conc.
Air	tetrachloroethylene	210,000 ng/m^3	1,1,2-trichloroethane	9,000 ng/m^3
	trichloroethylene	125,000	vinyl chloride	1,200
	1,1,1-trichloroethane	62,000	1,2-dichloroethylene	1,000
	1,2-dichloroethane	96,000	1,1,2,2-tetrachloroethane	750
	chloroform	47,000		
	carbon tetrachloride	29,000		
	_o_,_m_,_p_-dichlorobenzenes	11,000		
	chlorobenzene	2,700		
Water	dichlorobenzene	209 μg/ℓ	chloronitrobenzene	10.7 μg/ℓ
	trichloroethane	42	methyl trichlorophenoxy acetate	5
	chloroform	14	methyl dichlorophenoxy acetate	3.5
	trichloroethylene	7	bromopropylbenzene	3
	dichloroethane	5	bromobenzene	3
	bromodichloroethane	5	tetrachloroethane	2.5
	bromodichloromethane	3.7	dichloroethylene	1.8
	tetrachloroethylene	3.6		
	dibromochloromethane	3.3		

Table 11-3. PREVALENT HALOGENATED COMPOUNDS OCCURRING IN AMBIENT AIR AND WATER OF BATON ROUGE, GEISMAR AND PLAQUEMINE, LA

Medium	Occurrence: Ubiquitous	Mean	Area Specific	Mean
Air	chloroform	5,500 ng/m^3	1,1,2-trichloroethane	632 ng/m^3
	1,2-dichloroethane	1,656	1,2-dichloroethylene	472
	carbon tetrachloride	811	dichlorobutane	409
	1,1,1-trichloroethane	605	1,2-dichloropropane	306
	trichloroethylene	142	vinylidene chloride	78
	tetrachloroethylene	118	1,1,2,2-tetrachloroethane	70
	1,1-dichloroethane	86		
Water	trichloroethylene	96 μg/ℓ	bromobenzene	13 μg/ℓ
	chloroform	20	1,2-dichloroethylene	4
	trichloroethane	11	hexachloroethane	1.6
	dichloroethane	7.7		
	carbon tetrachloride	7.1		
	dichlorobenzene	4.2		
	chlorodibromomethane	3.5		
	tetrachloroethylene	1.9		

Table 11-4. PREVALENT HALOGENATED COMPOUNDS OCCURRING IN AMBIENT AIR AND WATER OF HOUSTON, DEER PARK AND PASADENA, TX

	Occurrence			
Medium	Ubiquitous	Mean Conc.	Area Specific	Mean Conc.
Air	1,2-dichloroethane	3,162 ng/m^3	1,2-dichloroethylene	697 ng/m^3
	1,1,1-trichloroethane	2,428	1,1,2-trichloroethane	584
	chloroform	1,000	chloroprene	251
	carbon tetrachloride	532	dichloropropane isomer	243
	trichloroethylene	345	vinylidene chloride	188
	_o_,_m_,_p_-dichlorobenzenes	300 ($\sim$100 ea.)	pentachloroethane	156
	tetrachloroethylene	189	hexachloroethane	121
	1,1-dichloroethane	162		
	chlorobenzene	164		
Water	trichloroethylene	54 µg/ℓ	trichlorobutane	185 µg/ℓ
	trichloroethane	24	trichloropentane	92
	dichlorobenzene	21	bis-(chloroisopropyl)ether	19
	carbon tetrachloride	13	trichlorohexane	16
	chloroform	9	dichlorobutane	8
	tetrachloroethylene	8	dichloroheptane	4
			chloroprene dimer	2
			pentachloroanisole	2

Pesticides

Table 11-5 presents the ranking of the pesticides and PCB's by reported concentrations in human fat and milk. These data represent a summary of the information which was presented in Section 7 which indicated that the predominant concentration of pesticides and PCB occurred in fat and milk. For the pesticides which were measured, the predominant species were DDE, DDT, mirex and PCB's. Although these data were not exclusively obtained for the areas selected for study in this program, they do represent a general trend upon which a selection of the pesticides for monitoring in human tissue and milk can be made for the five geographical areas.

EXTRAPOLATED DOSAGE OF HALOGENATED HYDROCARBONS TO MAN

The potential human 24 hr dosage based upon the mean concentrations of halogenated hydrocarbons for the four geographical areas (Houston, Baton Rouge, NJ, and Niagara/Buffalo, NY) are presented in Tables 11-6 - 11-9. The dosage was calculated using a human air and water intake of 8,640 ℓ/24 hrs and 1 ℓ/24 hrs, respectively. Based upon the average concentrations which were given in the previous table (11-1 - 11-4), the potential dosage from air + water was determined. As in the previous tables, the compounds were again grouped according to their occurrence as ubiquitous or area specific.

The general criterion which was used for selecting an arbitrary cut-off point was a potential dosage of $\sim$1 μg/24 hrs of a substance. An estimation can be made as to whether it is possible to detect using the current analytical methodology, the halogenated hydrocarbons diluted in 8 ℓ of human blood (average man 70 kg) for a dosage of 1 μg/24 hrs. This calculation of course does not account for the half-life (metabolism and/or excretion) of a compound; however it does provide an estimation of the maximum quantity of halogenated hydrocarbon which might be present in the blood. From this value, then it can be determined whether it is potentially possible to detect a compound by the analytical techniques to be employed. An example of such calculation is as follows:

$$\text{Blood Level } (\mu g/\ell) = \frac{[\text{air conc. } (\mu g/m^3) \text{ x air intake } (m^3/24 \text{ hr})] + [\text{water conc.}/\mu g/\ell) \text{ x water intake } \mu g/\ell)}{8\ \ell}$$

Table 11-5. RANKING OF PESTICIDES AND PCB's BY REPORTED CONCENTRATIONS IN HUMAN FAT AND MILK

Compound	Fat[a]		Milk[b]	
	Wtd. Mean Conc.[d]	Number of Samples	Wtd. Mean Conc.	Number of Samples
DDE	4,836	2,444	99	103
DDT	2,651	1,545	94	100
Mirex	2,500	6		
PCB's	2,080	836	<10	96
BHC	472	1,044	3.4	106
Dieldrin	155	659	4.0	92
Heptachlor epoxide	145	672	3.5	71
DDD	95	114	4	54
t-Nonachlor	50	5	1	57
Oxychlordane			5	57
Endrin	<30	246		

[a]All fat and adipose tissue samples included, except milk fat, conc. = ppb.

[b]Whole milk only.

[c]All isomers summed.

[d]Mean value calculated from a weighted mean of values in Table 7-4. Where either the mean or number of samples analyzed were unavailable, the data were excluded from calculation.

Table 11-6. TOTAL POTENTIAL 24 HR DOSE OF HALOGENATED COMPOUNDS TO HUMANS FROM AIR AND WATER IN NIAGARA FALLS AND BUFFALO, NY

Ubiquitous			Area Specific		
Compound	Media	ng/24 hr	Compound	Media	ng/24 hr
chloroform	A,W	772,060	chlorobenzotrifluoride isomers	A	98,496
tetrachloroethylene	A,W	60,752	chlorotoluene isomers	A	58,752
1,1,1-trichloroethane	A,W	31,404	trichloroebenzene isomers	A,W	20,372
carbon tetrachloride	A,W	14,690	trichlorotoluene isomers	A	2,765
bromodichloromethane	W	8,300	dichlorotoluene isomers	A	2,678
chlorodibromomethane	W	2,000	1,3-hexachlorobutadiene	A,W	2,230
			dichlorobenzotrifluoride	A	1,667
	Total:	889,200		Total:	187,360

Table 11-7. TOTAL POTENTIAL 24 HR DOSE OF HALOGENATED COMPOUNDS TO HUMANS FROM AIR AND WATER IN RAHWAY/WOODBRIDGE, BOUNDBROOK, AND PASSAIC, NJ

Ubiquitous			Area Specific		
Compound	Media	ng/24 hr	Compound	Media	ng/24 hr
tetrachloroethylene	A,W	1,818,000	1,1,2-trichloroethane	A	77,760
trichloroethylene	A,W	1,087,000	vinyl chloride	A	10,368
1,1,1-trichloroethane	A,W	57 ,680	chloronitrobenzene	W	10,700
1,2-dichloroethane	A,W	834,440	1,2-dichloroethylene	A	10,440
chloroform	A,W	420,000	1,1,2,2-tetrachloroethane	A,W	8,980
carbon tetrachloride	A	250,560	methyl trichlorophenoxy acetate	W	5,000
o,m,p-dichlorobenzenes	A	304,040	methyl dichlorophenoxy acetate	W	3,500
chlorobenzene	A	23,330	bromopropylbenzene	W	3,000
bromodichloroethane	W	5,000	bromobenzene	W	3,000
bromodichloromethane	W	3,700			
dibromochloromethane	W	3,300			
	Total:	5,327,130		Total:	132,748

Table 11-8. TOTAL POTENTIAL 24 HR DOSE OF HALOGENATED COMPOUNDS TO HUMANS FROM AIR AND WATER IN BATON ROUGE, GEISMAR AND PLAQUEMINE, LA[a]

Ubiquitous			Area Specific		
Compound	Media	ng/24 hr	Compound	Media	ng/24 hr
trichloroethylene	A,W	97,230	bromobenzene	W	13,000
chloroform	A,W	67,520	1,2-dichloroethylene	A,W	8,078
1,2-dichloroethane	A,W	22,007	1,1,2-trichloroethane	A	5,460
carbon tetrachloride	A,W	14,110	dichlorobutane	A	3,534
1,1,1-trichloroethane	A,W	16,227	hexachloroethane	W	1,600
methylene chloride	A,W	10,255	vinylidene chloride	A	673
dichlorobenzene	W	4,200	1,1,2,2-tetrachloroethane	A	604
chlorodibromomethane	W	3,500			
tetrachloroethylene	A,W	2,920			
1,1-dichloroethane	A	8,440			
	Total:	224,402		Total:	32,949

[a]Based upon human air and water intake of 8,640 ℓ/24 hr and 1 ℓ/24 hr, respectively.

Table 11-9. TOTAL POTENTIAL 24 HR DOSE OF HALOGENATED COMPOUNDS TO HUMANS FROM AIR AND WATER IN HOUSTON, DEER PARK, AND PASADENA, TX[a]

Ubiquitous			Area Specific		
Compound	Media	ng/24 hr	Compound	Media	ng/24 hr
trichloroethylene	A,W	54,290	trichlorobutane	W	185,000
1,1,1-trichloroethane	A,W	45,000	trichloropentane	W	92,000
1,2-dichloroethane	A	27,320	bis-(chloroisopropyl)ether	W	19,000
dichlorobenzene	A,W	23,596	trichlorohexane	W	16,000
methylene chloride	A	22,378	dichlorobutane	W	8,000
carbon tetrachloride	A,W	17,596	1,2-dichloroethylene	A	6,022
tetrachloroethylene	A,W	9,633	1,1,2-trichloroethane	A	5,045
chloroform	W	7,640	dichloroheptane	W	4,000
chlorobenzene	A	1,417	chloroprene	A	2,169
1,1-dichloroethane	A	1,400	dichloropropane isomer	A	2,099
			chloroprene dimer	A,W	2,000
			pentachloroanisole	W	2,000
			vinylidene chloride	A	1,624
			pentachloroethane	A	1,348
			hexach oroethane	A	1,045
	Total:	210,270		Total:	347,352

[a]Based upon human air and water intake of 8,640 ℓ/24 hr and 1 ℓ/24 hr, respectively.

$$\text{Blood Level } (\mu g/\ell) = \frac{[2.9\ \mu g/24\ hr] + [54\ \mu g/24\ hr]}{8\ \ell} = \frac{7\ \mu g}{\ell} \text{ or } \frac{7\ ng}{ml}$$

assuming 4 half-lives, the concentration may be as low as 0.437 $\frac{ng}{ml}$.

Beginning with the potential dosage of halogenated compounds to humans from air and water in Niagara Falls and Buffalo, NY, the data listed in Table 11-6 indicate substantial quantities of compounds can be ingested during a 24 hr period. Recalling that these calculations are based on mean concentrations which were observed in these areas, then it is conceivable for chloroform, mg quantities may be ingested by the human population. Furthermore, the total human body-burden load of halogenated hydrocarbons may reach well into the mg/24 hr period.

The levels of ubiquitous halogenated hydrocarbons occurring in the selected sites for Northern New Jersey appear to be considerably higher than the other major geographical areas selected for study. The potential dosage of many of the ubiquitous halogenated compounds may reach well into the mg range/a 24 hr period when considering their ingestion through air and water. The total human body-burden of halogenated hydrocarbons is in the mg range on a 24 hr basis.

The remaining two geographical areas, Baton Rouge, LA and vicinity and Houston, TX and vicinity also contain substantial quantities of halogenated hydrocarbons which may lead to a significant human body-burden. A comparison of each of the tables clearly delineates those compounds which are area specific and represent the most prevalent and thus highest total potential dosage to man.

HALOGENATED HYDROCARBONS SELECTED FOR STUDY

Vapor-Phase

As indicated in the sections on potential sources and the measured halogenated hydrocarbons in the environment, there are many compounds to consider in this program. The magnitude of the number of compounds which have been found in each of the geographical areas is well beyond the level of effort which this program can devote to their study. For this reason, a set of criteria were defined which were used to guide the selection of compounds for study in making a comparative analysis between man and the environment. These criteria are: (1) their known presence in environmental media directly related to man's intake and exposure for the five geographical areas under consideration. Their known presence were to be examined on the basis of site-specific vs. ubiquitous pollutants, their relative concentration and their propensity to persist in the environment; (2) their known or suspected carcinogenic/mutagenic activity, e.g. those which are procarcinogens vs. co-carcinogens. This information was presented in Section 8 of this report. In combination with other pollutants, the question to be asked was whether they act synergistically or antagonistically. Information concerning their metabolism and metabolite activity was also considered and discussed in Section 9; (3) their known production, usage or disposal in the areas of study, i.e. their potential air emission, liquid effluents traced to drinking aquifers, their agricultural usages such as pesticides which might be involved in run-off during precipitation and eventually contaminate the drinking water supplies or foods and their resistance to biodegradation. This information was discussed in Section 6; (4) their presence in human biological fluids and tissue. Information concerning their half-life in the body was important as to whether their monitoring was even feasible and their persistence as either parent compounds or major metabolites. Again much of this information was discussed in Section 7 and 9.

Using these criteria as a guideline, a series of halogenated hydrocarbons have been selected which are suggestive for monitoring in air, water and human samples.

Vapor-Phase

Table 11-10 presents the compounds which have been selected for monitoring in air and water in Niagara and Buffalo, NY. Correspondingly, these compounds are proposed to be monitored in human blood (Table 11-11) and for the more volatile constituents also in breath. A tentative selection has been made for the compounds which are to be monitored in urine.

Table 11-12 presents the halogenated hydrocarbons to be monitored in air and water in Rahway/Woodbridge, Bound Brook and Passaic, NJ. Of course all of these compounds will be monitored in blood (Table 11-13) while the more volatile constituents are to be examined in breath.

Table 11-10. HALOGENATED COMPOUNDS SELECTED FOR MONITORING IN AIR AND WATER IN NIAGARA FALLS AND BUFFALO, NY

	Air	Water
Ubiquitous	chloroform	chloroform
	1,1,1-trichloroethane	1,1,1-trichloroethane
	carbon tetrachloride	tetrachloroethylene
	trichloroethylene	bromodichloromethane
	tetrachloroethylene	chlorodibromomethane
		carbon tetrachloride
		_m_-dichlorobenzene
Area Specific	chlorobenzotrifluoride isomers	trichlorobenzene isomers
	chlorotoluene isomers	tetrachlorobenzene isomers
	trichlorobenzene isomers	1,3-hexachlorobutadiene
	trichlorotoluene isomers	bromoform
	1,3-hexachlorobutadiene	
	dichlorotoluene isomers	

Table 11-11. HALOGENATED COMPOUNDS SELECTED FOR MONITORING IN HUMAN SAMPLES FROM NIAGARA FALLS AND BUFFALO, NY

	Blood	Breath	Urine[a]
Ubiquitous	chloroform	chloroform	
	1,1,1-trichloroethane	1,1,1-trichloroethane	
	carbon tetrachloride	carbon tetrachloride	
	trichloroethylene	trichloroethylene	
	tetrachloroethylene	tetrachloroethylene	
Area Specific	chlorobenzotrifluoride isomers	-	
	chlorotoluene isomers	-	
	trichlorobenzene isomers	-	
	trichlorotoluene isomers	-	
	dichlorotoluene isomers	-	
	tetrachlorobenzene isomers	-	
	bromoform	-	
	1,3-hexachlorobutadiene	-	

[a]To be selected.

Table 11-12. HALOGENATED COMPOUNDS SELECTED FOR MONITORING IN AIR AND WATER IN RAHWAY/WOODBRIDGE, BOUNDBROOK AND PASSAIC, NJ

	Air	Water
Ubiquitous	chloroform	chloroform
	1,2-dichloroethane	1,2-dichloroethane
	1,1,1-trichloroethane	1,1,1-trichloroethane
	carbon tetrachloride	trichloroethylene
	trichloroethylene	tetrachloroethylene
	tetrachloroethylene	bromodichloroethane
	chlorobenzene	bromodichloromethane
	o,*m*,*p*-dichlorobenzenes	dichlorobenzenes
Area Specific	vinyl chloride	chloronitrobenzene
	1,2-dichloroethylene	methyl dichlorophenoxy acetate
	1,1,2-trichloroethane	bromopropylbenzene
	1,1,2,2-tetrachloroethane	bromobenzene

Table 11-13. HALOGENATED COMPOUNDS SELECTED FOR MONITORING IN HUMAN SAMPLES FROM RAHWAY/WOODBRIDGE, BOUNDBROOK AND PASSAIC, NJ

	Blood	Breath	Urine[a]
Ubiquitous	chloroform	chloroform	
	1,2-dichloroethane	1,2-dichloroethane	
	1,1,1-trichloroethane	1,1,1-trichloroethane	
	carbon tetrachloride	carbon tetrachloride	
	trichloroethylene	trichloroethylene	
	tetrachloroethylene	tetrachloroethylene	
	chlorobenzene	-	
	o,m,p-dichlorobenzenes	-	
	bromodichloromethane	bromodichloromethane	
Area Specific	vinyl chloride	vinyl chloride	
	1,2-dichloroethylene	1,2-dichloroethylene	
	1,1,2-trichloroethane	1,1,2-trichloroethane	
	1,1,2,2-tetrachloroethane	-	
	chloronitrobenzene	-	
	methyl dichlorophenoxy acetate	-	
	bromopropylbenzene	-	
	bromobenzene	-	

[a]To be selected.

Tables 11-14 - 11-17 presents the halogenated substances selected for monitoring in the two remaining geographical areas. The Greensboro, NC area was selected essentially as a control and thus all of the ubiquitous which are listed for the other four geographical areas will be monitored in the air, water and blood samples from Greensboro as well as those compounds which were designated as area-specific.

Pesticide

Table 11-18 presents the pesticides and PCB's which have been selected for correlative studies in biological tissue and soil samples for all of the geographical areas.

Table 11-14. HALOGENATED COMPOUNDS SELECTED FOR MONITORING IN AIR AND WATER IN BATON ROUGE, GEISMAR AND PLAQUEMINE, LA

	Air	Water
Ubiquitous	chloroform 1,2-dichloroethane 1,1,1-trichloroethane carbon tetrachloride trichloroethylene tetrachloroethylene	chloroform 1,2-dichloroethane 1,1,1-trichloroethane carbon tetrachloride chlorodibromomethane dichlorobenzenes
Area Specific	1,1,2-trichloroethane 1,2-dichloroethylene dichlorobutane 1,2-dichloropropane 1,1,2,2-tetrachloroethane	1,2-dichloroethylene bromobenzene hexachloroethane

Table 11-15. HALOGENATED COMPOUNDS SELECTED FOR MONITORING IN HUMAN SAMPLES FROM BATON ROUGE, GEISMAR, AND PLAQUEMINE, LA

	Blood	Breath	Urine[a]
Ubiquitous	chloroform	chloroform	
	1,2-dichloroethane	1,2-dichloroethane	
	1,1,1-trichloroethane	1,1,1-trichloroethane	
	carbon tetrachloride	carbon tetrachloride	
	trichloroethylene	trichloroethylene	
	tetrachloroethylene	tetrachloroethylene	
	chlorodibromomethane	chlorodibromomethane	
	dichlorobenzenes	-	
Area Specific	1,2-dichloroethylene	1,2-dichloroethylene	
	1,1,2-trichloroethane	1,1,2-trichloroethane	
	dichlorobutane	dichlorobutane	
	1,2-dichloropropane	1,2-dichloropropane	
	1,1,2,2-tetrachloroethane	1,1,2,2-tetrachloroethane	
	bromobènzene	-	
	hexachloroethane	-	

[a]To be selected.

Table 11-16. HALOGENATED COMPOUNDS SELECTED FOR MONITORING IN AIR AND WATER IN HOUSTON, DEER PARK AND PASADENA, TX

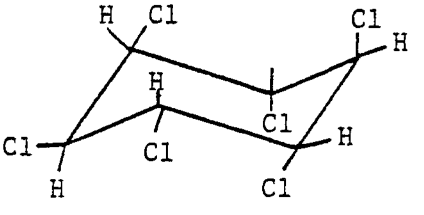
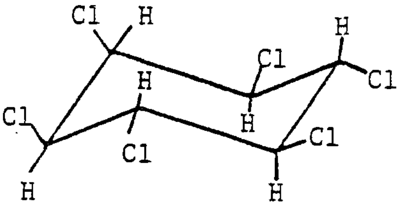
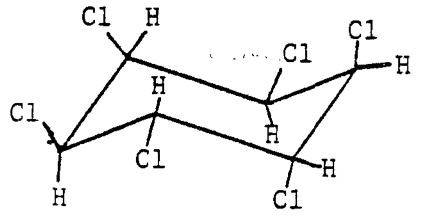
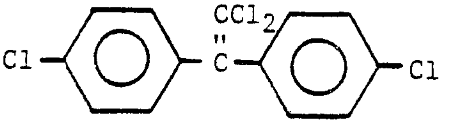
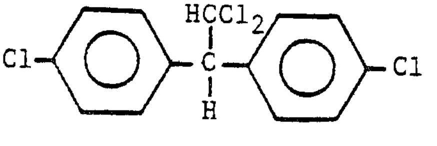
	Air	Water
Ubiquitous	chloroform 1,2-dichloroethane 1,1,1-trichloroethane carbon tetrachloride trichloroethylene tetrachloroethylene chlorobenzene _o_,_m_,_p_-dichlorobenzenes	chloroform 1,1,1-trichloroethane carbon tetrachloride trichloroethylene tetrachloroethylene
Area Specific	1,2-dichloroethylene 1,1,2-trichloroethane chloroprene	dichlorobutane trichlorobutane trichloropentane bis-(chloroisopropyl)ether trichlorohexane

Table 11-17. HALOGENATED COMPOUNDS SELECTED FOR MONITORING IN HUMAN SAMPLES FROM HOUSTON, DEER PARK AND PASADENA, TX

	Blood	Breath	Urine[a]
Ubiquitous	chloroform	chloroform	
	1,2-dichloroethane	1,2-dichloroethane	
	1,1,1-trichloroethane	1,1,1-trichloroethane	
	carbon tetrachloride	carbon tetrachloride	
	trichloroethylene	trichloroethylene	
	tetrachloroethylene	tetrachloroethylene	
	chlorobenzene	-	
	o,m,p-dichlorobenzenes	-	
Site Specific	1,2-dichloroethylene	1,2-dichloroethylene	
	1,1,2-trichloroethane	1,1,2-trichloroethane	
	chloroprene	-	
	dichlorobutane	dichlorobutane	
	trichlorobutane	-	
	trichloropentane	-	
	bis-(chloroisopropyl)ether	-	
	trichlorohexane	-	

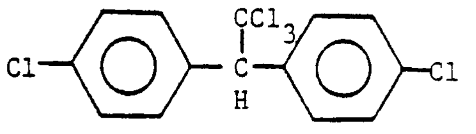
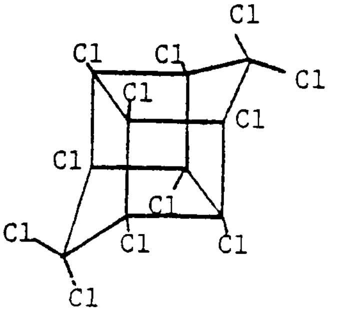
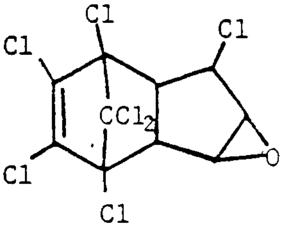
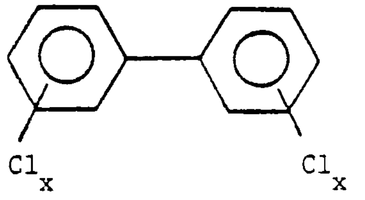
[a] To be selected.

Table 11-18. PESTICIDES AND PCB's SELECTED FOR CORRELATIVE STUDIES IN BIOLOGICAL TISSUE AND SOIL SAMPLES FOR ALL GEOGRAPHICAL AREAS

Compound	Structure	Molecular Weight
γ-BHC (Lindane)		288
β-BHC		288
α-BHC		288
p,p'-DDE		318
p,p'-DDD		320

(continued)

Table 11-18 (cont'd.)

Compound	Structure	Molecular Weight
p,p'-DDT		354
Mirex		540
Heptachlor epoxide		386
PCB's		188 - 494

APPENDIX A

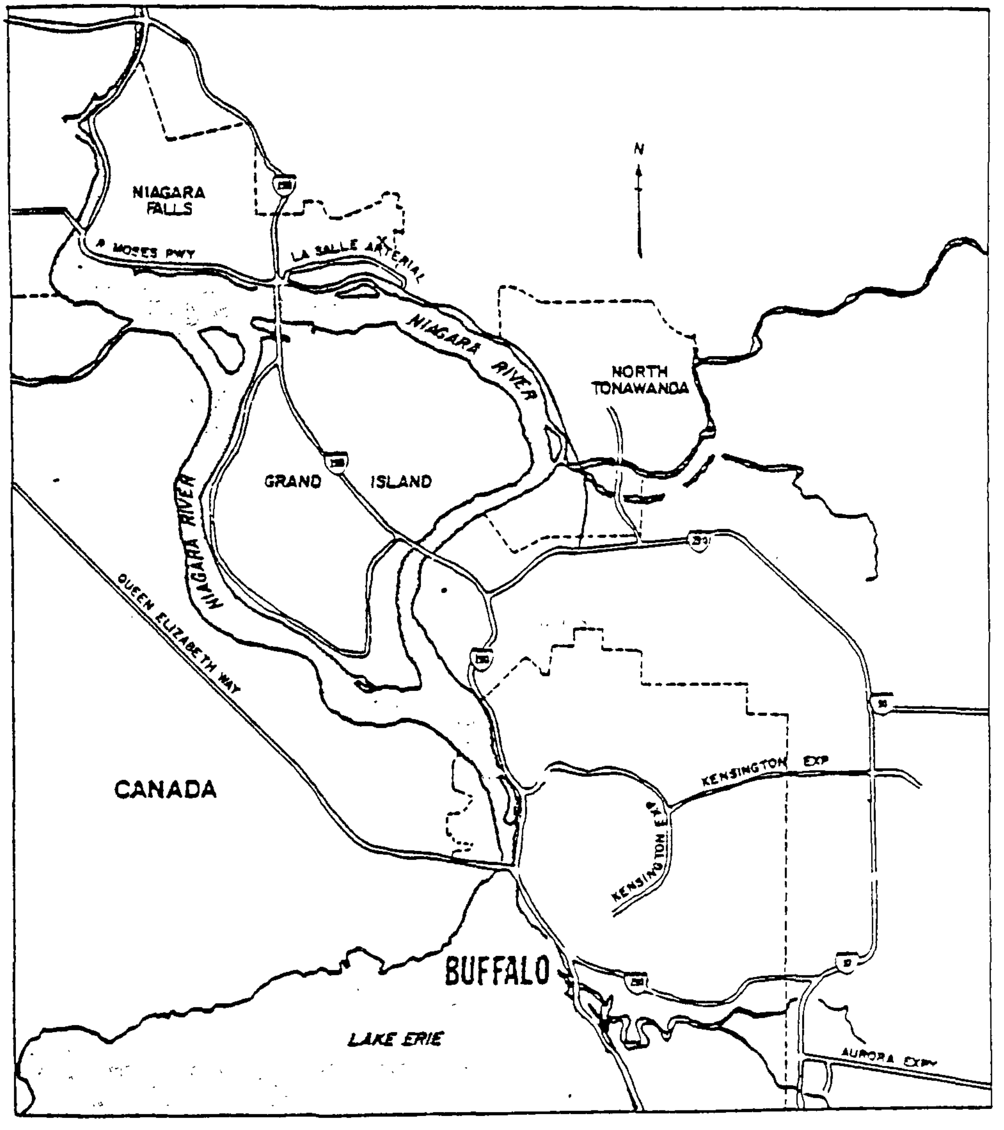


Figure A-1. Map of Buffalo and Niagara Falls, NY Area (x = sampling site near LaSalle Arterial).

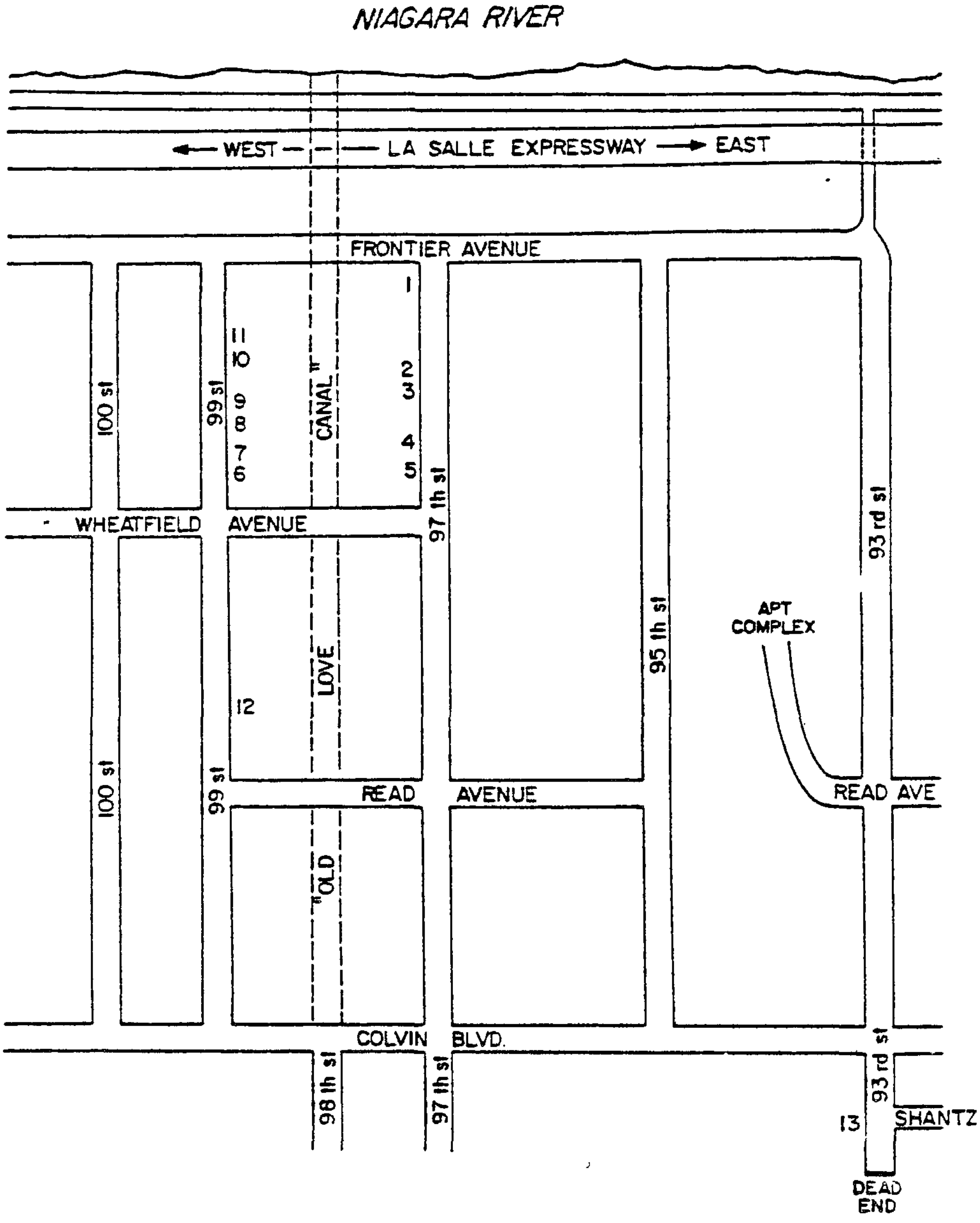


Figure A-2. Map depicting sampling locations 1 to 13 in Niagara Falls, NY.

Table A-1. SAMPLING PROTOCOL FOR VAPOR-PHASE ORGANICS IN AIR FROM HOUSEHOLD BASEMENTS AND SCHOOL ROOMS IN NIAGARA, NY

			Remarks		
Sampling Location[a]	Sampling Time (min)	Sampling Volume (ℓ)	Date Relative Humidity	Time Temp. (°C)	Odors[b]
1	198	268	2/9/78 52% RH	1051-1409 15°	6/6
2	135	95	2/7/78 49% RH	1035-1250 22°	10/9.5
3	235	258	2/7/78 66% RH	1055-1450 18°	9.5/10
4	207	300	2/7/78 68% RH	1130-1457 16°	6/6
5	562	597	2/8/78 50% RH	1013-1935 17°	8/8
6	212	140	2/8/78 44% RH	0923-1255 19°	6/7
7	186	134	2/9/78 49% RH	0910-1216 13°	1/1
8	192	283	2/7/78 61% RH	1155-1507 18°	1/1
9	151	219	2/9/78 37% RH	0950-1221 17°	1/1
10	200	263	2/8/78 48% RH	0945-1305 22°	1/2
11	154	226	2/8/78 31% RH	1038-1312 18°	1/1

(continued)

Table A-1 (cont'd.)

Sampling Location[a]	Sampling Time (min)	Sampling Volume (ℓ)	Remarks: Date / Relative Humidity	Remarks: Time / Temp. (°C)	Remarks: Odors[b]
12A	480	43	2/8/78	0855-1655	1/1
12B	520	47	22% RH	0845-1725	
				21°	
13A	490	44	2/8/78	0830-1460	
13B	490	66	25% RH	0832-1642	1/1
13C	536	72		23°	

[a]Each household basement was designated as a sampling location (Reference A-1).

[b]Using a scale of 1-10, subjective evaluations were made for presence of chlorinated and general odors in basements.

Table A-2. SAMPLING PROTOCOL FOR COLLECTION OF SEMI-VOLATILE ORGANICS ON POLYURETHANE FOAM FROM AIR IN HOUSEHOLD BASEMENTS IN NIAGARA, NY[a]

Sampling Location	Sampling Time (min)	Sampling Volume (ℓ)	Remarks	
			Date	Time
1	497	94,049	2/9/78	1051-1908
2	558	116,067	2/7/78	1025-1943
3	514	100,369	2/7/78	1056-1930
4	513	100,173	2/7/78	1130-2003
5	562	109,742	2/8/78	1013-1935
6	600	124,803	2/8/78	0923-1923
7	580	120,643	2/9/78	0912-1852
8	500	94,097	2/7/78	1155-2015
9	566	110,523	2/9/78	0934-1900
10	643	125,559	2/8/78	0945-2028
11	553	104,072	2/8/78	1038-1951

[a]See Reference A-1.

Table A-3. ESTIMATED LEVELS OF VAPOR-PHASE HALOGENATED ORGANIC VAPORS IN AIR OF HOUSEHOLD BASEMENTS AND SCHOOL ROOM IN NIAGARA, NY[a]

Chemical	Sampling/Location							
	L1	L2	L3	L4	L5	L6	L12A	B[c]
dichloroethylene	<263	<334	<294	<263	T(79)	T(334)	T(334)	<10
methylene chloride	1,534	<714	1,300	1,334	11,556	9,428	4,000	3.6
chloroform	1,670	834	464	684	13,484	8,584	2,668	22
1,1,1-trichloroethane	3,656	506	412	400	3,890	1,000	<334	<5
carbon tetrachloride	200	496	T(83)	5,038	562	704	<95	<2
trichloroethylene	1,224	2,920	270	5,344	1,374	15,880	T(116)	<5
tetrachloroethylene	6,346	10,652	3,342	5,386	51,992	37,442	<163	<7
pentachloroethane	<19	<53	<19	<17	<10	<36	<116	<5
pentachlorobutadiene	<22	<63	<23	<20	T(10)	<43	<140	<6
1,3-hexachlorobutadiene	<22	114	<23	26	100	414	<140	<6
chlorobenzene	1,940	4,232	1,000	3,674	2,778	<107	<348	<15
dichlorobenzene isomer	2,044	4,400	154	2,940	8,914	100,476	<186	<8
dichlorobenzene isomer	260	2,442	76	2,106	6,024	51,600	<186	<8
dichlorobenzene isomer	<30	<63	418	3,654	2,294	34,686	<186	<8
trichlorobenzene isomer	642	10,084	72	56	26	27,228	<140	<6
trichlorobenzene isomer	58	1,010	T(23)	1,306	3,424	2,370	<140	<6
trichlorobenzene isomer	<22	<63	<23	1,066	580	3,686	<140	<6

(continued)

Table A-3 (cont'd.)

Chemical	Sampling/Location L1	L2	L3	L4	L5	L6	L12A	B[c]
tetrachlorobenzene isomer	16	1,832	<23	280	214	2,400	<140	<6
tetrachlorobenzene isomer	12	9,600	62	360	406	17,142	<140	<6
tetrachlorobenzene isomer	<22	<63	<23	<20	<10	<43	<140	<6
pentachlorobenzene isomer	<22	494	T(23)	18	30	250	<140	<6
chlorotoluene isomer	2,552	14,990	1,754	4,586	3,022	226,514	<116	<5
chlorotoluene isomer	3,820	<53	<19	<17	<8	223,042	<116	<5
dichlorotoluene isomer	8,836	20,926	<19	5,240	7,428	158,628	<116	<5
dichlorotoluene isomer	3,956	6,316	86	5,320	2,318	98,428	<116	<5
dichlorotoluene isomer	<19	<53	48	314	<8	109,872	<116	<5
trichlorotoluene isomer	634	206	46	134	1,644	6,886	<116	<5
trichlorotoluene isomer	3,336	3,790	62	1,786	4,908	42,286	<116	<5
trichlorotoluene isomer	<19	1,810	T(19)	<17	466	43,700	<116	<5
trichlorotoluene isomer	1,142	842	T(19)	594	160	25,986	<116	<5
trichlorotoluene isomer	<19	<53	<19	60	<8	<36	<116	<5
tetrachlorotoluene isomer	148	168	<27	<15	56	<18	<116	<7
tetrachlorotoluene isomer	58	<26	<27	16	<8	970	<116	<7
chlorobenzaldehyde isomer	<26	180	<19	746	34	4,058	<116	<5
dichlorobenzaldehyde isomer	<26	<63	<23	<20	<10	950	<140	<6
bromotoluene isomer	25	T(53)	<19	134	66	4,372	<116	<5

(continued)

Table A-3 (cont'd.)

Chemical	Sampling/Location L1	L2	L3	L4	L5	L6	L12A	B[c]
bromochlorotoluene isomer	T(19)	<53	<19	80	28	1,542	<116	<5
chloronaphthalene isomer	78	84	<31	<27	<13	3,414	<186	<8
1,2-dichloropropane	1,406	<53	<19	<17	<8	<36	<116	<5
total halogenated organics	59,489	172,713	13,760	58,968	127,778	1,786,636	7,644	

[a]See Table A-1 for sampling protocol (Reference A-1).

[b]Values are in ng/m^3, T = trace, ( ) or < indicates limit of detection.

[c]Values are ng/cartridge.

Table A-4. SEMI-VOLATILE ORGANIC CHEMICALS IDENTIFIED IN AIR FROM HOUSEHOLD BASEMENT (L1), NIAGARA, NY USING PUF TECHNIQUE[a]

Chromatographic Peak No.	Elution Time (min)	Compound
1	0.73	dichlorotoluene
2	0.86	trichlorobenzene
3	1.00	unknown
4	1.24	trichlorotoluene
5	1.38	trichlorotoluene
6	1.54	tetrachlorobenzene
7	1.86	tetrachlorobenzene
8	1.89	chloronaphthalene
9	2.13	dichloroaniline (tent.)
10	2.19	tetrachlorotoluene
11	2.46	tetrachlorotoluene
12	2.73	tetrachlorotoluene
13	3.44	unknown
14	4.06	pentachlorotoluene

[a]See Reference A-1.

Table A-5. SEMI-VOLATILE ORGANIC CHEMICALS IDENTIFIED IN AIR FROM HOUSEHOLD BASEMENT (L3), NIAGARA, NY USING PUF TECHNIQUE[a]

Chromatographic Peak No.	Elution Time (min)	Compound
1	1.69	tetrachlorobenzene
2	3.06	pentachlorobenzene

[a]See Reference A-1.

Table A-6. SEMI-VOLATILE ORGANIC CHEMICALS IDENTIFIED IN AIR FROM HOUSEHOLD BASEMENT (L5), NIAGARA, NY USING PUF COLLECTION TECHNIQUE[a]

Chromatographic Peak No.	Elution Time (min)	Compound
1	0.54	dichlorobenzene
2	0.79	dichlorotoluene
3	0.89	trichlorobenzene
4	1.06	hexachlorobutadiene
5	1.23	unknown
6	1.36	trichlorotoluene
7	1.53	tetrachlorobenzene
8	1.83	tetrachlorobenzene
9	2.00	unknown
10	2.69	tetrachlorotoluene
11	3.16	pentachlorobenzene
12	5.66	hexachlorocyclohexane
13	5.93	pentachloropropane
14	6.39	unknown

[a]See reference A-1.

Table A-7. SEMI-VOLATILE ORGANIC CHEMICALS IDENTIFIED IN AIR FROM HOUSEHOLD BASEMENT (L6), NIAGARA, NY USING PUF COLLECTION TECHNIQUE[a]

Chromatographic Peak No.	Elution Time (min)	Compound
1	0.36	chlorotoluene
2	0.43	dichlorobenzene
3	0.59	dichlorotoluene
4	0.73	trichlorobenzene
5	1.01	trichlorotoluene
6	1.26	tetrachlorobenzene
7	1.49	tetrachlorobenzene
8	1.56	α-chloronaphthalene
9	2.26	tetrachlorotoluene
10	2.73	pentachlorobenzene
11	3.19	dichloronaphthalene
12	3.36	trichlorophenol (tent.)
13	3.46	pentachlorotoluene
14	4.33	pentachlorotoluene
15	5.79	hexachlorobenzene
16	6.00	unknown
17	6.76	hexachlorotoluene
18	11.39	pentachlorobiphenyl (tent)

[a]See reference A-1.

Table A-8. SEMI-VOLATILE ORGANIC CHEMICALS IDENTIFIED IN AIR FROM HOUSEHOLD BASEMENT (L4), NIAGARA, NY USING PUF COLLECTION TECHNIQUE[a]

Chromatographic Peak No.	Elution Time (min)	Compound
1	0.71	dichlorotoluene
2	0.83	dichlorophenol
3	0.86	trichlorobenzene
4	1.33	trichlorotoluene
5	1.46	tetrachlorobenzene
6	1.63	chloronaphthalene
7	1.69	trichlorophenol
8	1.73	tetrachlorobenzene
9	1.79	tetrachlorobenzene
10	1.93	trichloroaniline (tent.)
11	2.59	tetrachlorotoluene
12	3.06	pentachlorobenzene
13	3.79	pentachlorotoluene (tent.)
14	5.46	hexachlorocyclohexane

[a]See reference A-1.

Table A-9. SEMI-VOLATILE ORGANIC CHEMICALS IDENTIFIED IN AIR FROM HOUSEHOLD BASEMENT (L2), NIAGARA, NY USING PUF COLLECTION TECHNIQUE[a]

Chromatographic Peak No.	Elution Time (min)	Compound
1	0.76	dichlorotoluene
2	0.93	trichlorobenzene
3	1.39	trichlorotoluene
4	1.53	tetrachlorobenzene
5	1.83	tetrachlorobenzene
6	2.43	unknown
7	2.69	tetrachlorotoluene
8	3.00	tetrachlorotoluene
9	3.06	hexachlorocyclohexane
10	3.13	pentachlorobenzene
12	3.43	unknown
13	3.96	pentachlorotoluene
14	4.89	pentachlorotoluene
15	5.66	pentachlorotoluene
16	5.76	hexachlorocyclohexane
17	6.06	dichlorobiphenyl (tent.)
18	6.39	hexachlorobenzene
19	6.69	unknown
20	7.33	hexachlorotoluene
21	9.09	chlorobenzofluorene (tent.)
22	10.13	heptachlorotoluene

[a]See reference A-1.

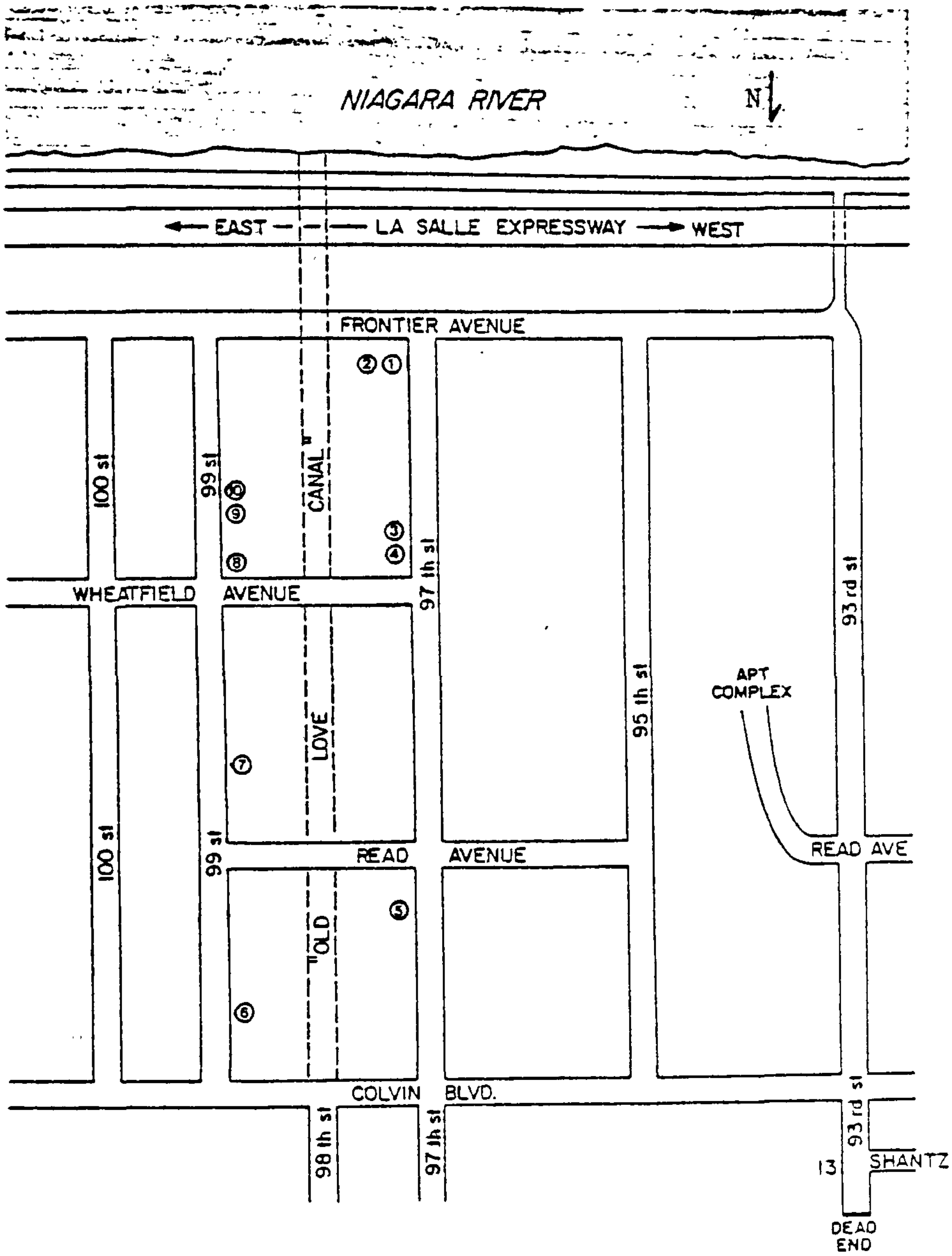


Figure A-3. Map of "Old Love" Canal area of Niagara Falls, NY - sampling locations for body-burden study.

Table A-10. AIR EXPOSURE MONITORING PROTOCOL FOR THE "OLD LOVE" CANAL AREA OF NIAGARA FALLS, NY

Location	Date	Period of Air Monitoring		Volume of Air Collected (M^3)/Cartridge		Tapwater		Other	Participant
		Inside	Outside	Inside	Outside	Date	No. of Samples		
1	7/6/78	1022-1747	1028-1747[a]	0.020	0.022	7/6/78	2	-	10066
2	7/6,7/78	1800-0807	1759-0810[a]	0.041	0.042	Same household as 1		-	10090
3[b,c]	7/6,7/78	2113-0835	2113-0838	0.034	0.034	7/6/78	2	-	10074
4	7/6/78	0929-1511	0927-1515	0.017	0.017	7/6/78	2	Radishes from backyard garden	10017
5	7/6,7/78	1548-0858	1550-0857	0.051	0.051	7/6/78	2	-	10041
6	7/6/78	0854-1720	0857-1720	0.026	0.025	7/6/78	2	-	10033
8	7/6/78	1103-1737	1102-1737	0.017	0.017	7/6/78	2	-	10025
9[b]	7/6/78	1041-1630	1045-1637	0.017	0.018	7/6/78	2	-	10009
10[b]	7/6,7/78	1655-0926	1700-0927	0.050	0.049	7/6/78	2	-	10058

[a]The sampler was set up in the next yard, a corner lot and upwind of the "canal".

[b]Households previously included in the basement air monitoring.

[c]Location of MRI weather station.

Table A-11. METEOROLOGY FOR JULY 6 AND 7, 1978 IN THE "OLD LOVE" CANAL AREA OF NIAGARA FALLS, NY

Date	Time	Temp (C°)	Wind speed/Direction[a] (KM/Hr)	Wind speed/Direction[b] (KM/Hr)
7/6/78	1000	25	3 / S	13 SW
	1200	28	3 / S	17 SW
	1400	29	3 / S	20 SSW
	1600	29	2 /SSW	24 SW
	1800	29	<2 /SSW	24 SW
	2000	27	<2 /SSW	18 SW
	2200	23	calm	15 SW
	2400	22	calm	13 SW
7/7/78	0200	20	calm	13 SSW
	0400	20	calm	9 SSW
	0600	19	calm	13 SSW
	0800	23	calm	14 SSW
	1000	27	2 /S	20 SSW

[a] MRI weather station, 6' above ground level.

[b] Niagara Falls, N. Y. Weather Station.

Table A-12. ESTIMATED LEVELS OF VAPOR-PHASE HALOGENATED COMPOUNDS IN AIR INSIDE HOMES IN "OLD LOVE" CANAL AREA OF NIAGARA FALLS, NY[a]

Compound	Sample No. 1	2	3	4	5	6	8	9	10
chloroform	15,342	3,169	11,088	3,486	3,646	2,392	1,429	T[b]	950
carbon tetrachloride	–	352	868	T	33	T	657	–[c]	340
1,1-dichloroethane	–	–	–	–	–	–	–	–	–
1,2-dichloroethane	–	127	–	–	–	–	–	–	100
1,1,1-trichloroethane	–	577	1,073	T	364	1,216	600	–	430
trichloroethylene	–	T	–	–	T	T	T	–	T
tetrachloroethylene	–	422	794	–	540	1,334	1,142	–	480
chlorobenzene	–	–	–	–	–	588	286	–	60
dichlorobenzene isomer(s)	–	–	–	–	–	–	–	–	–
chlorotoluene isomer(s)	–	–	–	T	–	–	1,542	–	–
dichlorotoluene isomer(s)	–	–	–	–	–	–	–	–	–
chloronaphthalene isomer(s)	–	–	–	–	–	–	–	–	–
bromotoluene isomer(s)	–	–	–	–	–	–	–	–	–
trichlorobenzene isomer(s)	–	–	–	–	–	–	–	–	–
chlorobenzotrifluoride isomer(s)	–	–	–	–	–	–	–	–	–
tetrachlorobenzene isomer(s)	–	–	–	–	–	–	–	–	–
pentachlorobenzene	–	–	–	–	–	–	–	–	–
1,3-hexachlorobutadiene	–	–	–	–	–	–	–	–	–
trichlorotoluene isomer(s)	–	–	–	–	–	–	T	–	–
tetrachlorotoluene isomer(s)	–	–	–	–	–	–	–	–	–

(continued)

Table A-12 (cont'd.)

Compound	Sample No.								
	1	2	3	4	5	6	8	9	10
1,2-dichloropropane	–	–	–	–	–	–	–	–	–
chlorobenzaldehyde	–	–	–	–	–	–	–	–	–
dichlorobenzaldehyde	–	–	–	–	–	–	–	–	–
bromochlorotoluene isomer	–	–	–	–	–	–	–	–	–
1,2-dibromoethane	–	–	–	–	–	–	–	–	–

[a] Values are in ng/m^3.

[b] Trace.

[c] Not detected.

Table A-13. ESTIMATED LEVELS OF VAPOR-PHASE HALOGENATED COMPOUNDS IN AMBIENT AIR OUTSIDE HOMES OF "OLD LOVE" CANAL, NIAGARA, NY[a]

Compound	Sample No. 1	2	3	4	5	6	8	9	10
chloroform	15,846	105,461	70,308	30,231	1,385	51,692	1,050	19,692	55,923
carbon tetrachloride	2,000	3,692	2,923	1,615	2,231	1,000	1,000	T[b]	-
1,1-dichloroethane	-	-	-	-	-	-	-	-[c]	-
1,2-dichloroethane	-	-	-	-	T	-	NQ[d]	T	-
1,1,1-trichloroethane	2,111	5,444	2,222	1,778	4,222	1,444	2,667	1,667	-
trichloroethylene	-	-	-	-	285	-	-	611	-
tetrachloroethylene	591	714	735	14,000	647	400	750	2,111	122
chlorobenzene	-	119	-	T	T	T	T	-	-
dichlorobenzene (2 isomers)	-	190	206	T	353	T	350	444	-
1,2-dichloropropane	-	-	-	-	-	T	T	-	-
chlorotoluene (2 isomers)	T	T	1,235	647	T	-	2,750	T	T
chlorobenzaldehyde isomer	-	-	-	-	-	-	-	-	-
dichlorotoluene (3 isomers)	T	-	-	648	T	T	500	T	T
chloronaphthalene isomer	T	-	-	T	-	-	T	T	T
bromotoluene isomer	-	-	-	-	-	-	-	-	T
dichlorobenzaldehyde isomer	-	T	-	-	T	T	-	-	-
trichlorobenzene (3 isomers)	-	T	-	T	T	T	-	T	T
1,2-dibromoethane	-	T	-	-	T	T	T	-	-
trichlorotoluene (5 isomers)	T	T	T	T	T	T	T	T	T
tetrachlorotoluene isomer	-	T	T	-	-	T	-	-	-
bromochlorotoluene isomer	-	-	-	-	-	T	-	-	-
chlorobenzodichlorofluoride isomer	-	-	-	-	-	-	-	-	-

(continued)

Table A-13 (cont'd.)

Compound	Sample No.								
	1	2	3	4	5	6	8	9	10
chlorobenzotrifluoride (2 isomers)	-	-	-	-	-	-	-	-	-
1,2-bis(trifluoromethyl)benzene	-	-	-	-	-	-	-	-	-
pentachlorobenzene	-	-	-	-	-	-	-	-	-
tetrachlorobenzene (3 isomers)	-	-	-	T	T	T	300	T	T
1,3-hexachlorobutadiene	-	-	T	-	-	T	-	-	T
1,2-dichloroethylene	-	-	-	T	-	-	T	-	T

[a] Values are ng/m^3.

[b] Trace.

[c] Not detected.

[d] Not quantitated.

Table A-14. SAMPLING PROTOCOL FOR SITE NO. 2, NIAGARA FALLS, N. Y. - TRIP 1

Period	Location	Sampling Time	Sampling Volume (ℓ)	Type of Sample	Meteorological Conditions: T (°C)	% RH	Wind Dir./ Speed (km/h)	Other
P1 7/8-7/9/78	No Samples Collected							
P2 7/10-7/11/78	L5	1135 (7/10)-1151 (7/11)	60.9[a]	Air	11-23	84-76	SSW-NW/11-28	light rain 0925
	L6	1213 (7/10)-1204 (7/11)	95.4[a]	Air				
	L7	1235 (7/10)-1220 (7/11)	71.6[a]	Air				
	L8	1305 (7/10)-1150 (7/11)	70.2[a]	Air				
P3 7/11/78	L5		2 x 120 ml[c]	Tap water	11-23	76-55	NW-NNW/11-24	
	L8		120 ml	Tap water				
	L11	0910-1510	22.0[a,b,f]	Air				
	L12	1230	3 cores[d]	Soil				
	L13		1[e]	Tap water				
P4 7/12-7/13/78	L5	1545 (7/12)-0920 (7/13)	89.5[a]	Air	11-26	75-42	SSW-WSW/calm-19	
	L6	1005 (7/12)-0908 (7/13)	77.6[a]	Air				
		0915	2 x 120 ml[c]	Tap water				
	L7	0930 (7/12)-0852 (7/13)	63.1[a]	Air				
		0900	2 x 120 ml[c]	Tap water				
	L8	0910 (7/12)-0844 (7/13)	72.7[a]	Air				
	L9	0910	3 cores[d]	Soil				
	L10	0840 (7/12)-1310 (7/13)	19.5[a,g]	Air				

[a]Volume of air/cartridge.

[b]Average of 2 calculations: 1) Sampling time x flow rate; 2) Counts x Volume/count.

[c]1st 120 ml = First water from tap; 2nd 120 ml = after 2 min run.

[d]5 cm diameter x 6 cm core.

[e]Finished water - water treatment plant.

[f]99th Street Elementary School.

[g]93rd Street Elementary School.

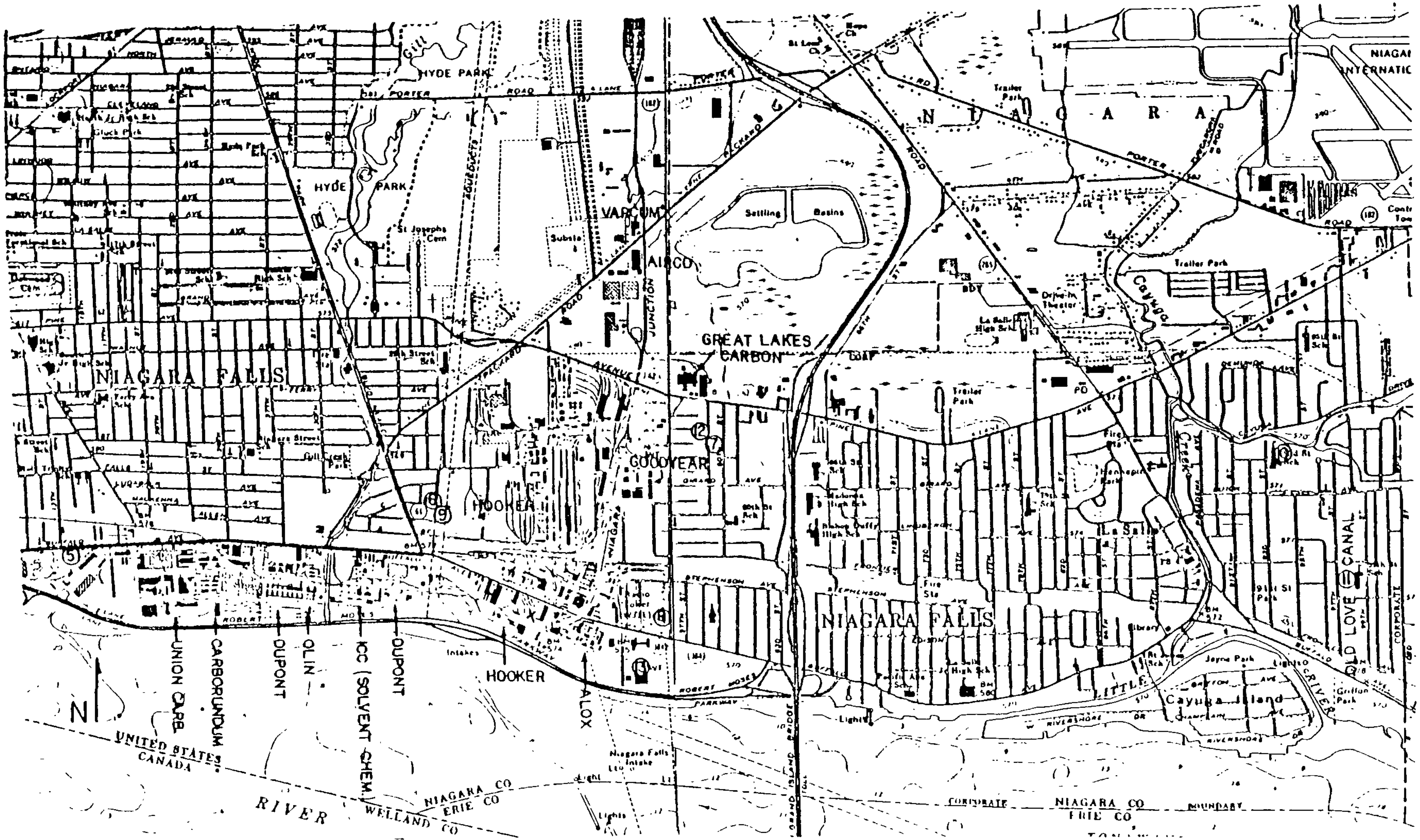


Figure A-4. Sampling locations and plant identifications for Site No. 2, Niagara Falls, N. Y.

Table A-15. SAMPLING PROTOCOL FOR SITE NO. 3, BUFFALO, N.Y. - TRIP 1

Period	Location	Sampling Time	Sampling Volume (ℓ)	Type of Sample	Meteorological Conditions			
					T (°C)	% RH	Wind Dir./ Speed (km/h)	Other
P1 7/8-7/9/78	No Samples Collected							
P2 7/10-7/11/78	L1	0755 (7/10)-0751 (7/11)	87.2[a,b]	Air	11-23	84-76	SSW-NW/11-28	light rain 0925
	L2	0820 (7/10)-0745 (7/11)	74.7[a,b]	Air				
	L3	0845 (7/10)-0809 (7/11)	60.3[a,b]	Air				
	L4	0905 (7/10)-0822 (7/11)	66.5[a,b]	Air				
P3 7/11/78	L1		2 x 120 ml[c]	Tap water	11-23	76-55	NW-NNW/11-24	
	L3		2 x 120 ml[c]	Tap water				
	L4		2 x 120 ml[c]	Tap water				
	L12		2 x 120 ml[c]	Tap water				
	L13		3 cores[d]	Soil				
	L14		1[e]	Tap water				
P4 7/12-7/13/78	L1	0854 (7/12)-0807 (7/13)	60.0[a]	Air	11-26	75-42	SSW-WSW/calm-19	
	L2	0904 (7/12)-0735 (7/13)	86.7[a]	Air				
	L3	0920 (7/12)-0759 (7/13)	62.4[a]	Air				
	L4	0931 (7/12)-0752 (7/13)	67.2[a]	Air				

[a] Volume of air/cartridge.

[b] Average of 2 calculations: 1) sampling time x flow rate; 2) counts x volume/count.

[c] 1st 120 ml = First water from tap; 2nd 120 ml = after 2 min. run.

[d] 5 cm diameter x 60 cm core.

[e] Finished water - water treatment plant.

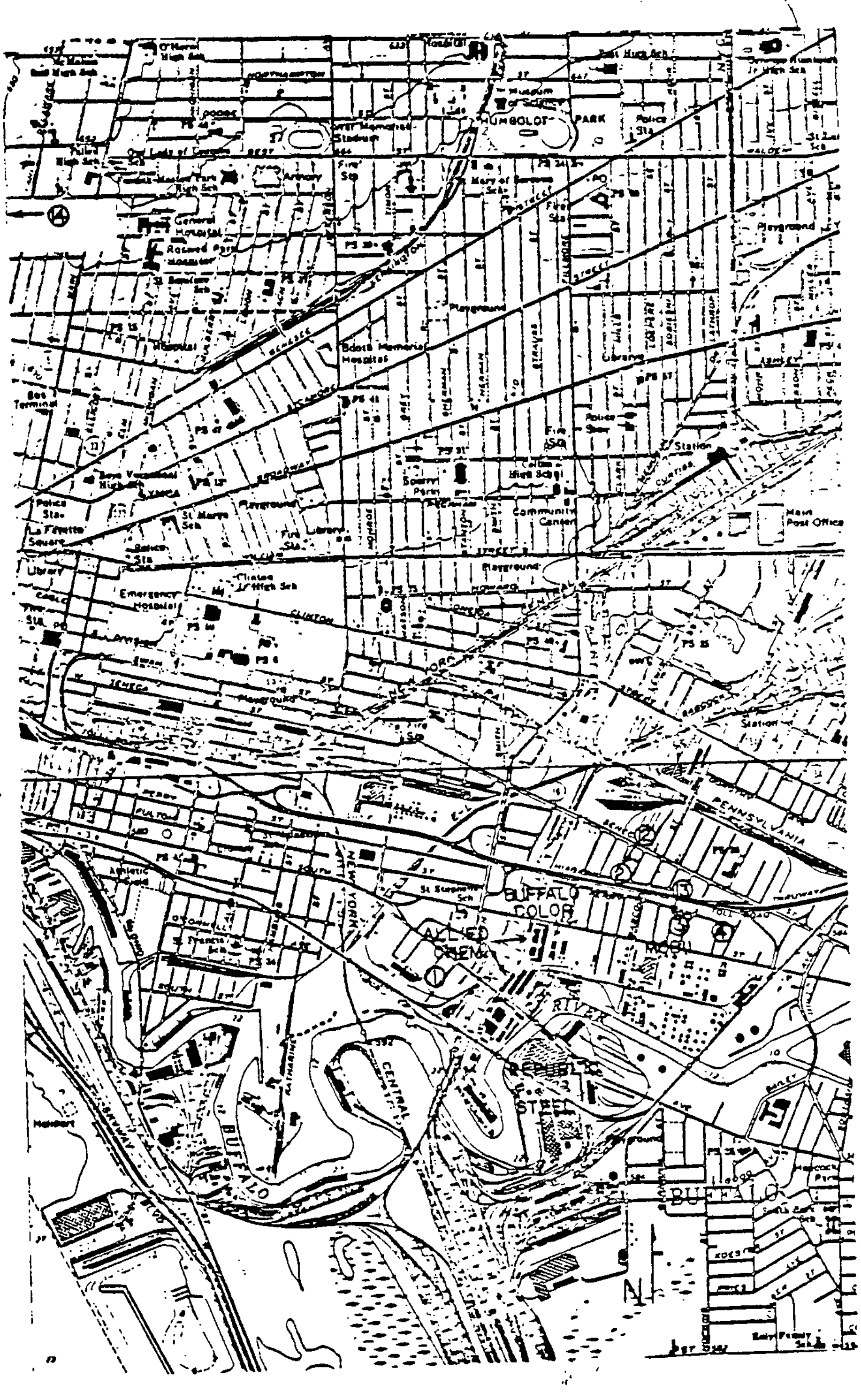


Figure A-5. Sampling locations and plant identifications at Site No. 3, Buffalo, N.Y.

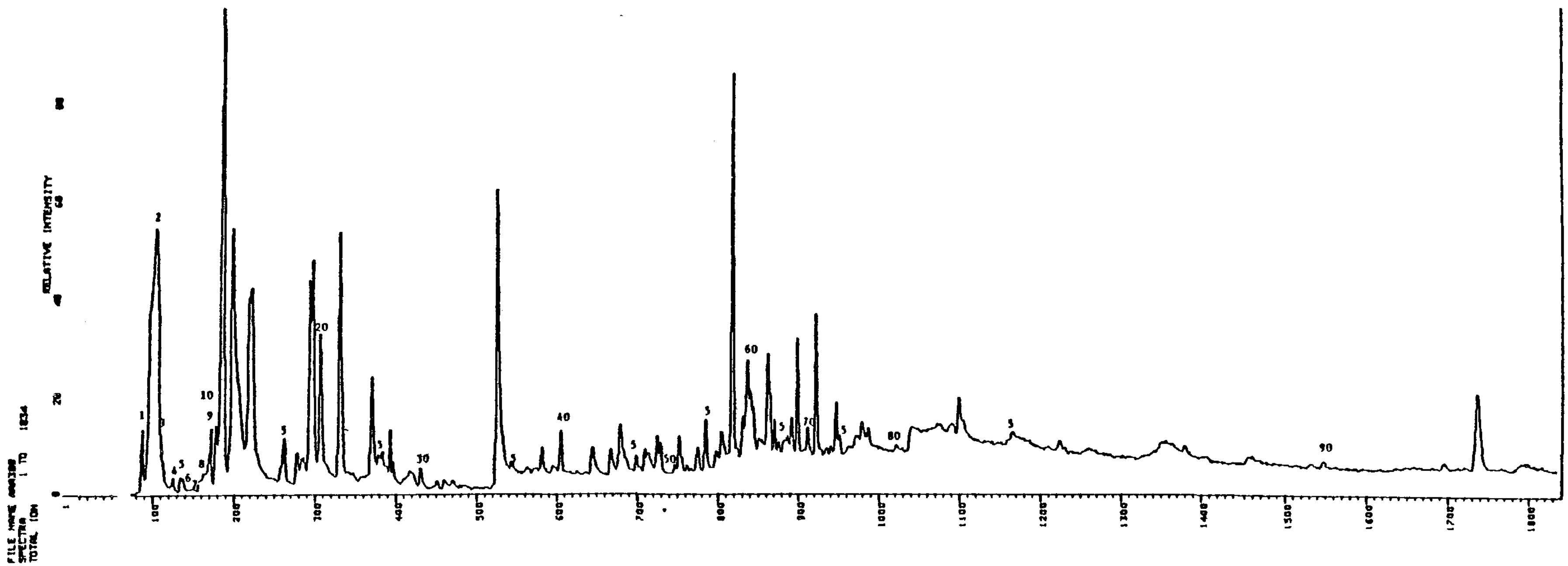


Figure A-6. GC/MS profile of vapor-phase organics in ambient air in Niagara Falls, NY (P4/L7). See Table A-16.

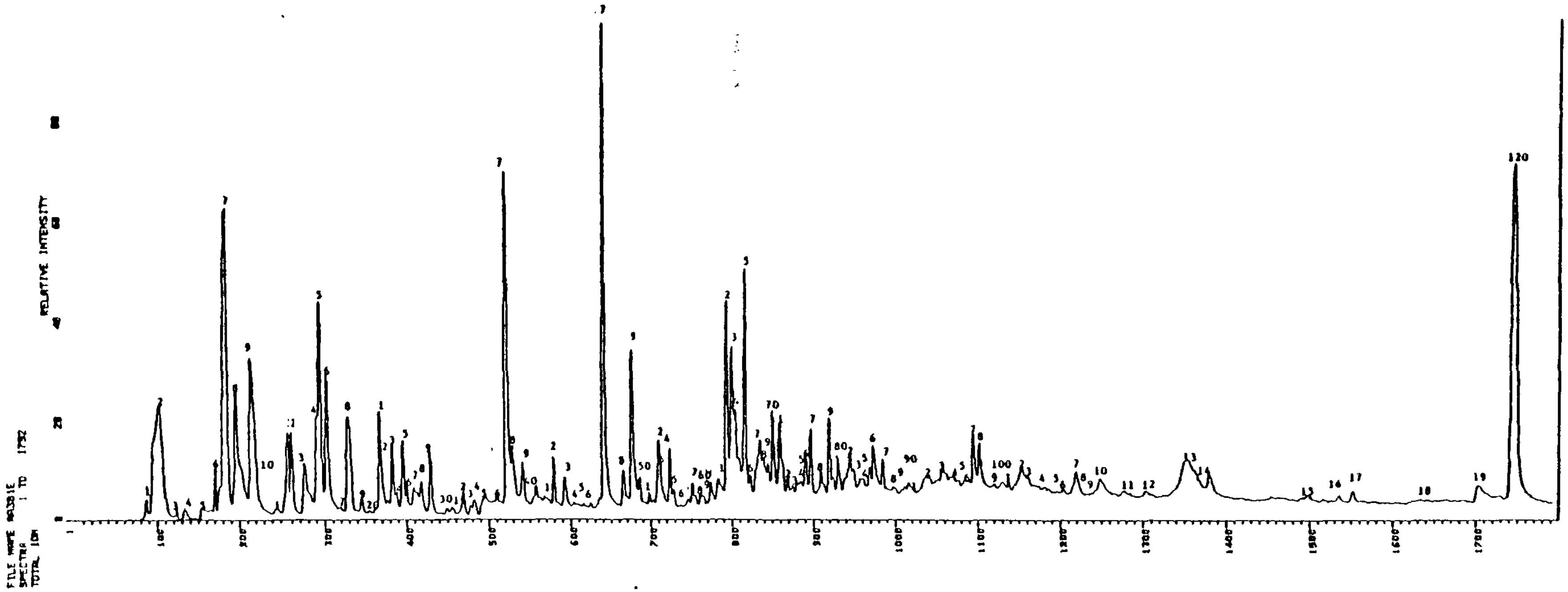


Figure A-7. GC/MS profile of vapor-phase organics in ambient air in Niagara Falls, NY (P4/L8). See Table A-17.

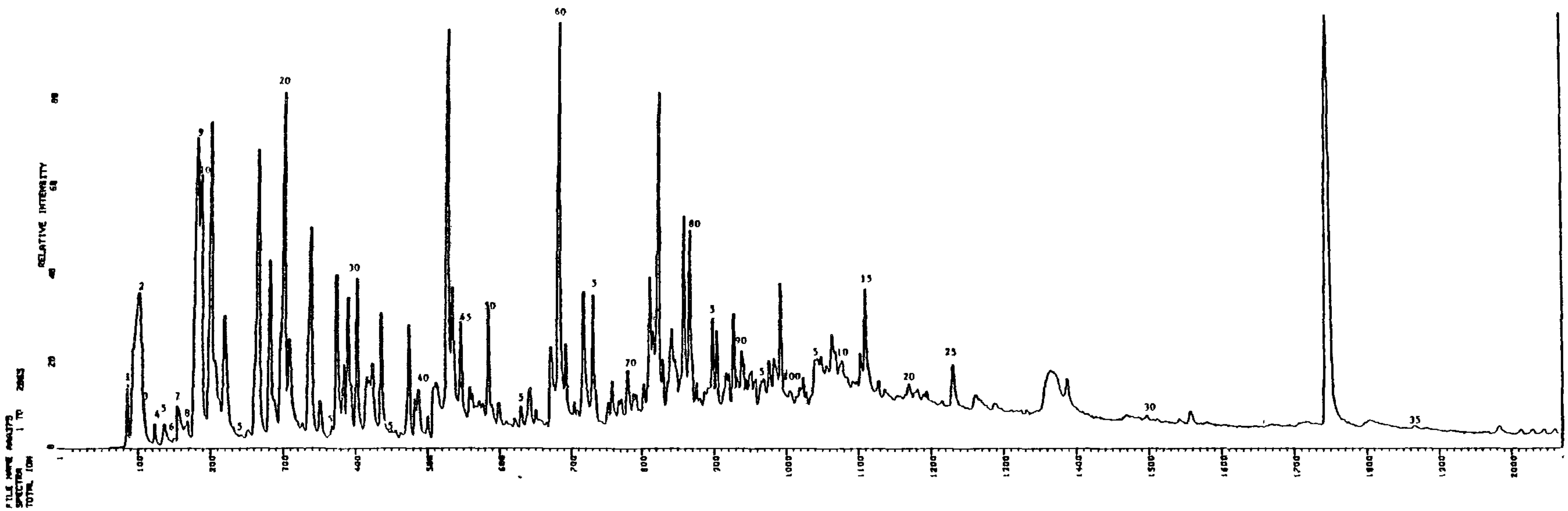


Figure A-8. GC/MS profile of vapor-phase organics in ambient air in Buffalo, NY (P4/L2). See Table A-18.

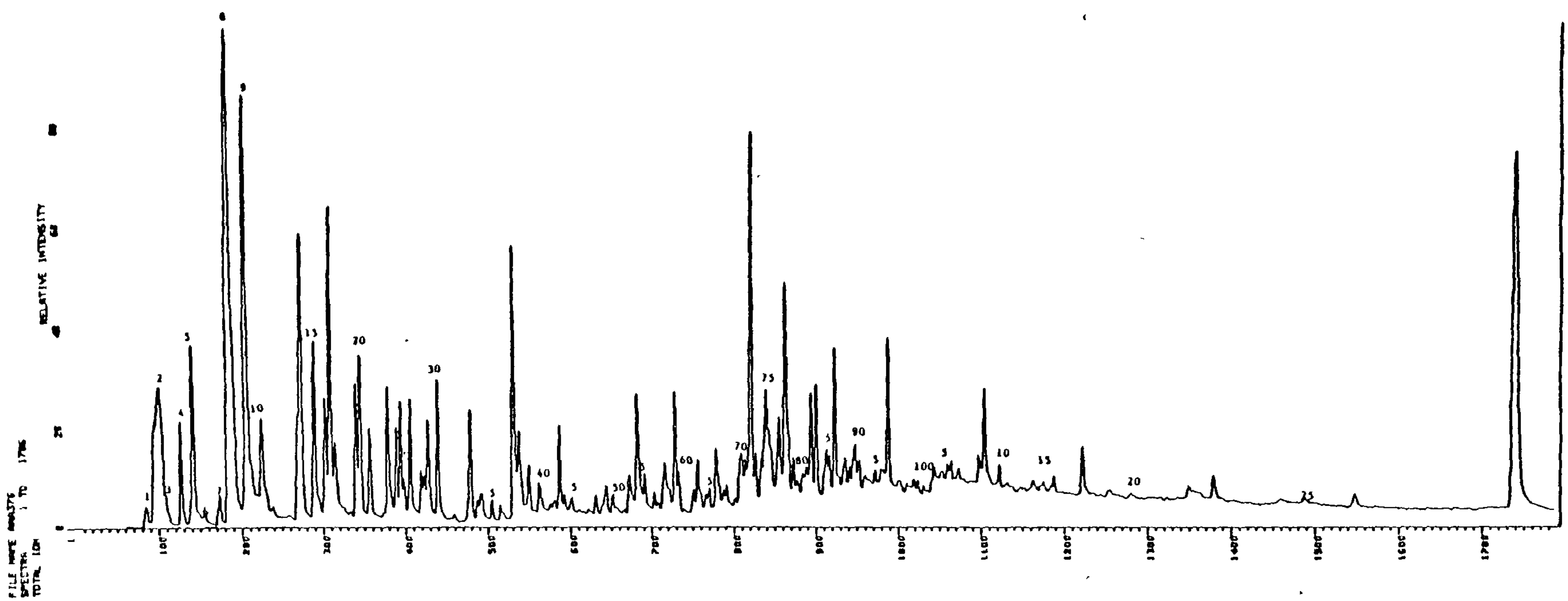


Figure A-9. GC/MS profile of vapor-phase organics in ambient air from Buffalo, NY (P4/L3). See Table A-19.

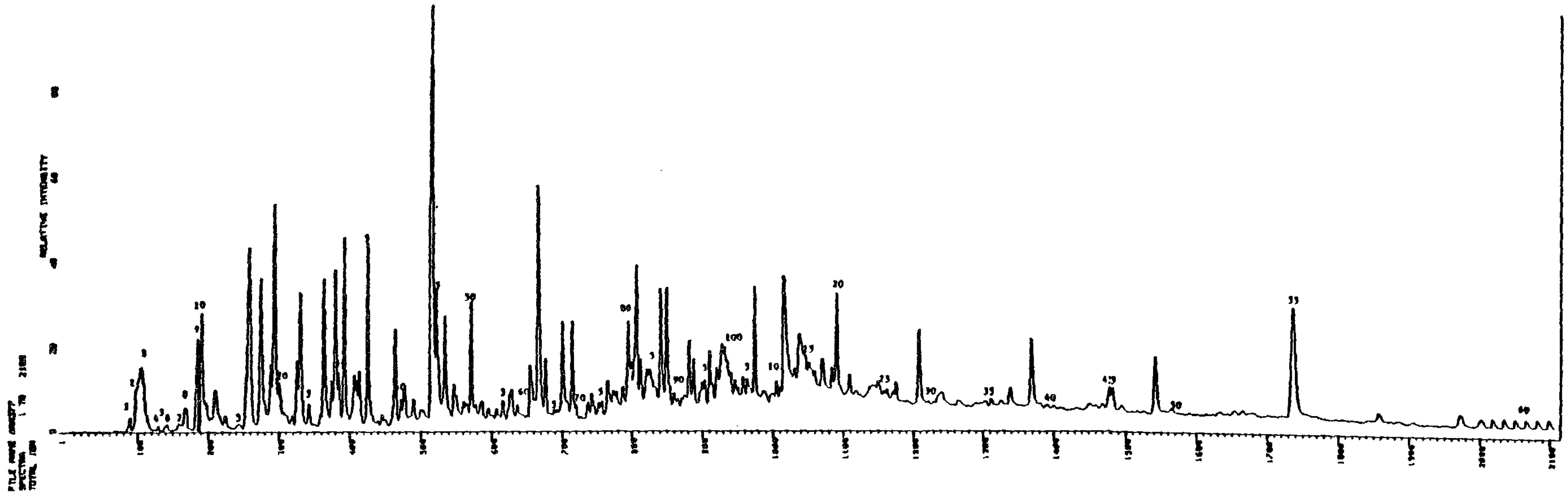


Figure A-10. GC/MS profile of vapor-phase organics in ambient air from Buffalo, NY (P4/L4). See Table A-20.

Table A-16. VAPOR-PHASE HALOGENATED ORGANICS IDENTIFIED IN NIAGARA FALLS, NY (P4/L7)[a]

Chromato-graphic Peak No.	Elution Temp. (°C)	Compound	Chromato-graphic Peak No.	Elution Temp. (°C)	Compound
3	64	CF_2Cl_2	24	106	carbon tetrachloride
7	71	bromomethane (tent.)	29	114	trichloroethylene
11	75	CCl_3F (Freon 11)	39	141	tetrachloroethylene
13	81	methylene chloride	42	149	chlorobenzotrifluoride isomer
14	81	CCl_2FCClF_2 (Freon 113)	56	174	chlorotoluene isomer
20	95	chloroform	66	187	dichlorobenzene isomer
23	101	1,1,1-trichloroethane	83	221	chlorobenzotrifluoride isomer

[a]See Table A-14 for sampling protocol.

Table A-17. VAPOR-PHASE HALOGENATED ORGANICS IDENTIFIED IN NIAGARA FALLS, NY (P4/L8)[a]

Chromato-graphic Peak No.	Elution Temp. (°C)	Compound	Chromato-graphic Peak No.	Elution Temp. (°C)	Compound
5	73	CF_2Cl_2 (Freon 12) (tent.)	67	181	dichlorobenzotrifluoride
7	75	CCl_3F (Freon 11)	73	186	*m*- and/or *p*-dichlorobenzene
8	77	CH_2ClF	78	191	*o*-dichlorobenzene
9	80	methylene chloride	91	209	dichlorotoluene isomer
10	81	CCl_2FCClF_2 (Freon 113)	93	214	dichlorotoluene isomer
16	94	chloroform	96	220	trichlorobenzene isomer
19	101	1,1,1-trichloroethane	100	227	trichlorobenzene isomer
22	106	carbon tetrachloride	101	228	hexachlorobutadiene
28	113	trichloroethylene	108	240	trichlorotoluene isomer
43	141	tetrachloroethylene	109	240	trichlorotoluene isomer
47	148	chlorobenzotrifluoride isomer	112	240	tetrachlorobenzene isomer
53	160	chlorobenzotrifluoride isomer	114	240	tetrachlorobenzene isomer
62	173	chlorotoluene	118	240	pentachlorobenzene

[a]See Table A-14 for sampling protocol.

Table A-18. VAPOR-PHASE HALOGENATED ORGANICS IN AMBIENT AIR IN BUFFALO, NY (P4/L2)[a]

Chromato-graphic Peak No.	Elution Temp. (°C)	Compound	Chromato-graphic Peak No.	Elution Temp. (°C)	Compound
3	64	CF_2Cl_2	27	106	carbon tetrachloride
6	70	bromomethane (tent.)	33	114	trichloroethylene
9	75	$CFCl_3$ (Freon 11)	52	142	tetrachloroethylene
12	81	methylene chloride	83	187	m- and/or p-dichlorobenzene
14	82	CCl_2FCClF_2 (Freon 113)	87	193	o-dichlorobenzene
21	95	chloroform	92	198	trimethylphenyl chloride (tent.)
[illegible]	102	1,1,1-trichloroethane			

[a]See Table A-15 for sampling protocol.

Table A-19. VAPOR-PHASE HALOGENATED ORGANICS IN AMBIENT AIR FROM BUFFALO, NY (P4/L3)[a]

Chromato-graphic Peak No.	Elution Temp. (°C)	Compound	Chromato-graphic Peak No.	Elution Temp. (°C)	Compound
3	64	CF_2Cl_2	22	107	carbon tetrachloride
8	76	CCl_3F (Freon 11)	29	114	trichloroethylene
10	82	methylene chloride	45	142	tetrachloroethylene
11	83	CCl_2FCClF_2 (Freon 113)	81	187	m- and/or p-dichlorobenzene
18	97	chloroform	85	191	o-dichlorobenzene
21	103	1,1,1-trichloroethane			

[a]See Table A-15 for sampling protocol.

Table A-20. VAPOR-PHASE HALOGENATED ORGANICS IN AMBIENT AIR FROM BUFFALO, NY (P4/L4)[a]

Chromato-graphic Peak No.	Elution Temp. (°C)	Compound	Chromato-graphic Peak No.	Elution Temp. (°C)	Compound
9	75	CCl_3F (Freon 11)	34	113	trichloroethylene
13	80	methylene chloride	52	139	tetrachloroethylene
14	81	CCl_2FCClF_2 (Freon 113)	83	176	C_2-alkyl chlorobenzene isomer
20	94	chloroform	89	184	_m_- and/or _p_-dichlorobenzene
25	101	1,1,1-trichloroethane	94	189	_o_-dichlorobenzene
28	105	carbon tetrachloride	118	218	trichlorobenzene isomer

[a]See Table A-15 for sampling protocol.

Table A-21. ESTIMATED LEVELS OF SITE-SPECIFIC VAPOR-PHASE HALOGENATED COMPOUNDS IN AMBIENT AIR IN NIAGARA FALLS, NY[a]

Compound	B	Period/Location					
		P3/L11	P4/L5	P4/L6	P4/L7	P4/L8	P4/L10
chlorobenzotrifluoride	ND	ND	ND	410[c]	523	19,586	ND
chlorotoluene	ND	ND	427	2,333	527	12,274	ND
dichlorobenzotrifluoride	ND	ND	ND	ND	ND	193	ND
dichlorotoluene	ND	ND	43	113	ND	446	ND
trichlorobenzene	ND	ND	39	5,346	43	324	ND
hexachlorobutadiene	ND	ND	54	T	ND	389	ND
trichlorotoluene	ND	ND	ND	ND	ND	568	ND
tetrachlorobenzene	ND	ND	ND	230	ND	451	ND
pentachlorobenzene	ND	ND	ND	ND	ND	17	ND

[a] See Table A-14 for sampling protocol.

[b] B = blank Tenax cartridge.

[c] Values in ng/m^3, ND = not detected, T = trace.

Table A-22. ESTIMATED LEVELS OF PURGEABLE HALOGENATED COMPOUNDS IN DRINKING WATER FROM "OLD LOVE" CANAL IN NIAGARA FALLS, NY[a]

	Sample No.							
Halogenated Compound	1	3	4	5	6	8	9	10
1,1-dichloroethane	–	–	–	–	–	–	–	–
chloroform	13,194	17,525	6,467	14,092	9,542	>24,700	4,433	17,495
1,2-dichloroethane	45	–	–	–	–	–	–[b]	50
1,1,1-trichloroethane	48	75	8	25	417	16	17	120
carbon tetrachloride	69	16	25	16	192	33	–	88
trichloroethylene	214	–	16	8	65	–	8	253
tetrachloroethylene	486	350	608	375	2,875	650	383	448
chlorobenzene	16	8	25	16	42	8	58	16
dichlorobenzene isomer(s)	92	8	92	83	825	75	117	72
bromodichloromethane	4,100	3,458	6,352	4,417	10,375	4,550	1,758	4,498
chlorodibromomethane	87	75	2,133	6,767	3,108	1,400	–	1,098
bromoform	50	16	–	75	–	50	–	60
trichlorobenzene	464	467	450	575	542	483	325	755
hexachlorobutadiene	55	142	75	T[c]	–	167	58	–
tetrachlorobenzene	–	1,083	1,517	1,958	658	175	125	–
pentachlorobenzene	–	–	–	–	–	242	–	–
dichloropropane	–	–	–	–	–	–	1,192	–

[a]Values are ng/ℓ. See Table A-10 for sampling protocol.

[b]Not detected.

[c]Trace

Table A-23. ESTIMATED LEVELS OF PURGEABLE HALOGENATED COMPOUNDS IN DRINKING WATER FROM "OLD LOVE" CANAL IN NIAGARA FALLS, NY[a]

Category	Compound	Sample No. 1	Sample No. 10
Ubiquitous	chloroform	13,194[b]	17,495
	1,2-dichloroethane	45	<50
	1,1,1-trichloroethane	48	120
	carbon tetrachloride	69	88
	trichloroethylene	214	253
	tetrachloroethylene	486	448
	chlorobenzene	16	16
	_m_-dichlorobenzene	36	72
	_o_-dichlorobenzene	56	ND
	bromodichloromethane	4,100	4,498
	chlorodibromomethane	887	1,098
	bromoform	50	60
Site-Specific	chlorotoluene	ND	ND
	dichlorotoluene	ND	ND
	trichlorobenzene	464	755
	hexachlorobutadiene	55	ND

[a]See Table A-10 for sampling protocol, initial tap burst.

[b]Values are in ng/ℓ, ND = not detected.

Table A-24. ESTIMATED LEVELS OF PURGEABLE HALOGENATED COMPOUNDS IN DRINKING WATER SAMPLES FROM NIAGARA FALLS/BUFFALO, NY AREA[a]

Compound	Locations						
	L1	L2	L3	L4	L5	L6	L7
chloroform	39,625	29,392	34,600	–	20,667	13,133	18,125
carbon tetrachloride	133	108	108	83	25	50	42
1,1-dichloroethane	–[b]	–	–	–	–	–	–
1,2-dichloroethane	–	–	–	–	–	–	–
1,1,1-trichloroethane	42	242	150	75	242	42	50
trichloroethylene	133	92	50	258	50	167	67
bromoform	67	69	100	142	133	158	167
chlorodibromomethane	1,300	908	–	1,333	2,225	1,858	3,533
chlorobenzene	42	50	83	29	83	33	46
_m_-dichlorobenzene	108	183	150	358	125	200	104
_o_-dichlorobenzene	–	150	142	–	–	67	–
bromodichloromethane	12,467	5,517	6,442	3,758	8,450	5,708	10,308
1,2-dichloropropane	–	–	–	–	–	–	–
chlorotoluene	–	–	–	–	–	–	–
chlorobenzaldehyde	–	–	–	–	–	–	–
dichlorotoluene isomer(s)	–	–	–	–	–	–	–
chloronaphthalene	–	–	–	–	–	–	–
bromotoluene	–	–	–	–	–	–	–
dichlorobenzaldehyde	–	–	–	–	–	–	–
trichlorobenzene isomer(s)	425	975	492	–	–	–	–

(continued)

Table A-24 (cont'd.)

Compound	Locations						
	L1	L2	L3	L4	L5	L6	L7
1,2-dibromoethane	–	–	–	–	–	–	–
trichlorotoluene	–	–	–	–	–	–	–
bromochlorotoluene	–	–	–	–	–	–	–
chlorobenzodichlorofluoride	–	–	–	–	–	–	–
1,2-bis(trifluoromethyl)benzene	–	–	–	–	–	–	–
tetrachlorobenzene	–	–	–	–	–	–	–
tetrachlorotoluene	–	–	–	–	–	–	–
pentachlorobenzene	–	–	–	–	–	–	–
1,3-hexachlorobutadiene	108	–	92	–	–	–	–
chlorobenzotrifluoride	–	–	–	–	–	–	–
dichlorobenzotrifluoride	–	–	–	–	–	–	–
trichlorotoluene	–	–	–	–	–	–	–
tetrachloroethylene	633	908	542	442	225	283	267

[a]Values are in ng/ℓ. See Tables A-14 and A-15 for sampling protocol.

[b]Not detected.

Table A-25. QUANTITATIVE ANALYSIS OF EXTRACTABLE (SEMI-VOLATILE) HHC'S IN TAP WATER IN BUFFALO/NIAGARA[a]

	Compounds, ng/l (ppt)											
Samples[b]	Trifluralin	α-BHC	4,4'-dichloro-biphenyl	2,4',5-trichloro-biphenyl	Heptachlor	Aldrin	Heptachlor Epoxide	Endosulfan	p,p'-DDE	Dieldrin	p,p'-DDT	Endrin
P3L1	-	-	-	-	-	-	-	-	-	-	-	-
P3L3	-	-	-	-	-	-	-	-	-	-	-	-
P3L4	-	-	-	-	-	-	-	-	-	-	-	-
P3L5	-	-	-	-	-	-	-	-	-	-	-	-
P3L8	-	-	-	-	-	-	-	-	-	-	-	-
P3L11	-	-	-	-	-	-	-	-	-	-	-	-
P3L12	-	108	-	-	-	-	-	-	-	-	-	-
P3L14[b]	-	-	-	-	-	-	-	-	-	-	-	-
P4L[b]	-	-	-	-	-	-	-	-	-	-	-	-
P4L7	-	-	-	-	-	-	-	-	-	-	-	-
10008	-	-	-	-	-	-	-	-	-	-	-	-
10017	-	-	-	-	-	-	-	-	-	-	-	-
10025	-	-	-	-	-	-	-	-	-	-	-	-
10033	-	-	-	-	-	-	-	-	-	-	-	-
10041	-	-	-	-	-	-	-	-	-	-	-	-
10074	-	-	-	-	-	-	-	-	-	-	-	-

[a]Sample size = 120 ml; detection limit = 5-25 ng/l. Control: α-BHC, 1.04 μg, 64% recovery.

[b]See Tables A-10, A-14 and A-15 for sampling details.

Table A-26. BODY BURDEN SAMPLING PROTOCOL FOR THE "OLD LOVE" CANAL AREA OF NIAGARA FALLS, NY

Location[d]	Date	Time	Blood	Urine		Breath			Participant No.
				SpGr[a]	SpGr[b]	Volume(m^3)	Time(min)	Temp.°C	
1	7/6/78	1543	3 tubes	1.010	NC[c]	0.049	7	30	1
2	7/7/78	0740	3 tubes	1.033	NC	0.069	7	26	2
3	7/7/78	0814	3 tubes	1.025	NC	0.074	9	26	3
4	7/6/78	1446	3 tubes	1.009	1.020	0.050	12	30	4
5	6/7/78	0842	3 tubes	1.016	NC	0.067	12	27	5
6	7/6/78	1610	3 tubes	1.023	0.020	0.087	9	31	6
8	7/6/78	1636	3 tubes	1.015	1.023	0.075	10	31	8
9	7/6/78	1510	3 tubes	1.009	1.014	0.112	7	30	9
10	7/7/78	0916	3 tubes	1.016	NC	0.069	4	28	10

[a] Early morning sample.

[b] Spot sample at time of blood collection - omitted for early morning collection.

[c] None collected.

[d] See Figure A-3 for sampling locations.

Table A-27. ESTIMATED LEVELS OF HALOGENATED COMPOUNDS IN HUMAN BREATH FROM "OLD LOVE" CANAL IN NIAGARA FALLS, NY[a]

Compound	Sample No. 1	2	3	4	5	6	8	9	10
chloroform	3,896	23,529 ± 11,764	20,424	94,510	23,530	37,447	45,892	36,576	25,591
carbon tetrachloride	-	88 ± 22	T	796 ± 135	167 ± 75	689 ± 378	622	90 ± 36	T
1,1-dichloroethane	-	-	-	T	-	-	-	-[b]	-
1,2-dichloroethane	-	73 ± 12	-	T	136 ± 75	243 ± 108	351	-	-
1,1,1-trichloroethane	2,812	264 ± 44	T	286 ± 122	394 ± 122	329 ± 106	-	108 ± 36	T
trichloroethylene	-	-	T	T	T	-	1,904	-	T
tetrachloroethylene	750	632 ± 294	1,753	1,224 ± 285	667 ± 75	1,152 ± 129	-	658 ± 63	4,469
chlorobenzene	-	-	-	T	-	-	513	-	-
dichlorobenzene isomer(s)	T	58 ± 0	T	755 ± 204	-	5,294	338	459 ± 72[c]	-
chlorotoluene isomer(s)	-	-	-	-	-	-	-	261 ± 45	-
dichlorotoluene isomer(s)	-	1,220	-	-	-	-	-	-	-
chloronaphthalene isomer(s)	-	T	-	-	-	-	-	-	-
bromotoluene isomer(s)	-	T	-	-	-	-	-	-	-
trichlorobenzene isomer(s)	-	88	-	-	-	-	T	T[d]	-
chlorobenzotrifluoride isomer(s)	-	852 ± 441	T	T	-	-	27	-	T
tetrachlorobenzene isomer(s)	-	-	-	-	-	-	-	180	-
pentachlorobenzene	-	73	-	-	-	-	-	-	-
1,3-hexachlorobutadiene	-	-	-	-	-	-	-	T	-

[a]Values are in ng/m^3, duplicates where indicated. See Table A-26 for sampling protocol.

[b]Not detected.

[c]Sum for all isomers.

[d]T = trace.

Table A-28. ESTIMATED LEVELS OF PURGEABLE HALOGENATED COMPOUNDS IN HUMAN BLOOD SAMPLES FROM "OLD LOVE" CANAL IN NIAGARA FALLS, NY

Compound	Sample No. 1	2	3	4	5	6	8	9	10
methylene chloride	25,200	2,700	850	28,350	14,200	8,050	2,650	1,150[a]	2,050
chloroform	1,450	1,100	1,150	2,050	3,050	1,550	20,100	1,550	1,050
carbon tetrachloride	45	95	110	85	140	40	–	70	75
1,1,1-trichloroethane	2,000	550	250	550	500	850	1,650	950	1,800
trichloroethylene	–	100	200	300	100	–	–	2,550	150
tetrachloroethylene	350	850	900	22	1,200	500	255,550	1,000	900
chlorobenzene	–	50	100	1,100	50	50	16,800	100	50
m-dichlorobenzene	600	2,450	1,300	3,000	2,200	2,550	67,700	1,300	750
o-dichlorobenzene	150	–	–	250	200	200	–	350	–
bromodichloromethane	–	–	–	–	–	–	14,250	–[b]	–
tetrachlorobenzene	–	–	–	–	–	–	–	2,600	–

[a]Values are ng/ℓ. See Table A-26 for sampling protocol.

[b]Not detected.

Table A-29. ESTIMATED LEVELS OF PURGEABLE HALOGENATED COMPOUNDS IN HUMAN URINE SAMPLES FROM "OLD LOVE" CANAL, IN NIAGARA, NY[a]

		Sample No.				
Category	Compound	1	2	3	5	10
Ubiquitous	chloroform	1,460[b]	780	460	800	800
	1,2-dichloroethane	ND	ND	ND	ND	ND
	carbon tetrachloride	96	68	62	100	120
	trichloroethylene	220	550	318	320	400
	tetrachloroethylene	140	120	120	140	146
	chlorobenzene	ND	ND	17	20	ND
	m-dichlorobenzene	39,160	893	36	40	ND
Site-Specific	chlorotoluene	ND	(160)	ND	ND	ND
	bromotoluene	ND	(160)	ND	ND	ND

[a]See Table A-26 for sampling protocol, early morning collection.

[b]Values in ng/l, ( ) = near detection limit, ND = not detected.

Table A-30. ESTIMATED LEVELS OF PURGEABLE HALOGENATED COMPOUNDS IN HUMAN URINE SAMPLES FROM "OLD LOVE" CANAL IN NIAGARA FALLS, NY[a]

Compound	Sample No.				
	4	6	8	9	Control
chloroform	867	1,250	1,085	858[a]	169,440[b]
carbon tetrachloride	42	150	62	92	–
1,1-dichloroethane	–	–	–	–[c]	–
1,2-dichloroethane	75	–	50	–	–
1,1,1-trichloroethane	92	183	146	158	–
trichloroethylene	42	67	92	50	–
tetrachloroethylene	550	692	425	392	2,883
bromoform	–	–	–	–	–
chlorodibromomethane	–	–	–	–	–
chlorobenzene	67	117	50	92	658
_m_-dichlorobenzene	758	708	475	–	1,250
_o_-dichlorobenzene	142	725	108	–	–
bromodichloromethane	–	–	–	–	–

[a]Values in ng/ℓ. See Table A-26 for sampling protocol.

[b]Quantity observed in spiked urine samples.

[c]Not detected.

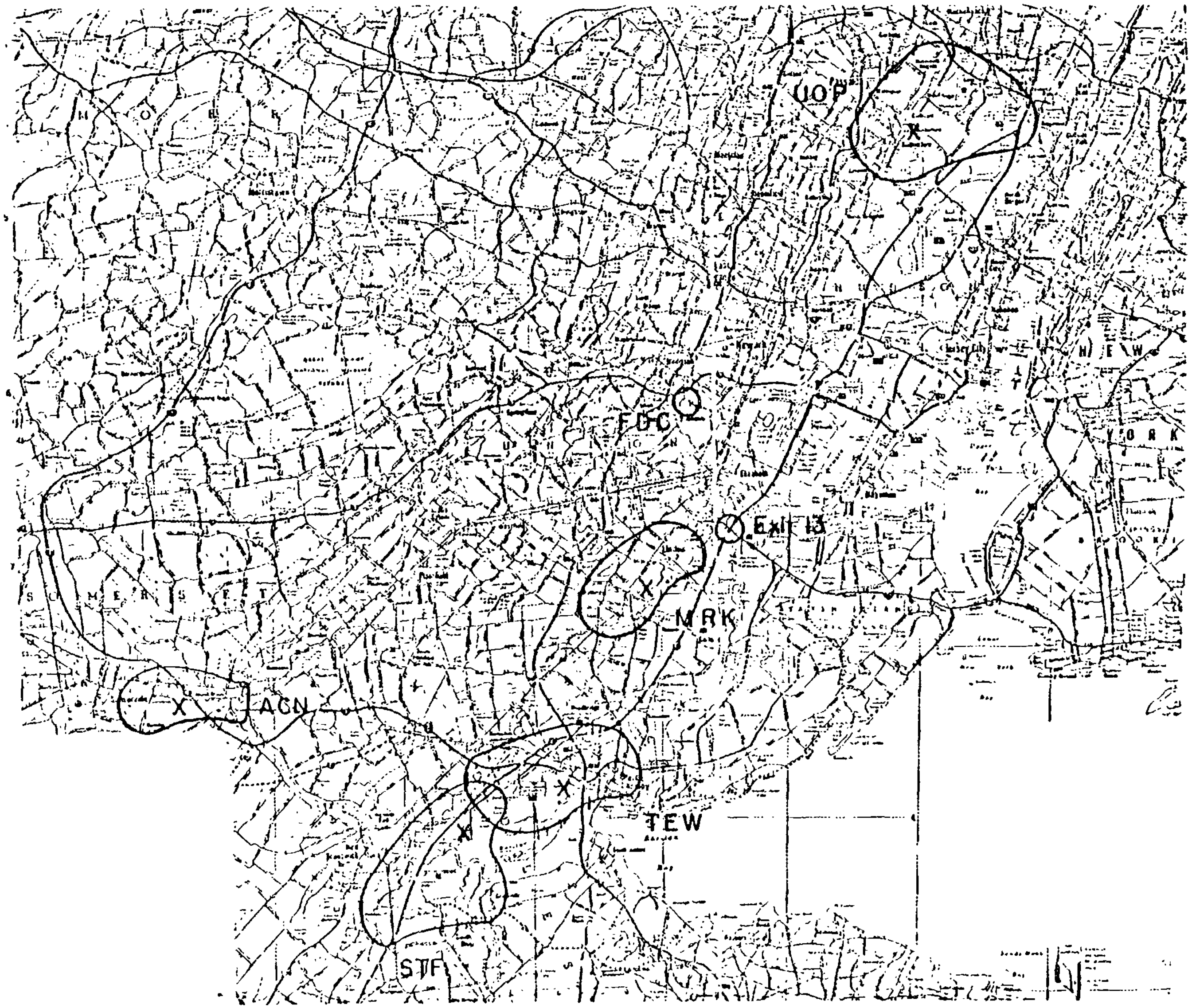


Figure A-11. Northern New Jersey, showing general sampling sites, Trip 2 (September, 1978).

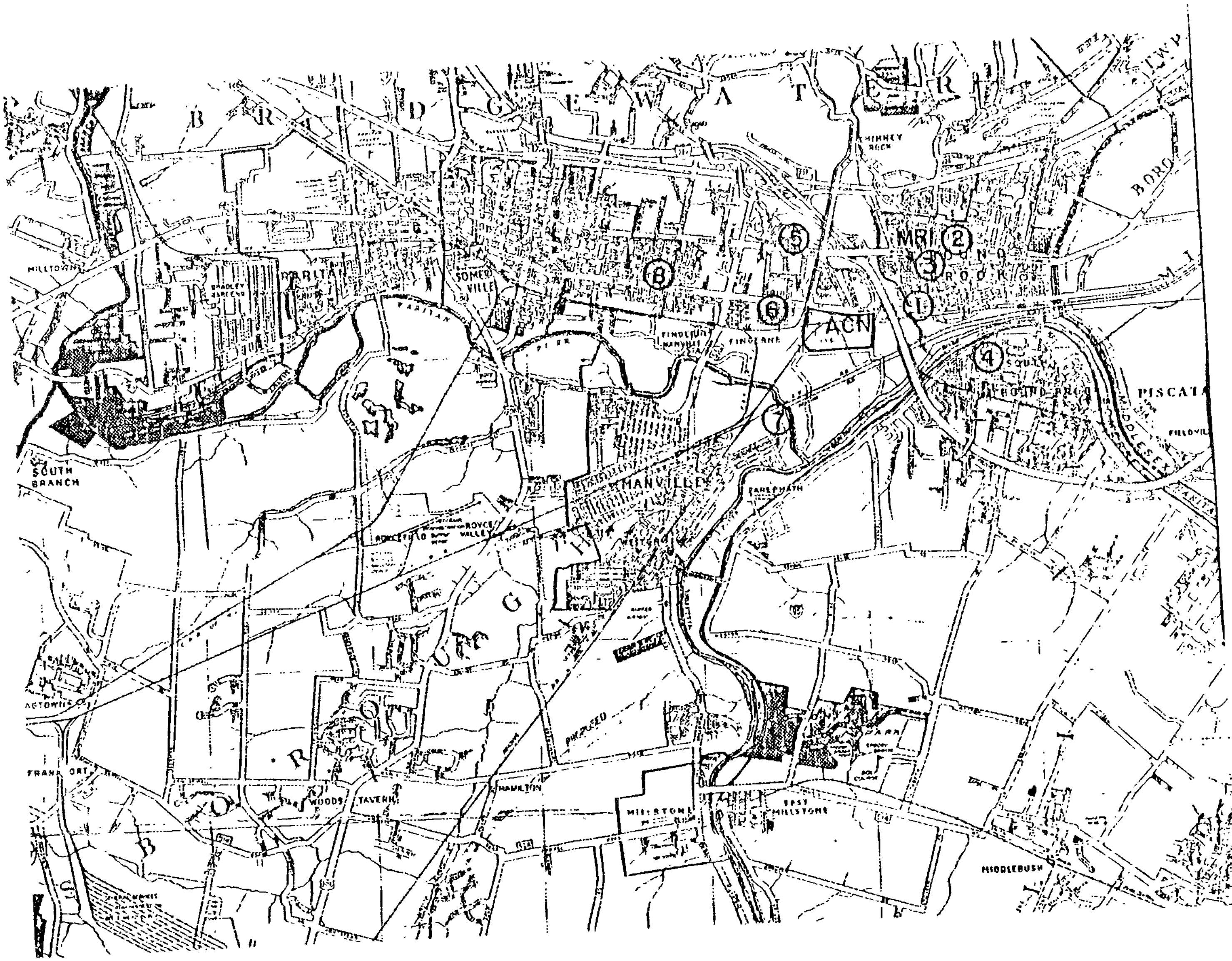


Figure A-12. Map of Bound Brook, NJ showing Site No. 1 and the sampling locations.

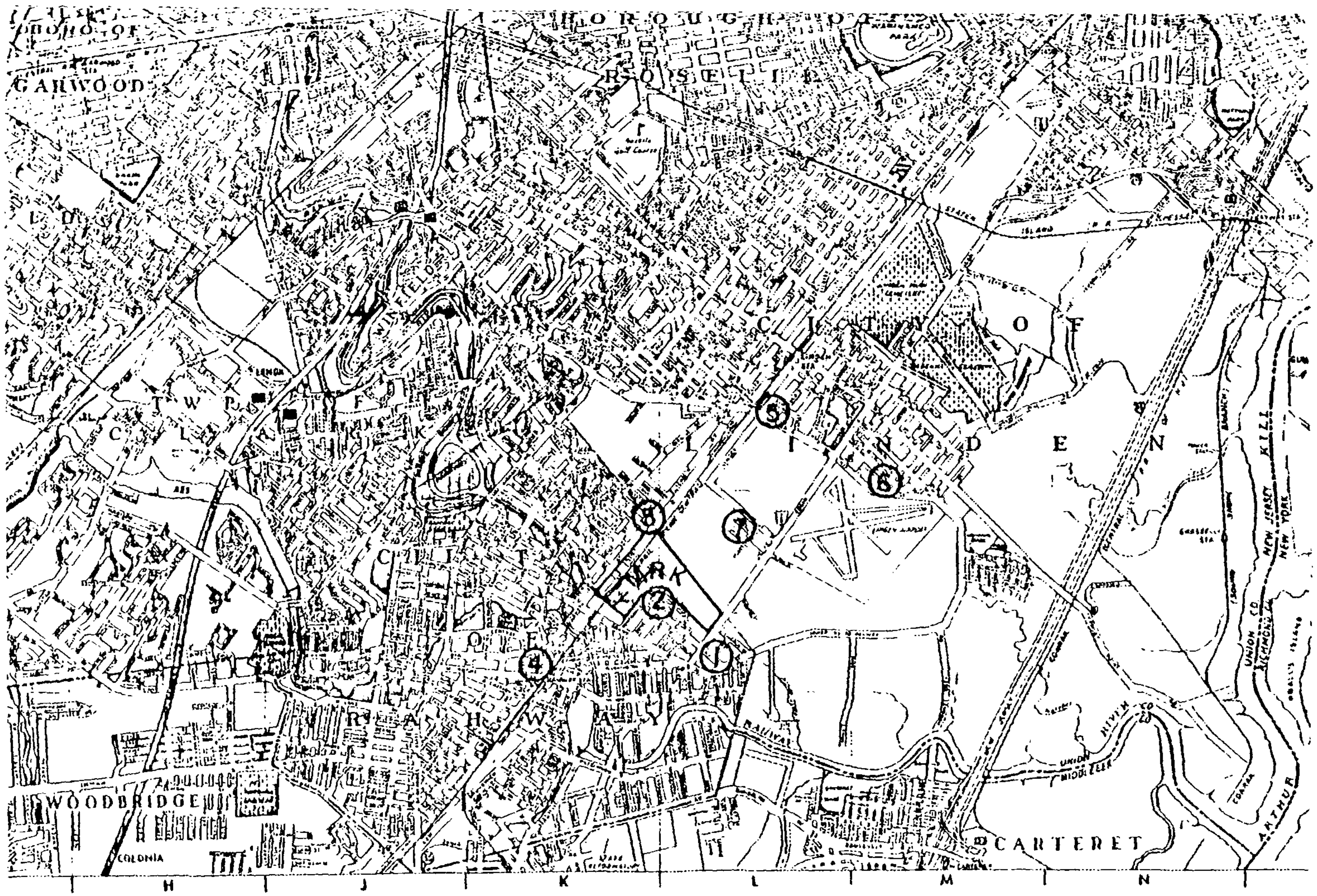


Figure A-13. Map of Rahway, NJ area showing Site No. 2 and the sampling locations.

Figure A-14. Map of Hillside, NJ area, showing Flash Dry Cleaners (FDC) and sampling locations.

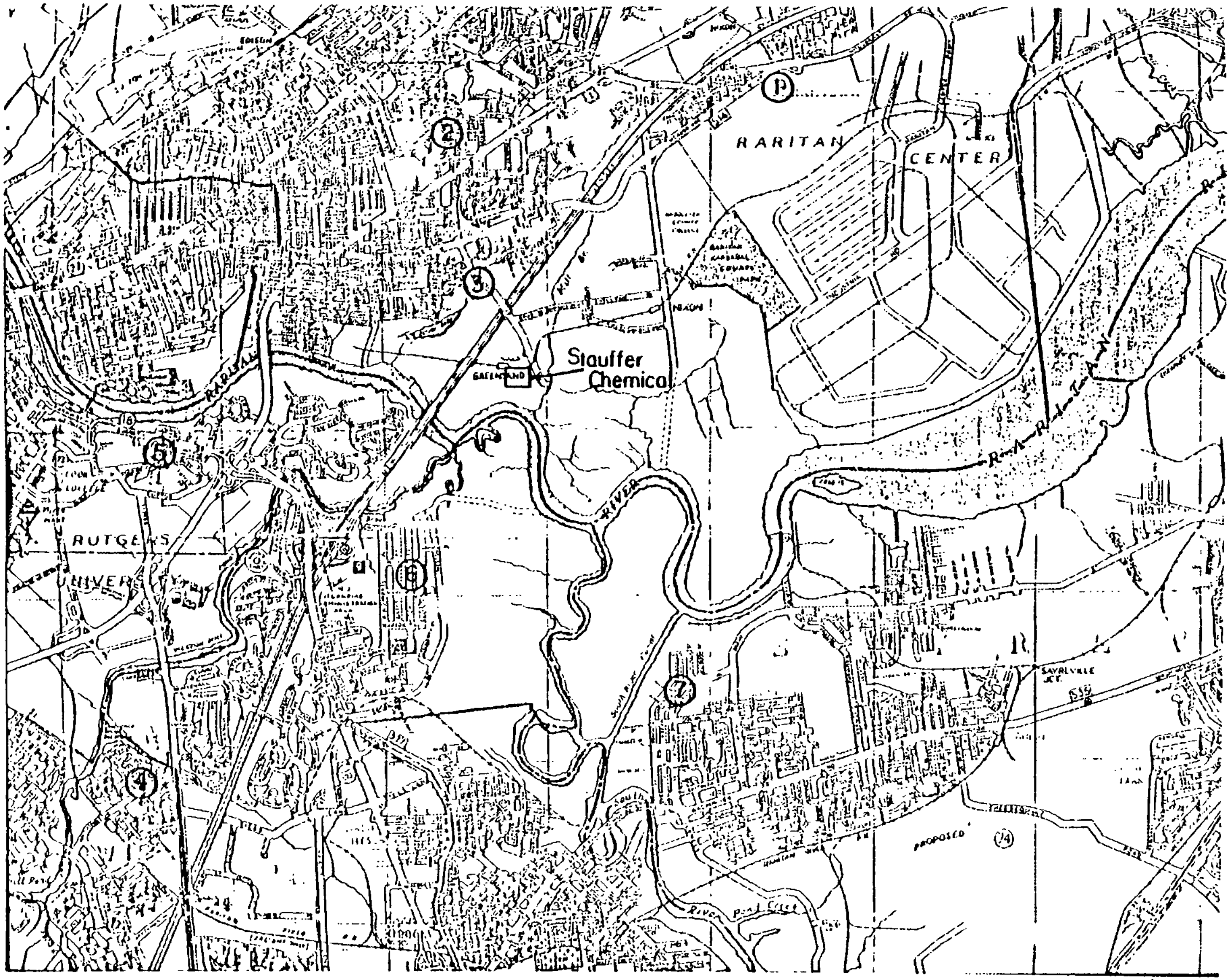


Figure A-15. Map of Edison, NJ area showing Site No. 3 and sampling locations.

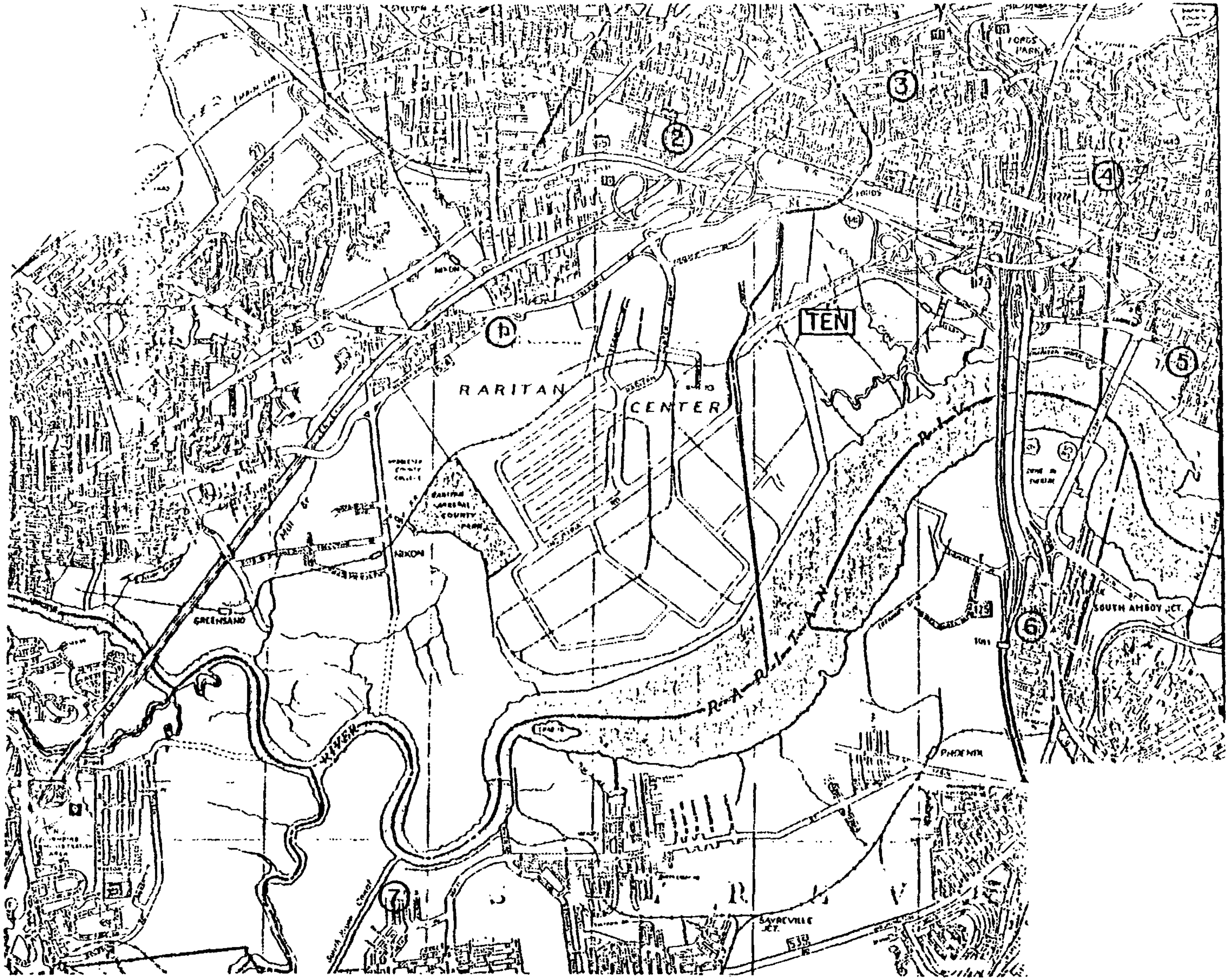


Figure A-16. Map of Fords, NJ area showing Site No. 4 and sampling locations.

Figure A-17. Map of Rutherford, NJ area showing Site No. 5 and sampling locations.

Table A-31. SAMPLING PROTOCOL FOR SITE NO. 1, BOUND BROOK, NJ - TRIP 2

Period	Location	Sampling Time	Sampling Volume(l)	Type of Sample	Meteorological Conditions			
					T (°C)	% RH	Wind Dir./Speed (Km/hr)	Other
P1 (9/18-9/19/78)	L1	1148(9/18)-1615(9/19)	115[a,b]	Air	12-22	69-100	N-NNE/0-3	Rain evening of 9/18
	L2	1015(9/18)-1634(9/19)	109[a,b]	Air				
	L3	0930(9/18)-1554(9/19)	84[a,b]	Air				
	L4	1206(9/18)-1505(9/19)	107[a,b]	Air				
	L5	0915(9/18)-1237(9/19)	123[a,b]	Air				
	L6	0955(9/18)-1330(9/19)	124[a,b]	Air				
	L7	1038(9/18) - unknown[c]	unknown[c]	Air				
	L8	1110(9/18)-1310(9/19)	133[a,b]	Air				
P2 (9/19-9/20/78)	L1	1615(9/19)-unknown[c]	unknown[c]	Air	10-15	62-89	NNE/0-3	
	L2	1640(9/19)-0955(9/20)	59[a,b]	Air				
	L3	1600(9/19)-unknown[c]	unknown[c]	Air				
	L4	1508(9/19)-unknown[c]	unknown[c]	Air				
	L5	1245(9/19)-1113(9/20)	101[a,b]	Air				
	L6	1335(9/19)-1045(9/20)	93[a,b]	Air				
	L8	1320(9/19)-1100(9/20)	95[a,b]	Air				
P2 (9/19/78)	L5		3x120 ml[d]	Tap Water				

[a] Volume of air/cartridge

[b] Sampling time x flow rate

[c] Pump failure during sampling period

[d] Samples taken immediately after turning on tap

Table A-32. SAMPLING PROTOCOL FOR SITE NO. 2, RAHWAY, NJ - TRIP 2

Period	Location	Sampling Time	Sampling Volume(l)	Type of Sample	Meteorological Conditions T (°C)	% RH	Wind Dir./Speed (Km/hr)	Other
P3	L1	1415(9/20)-1350(9/21)	106[a,b]	Air	?[d]-28	49-77	? - W/0-13	
(9/20-9/21/78)	L2	1435(9/20)-unknown[c]	unknown[c]	Air				
	L3	1452(9/20)-1535(9/21)	97[a,b]	Air				
	L4	1554(9/20)-1558(9/21)	91[a,b]	Air				
	L5	1635(9/20)-1411(9/21)	89[a,b]	Air				
	L6	1650(9/20)-1411(9/21)	81[a,b]	Air				
	L7	1735(9/20)-1458(9/21)	99[a,b]	Air				
P4	L1	1400(9/21)-1148(9/22)	91[a,b]	Air	19-28.5	60-86	WSW-N/0-13.5	
(9/21-9/22/78)	L2	1522(9/21)-1200(9/22)	83[a,b]					
	L3	1544(9/21)-1228(9/22)	83[a,b]	Air				
	L4	1605(9/21)-1212(9/22)	88[a,b]	Air				
	L5	1420(9/21)-1239(9/22)	98[a,b]	Air				
	L6	1415(9/21)-1248(9/22)	101[a,b]	Air				
	L7	1500(9/21)-1319(9/22)	89[a,b]	Air				
P3 (9/20/78)	L3		3x120 ml[e]	Tap Water				
P4 (9/21/78)	L2		3x120 ml[e]	Tap Water				

[a] Volume of air/cartridge
[b] Sampling time x flow rate
[c] Pump failure during sampling period
[d] Weather data non-existent for before 1300 on 9/21
[e] Samples taken immediately after turning on tap

Table A-33. SAMPLING PROTOCOL FOR SITE FDC (FLASH DRY CLEANERS), HILLSIDE, NJ - TRIP 2

Period	Location	Sampling Time	Sampling Volume(l)	Type of Sample	Meteorological Conditions T (°C)	% RH	Wind Dir./Speed (Km/hr)	Other
P4 (9/21/78)	L1	1150(9/21)-1210(9/21)	25[a,b]	Air	26	64	WSW/10-20	
	L2	1150(9/21)-1210(9/21)	33[a,c]	Air				

[a] Volume of air/cartridge

[b] Upwind sample

[c] Downwind sample

Table A-34. SAMPLING PROTOCOL FOR SITE NO. 3, EDISON, NJ - TRIP 2

Period	Location	Sampling Time	Sampling Volume(l)	Type of Sample	Meteorological Conditions T (°C)	% RH	Wind Dir./Speed (Km/hr)	Other
P5 (9/22-9/23/78)	L1	1555(9/22)-1415(9/23)	93[a,b]	Air	13-20	80-90	NNE-ESE/5-20	Rain during 9/22 evening
	L2	1630(9/22)-1500(9/23)	93[a,b]	Air				
	L3	1705(9/22)-1525(9/23)	85[a,b]	Air				
	L4	1759(9/22)-1749(9/23)	unknown[c]	Air				
	L5	1832(9/22)-1815(9/23)	95[a,b]	Air				
	L6	1725(9/22)-1707(9/23)	90[a,b]	Air				
	L7	1639(9/22)-1625(9/23)	91[a,b]	Air				
P6 (9/23-9/24/78)	L1	1423(9/23)-1445(9/24)	105[a,b]	Air	10-20	47-93	Variable/calm to 18	
	L2	1507(9/23) -1517(9/24)	98[a,b]	Air				
	L3	1537(9/23)-1535(9/24)	65[a,b]	Air				
	L4	1805(9/23)-1628(9/24)	unknown[c]	Air				
	L5	1829(9/23)-1612(9/24)	85[a,b]	Air				
	L6	1715(9/23)-1649(9/24)	unknown[c]	Air				
	L7	1630(9/23)-1721(9/24)	73[a,b]	Air				
P6 (9/23/78)	L4		3x120 ml[d]	Tap Water				
	L5		3x120 ml[d]	Tap Water				
	L6		3x120 ml[d]	Tap Water				
P7 (9/24/78)	L2		3x120 ml[d]	Tap Water				
	L3		3x120 ml[d]	Tap Water				
	L7		3x120 ml[d]	Tap Water				
P8 (9/25/78)	L1		3x120 ml[d]	Tap Water				

[a] Volume of air/cartridge
[b] Sampling time x flow rate
[c] Pump failure during sampling period
[d] First and second samples taken immediately after turning on tap; third sample after 2 min. run

Table A-35. SAMPLING PROTOCOL FOR SITE No. 4, FORDS, NJ - TRIP 2

Period	Location	Sampling Time	Sampling Volume(l)	Type of Sample	Meteorological Conditions T (°C)	% RH	Wind Dir./Speed (Km/hr)	Other
P8	L1	0815(9/25)-0802(9/26)	95[a,b]	Air	8-23	45-70	NNW-NE/9-29	
(9/25-9/26/78)	L2	0915(9/25)-unknown[c]	unknown[c]	Air				
	L3	0940(9/25) - unknown[c]	unknown[c]	Air				
	L4	1005(9/25)-unknown[c]	unknown[c]	Air				
	L5	1025(9/25)-1040(9/26)	94[a,b]	Air				
	L6	1045(9/25)-1035(9/26)	101[a,b]	Air				
	L7	1130(9/25)-1102(9/26)	74[a,b]	Air				
P9	L1	0815(9/26)-0920(9/27)	113[a,b]	Air	9-18	45-60	Variable/calm-18	
(9/26-9/27/78)	L2	0844(9/26)-unknown[c]	unknown[c]	Air				
	L3	0908(9/26)-0945(9/27)	95[a,b]	Air				
	L5	1048(9/26)-1015(9/27)	93[a,b]	Air				
	L6	1040(9/26)-1030(9/27)	99[a,b]	Air				
	L7	1114(9/26)-1100(9/27)	87[a,b]	Air				
P8	L2		3x120 ml[d]	Tap Water				
(9/25/78	L3		3x120 ml[d]	Tap Water				
	L4		3x120 ml[d]	Tap Water				
	L5		3x120 ml[d]	Tap Water				
	L6		3x120 ml[d]	Tap Water				
	L7		3x120 ml[d]	Tap Water				

[a] Volume of air/cartridge
[b] Sampling time x flow rate
[c] Pump failure during sampling period
[d] First and second samples taken immediately after turning on tap; third after 2 min run
[e] Samples taken immediately after turning on tap

Table A-36. SAMPLING PROTOCOL FOR SITE No. 5, CARLSTADT, NJ - TRIP 2

Period	Location	Sampling Time	Sampling Volume(l)	Type of Sample	Meteorological Conditions			
					T (°C)	% RH	Wind Dir./Speed (Km/hr)	Other
P10	L1	1142(9/28)-1211(9/29)	90[a,b]	Air	3-22	38-91	NW-NE/calm-29	
(9/28-9/29/78)	L2	1219(9/28)-1245(9/29)	97[a,b]	Air				
	L3	1257(9/28)-unknown[c]	unknown[c]	Air				
	L4	1322(9/28)-1345(9/29)	101[a,b]	Air				
	L5	1511(9/28)-1430(9/29)	85[a,b]	Air				
	L6	1625(9/28)-1518(9/29)	80[a,b]	Air				
	L7	1704(9/28)-1606(9/29)	82[a,b]	Air				
P11	L1	1226(9/29)-1222(9/30)	93[a,b]	Air	7-21	31-100	Variable/calm-28	
(9/29-9/30/78)	L2	1258(9/29)-unknown[c]	unknown[c]	Air				
	L3	1331(9/29)-1258(9/30)	107[a,b]	Air				
	L4	1356(9/29)-1312(9/30)	97[a,b]	Air				
	L5	1440(9/29)-1323(9/30)	86[a,b]	Air				
	L6	1538(9/29)-1343(9/30)	79[a,b]	Air				
	L7	1627(9/29)-1402(9/30)	71[a,b]	Air				
P12	L8	1117-1148	35[a,b,d]	Air	19	53	S/28	
(9/30/78)	L9	1115-1145	35[a,b,e]	Air				
P10	L2		3x120 ml	Tap Water				
	L4		3x120 ml	Tap Water				
	L5		3x120 ml	Tap Water				
	L6		3x120 ml	Tap Water				
	L7		3x120 ml	Tap Water				
P11 (9/29/78)	L1		3x120 ml	Tap Water				

[a] Volume of air/cartridge

[b] Sampling time x flow rate

[c] Pump failure during sampling period

[d] Upwind "grab scale"

ownwind "grab scale"

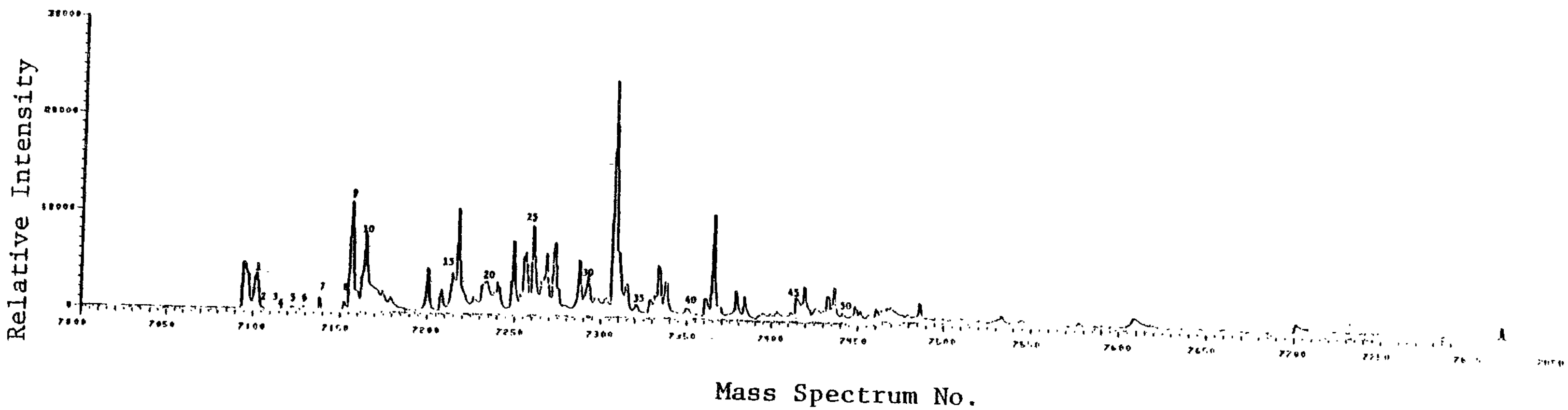


Figure A-18. GC/MS/COMP profile of vapor-phase organics in ambient air at Site No. 1 in Bound Brook, NJ (P1/L1). See Table A-38.

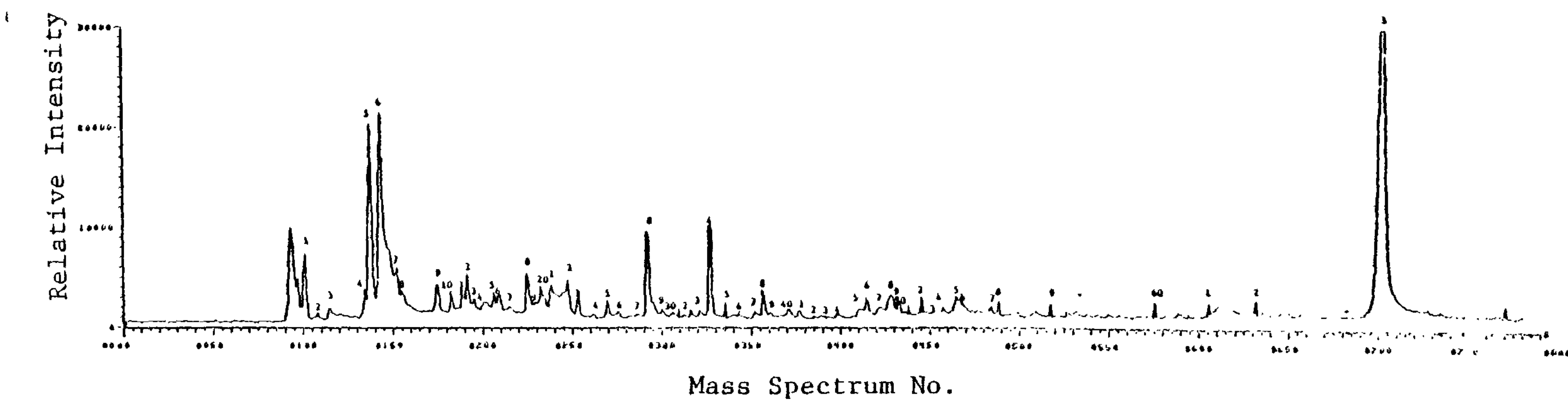


Figure A-19. GC/MS/COMP profile of vapor-phase organics in ambient air at Site No. 1 in Bound Brook, NJ (P2/L4). See Table A-37.

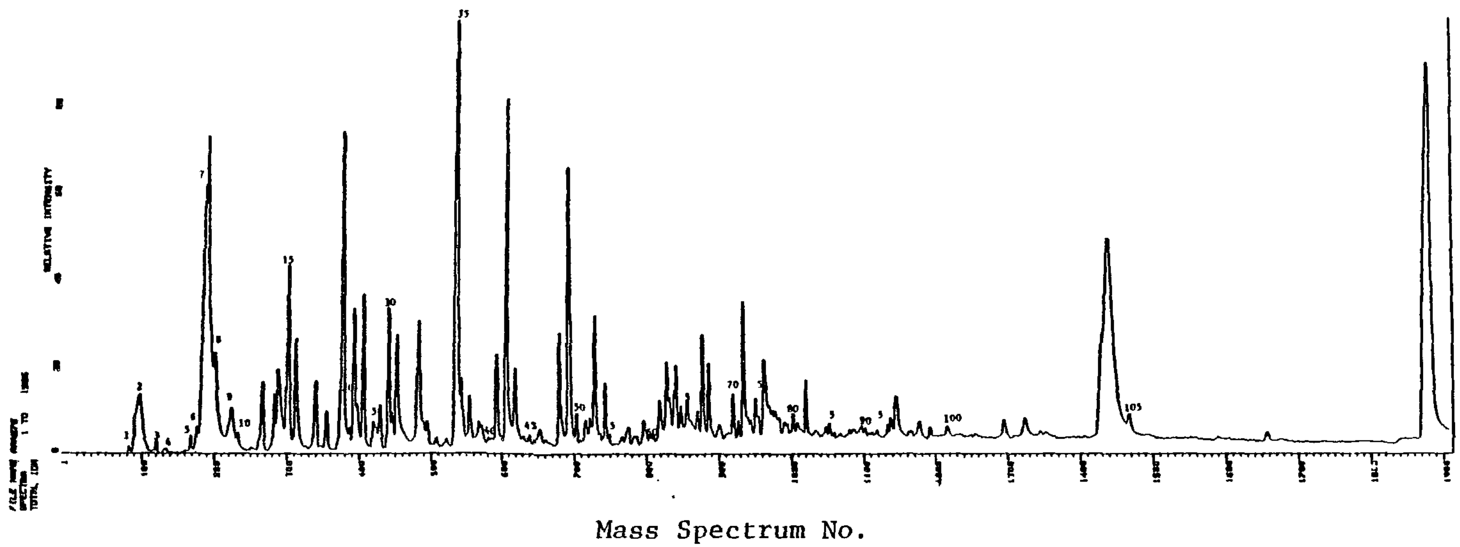


Table A-20. GC/MS/COMP profile of vapor-phase organics in ambient air at Site No. 2 in Rahway, NJ (P3/L7). See Table A-39.

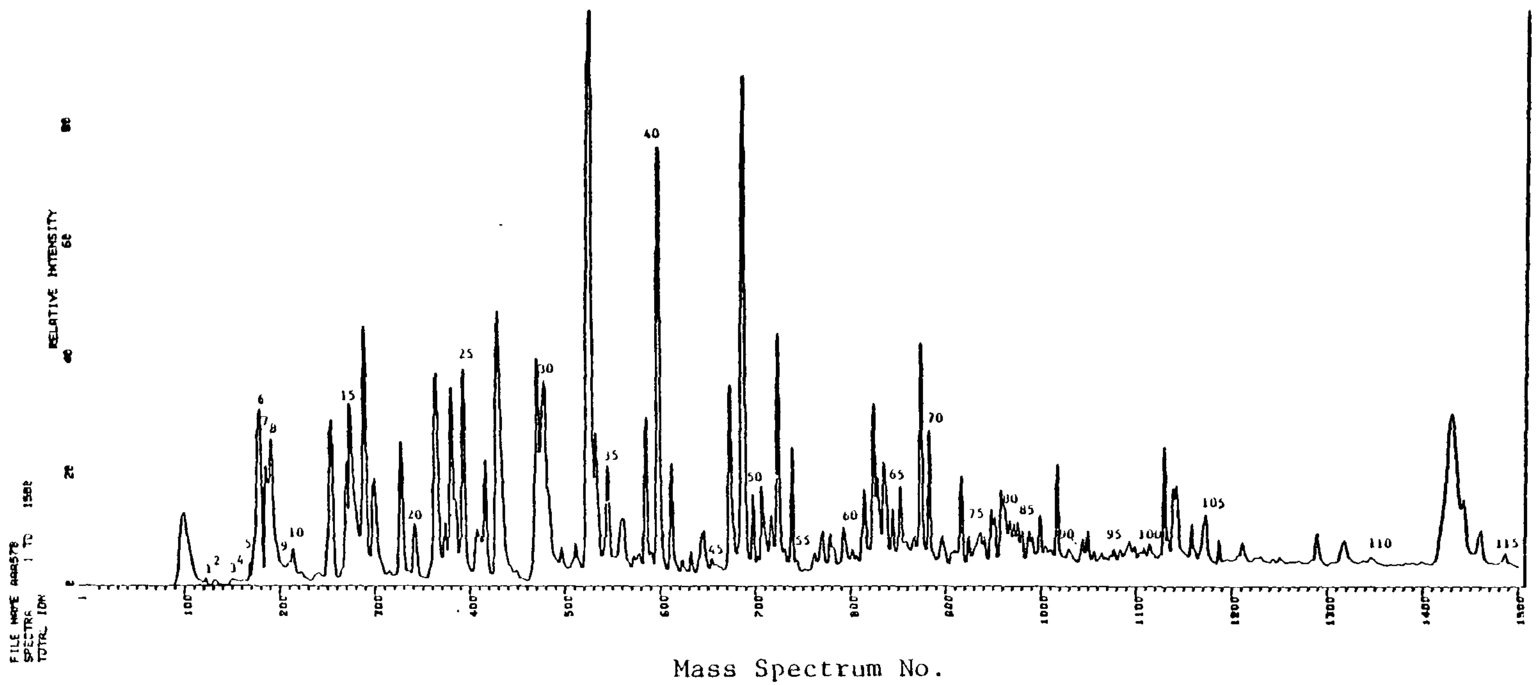


Table A-21. GC/MS/COMP profile of vapor-phase organics in ambient air at Site No. 2 in Rahway, NJ (P4/L2). See Table A-40.

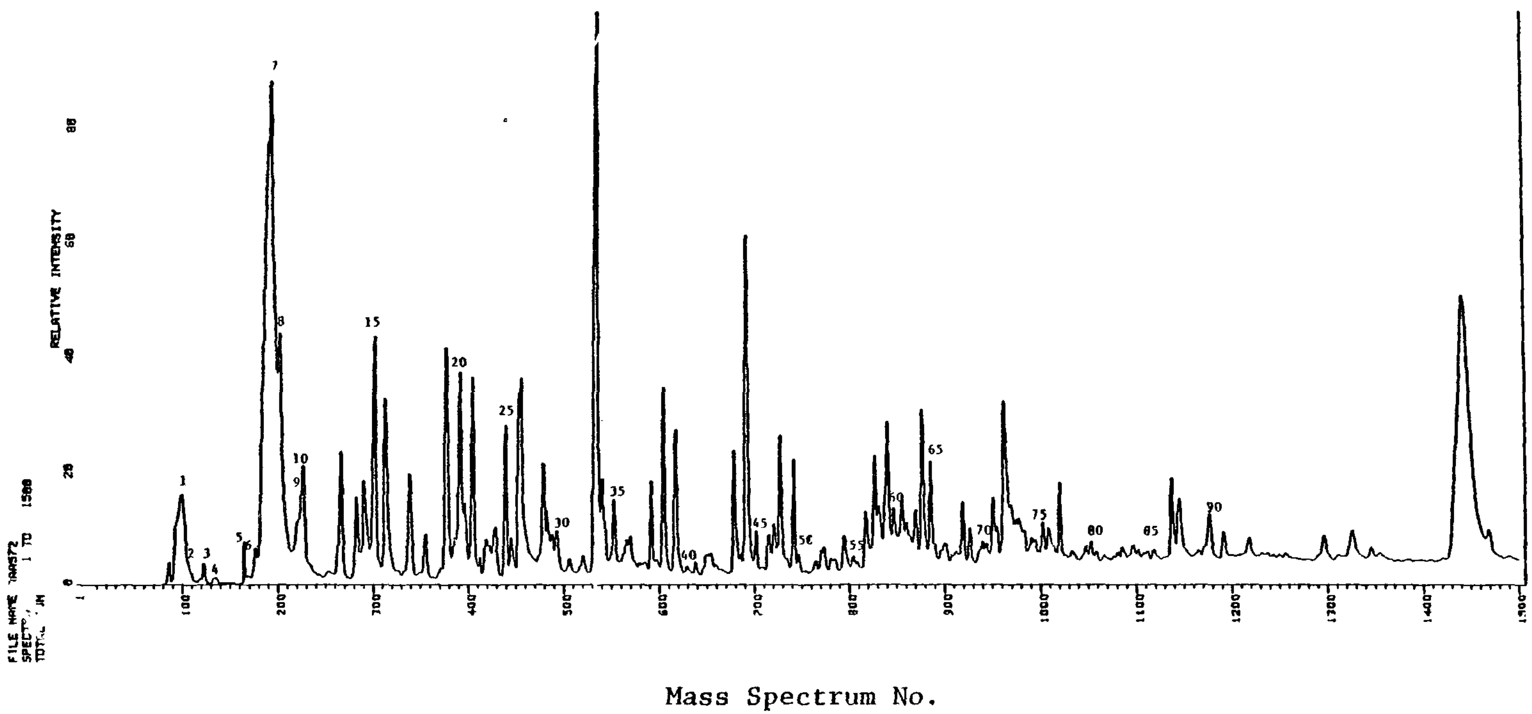


Figure A-22. GC/MS/COMP profile of vapor-phase organics in ambient air at Site No. 2 in Rahway, NJ (P3/L3). See Table A-41.

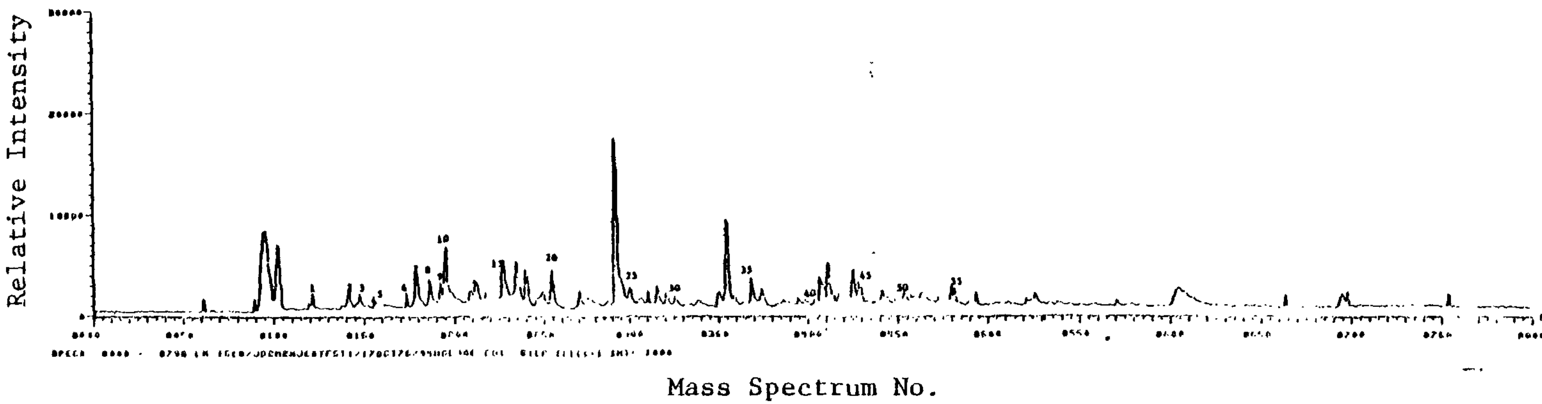


Figure A-23. GC/MS/COMP profile of vapor-phase organics in ambient air at Site No. 3 in Edison, NJ (P6/L5). See Table A-42.

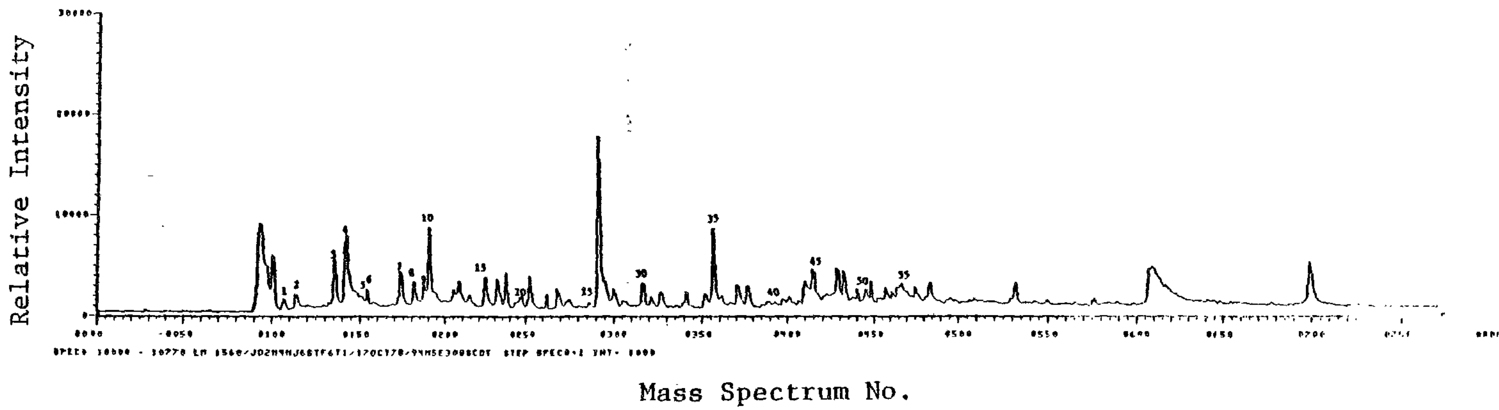


Figure A-24. GC/MS/COMP profile of vapor-phase organics in ambient air at Site No. 4 in Edison, NJ (P6/L6). See Table A-43.

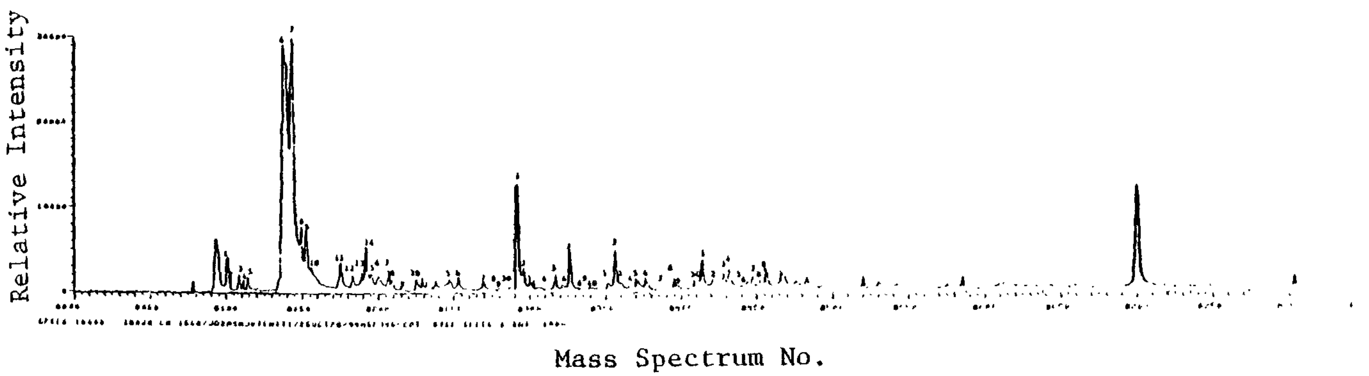


Figure A-25. GC/MS/COMP profile of vapor-phase organics in ambient air at Site No. 4 in Fords, NJ (P8/L1). See Table A-44.

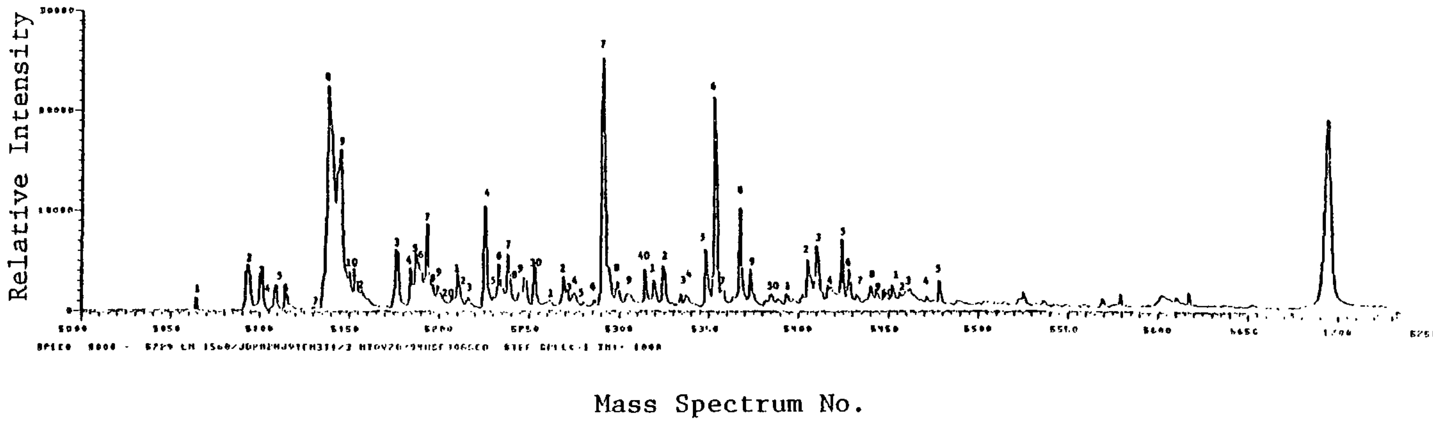


Figure A-26. GC/MS/COMP profile of vapor-phase organics in ambient air at Site No. 4 in Fords, NJ (P9/L3). See Table A-45.

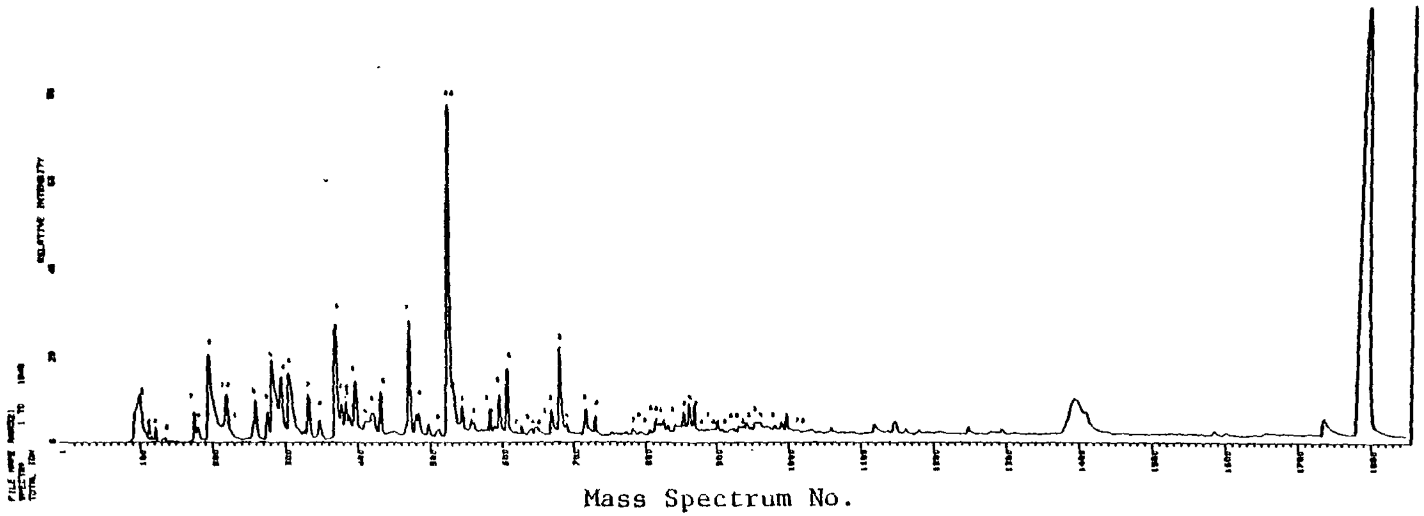


Figure A-27. GC/MS/COMP profile of vapor-phase organics in ambient air at Site No. 5 in Carlstadt, NJ (P10/L7). See Table A-46.

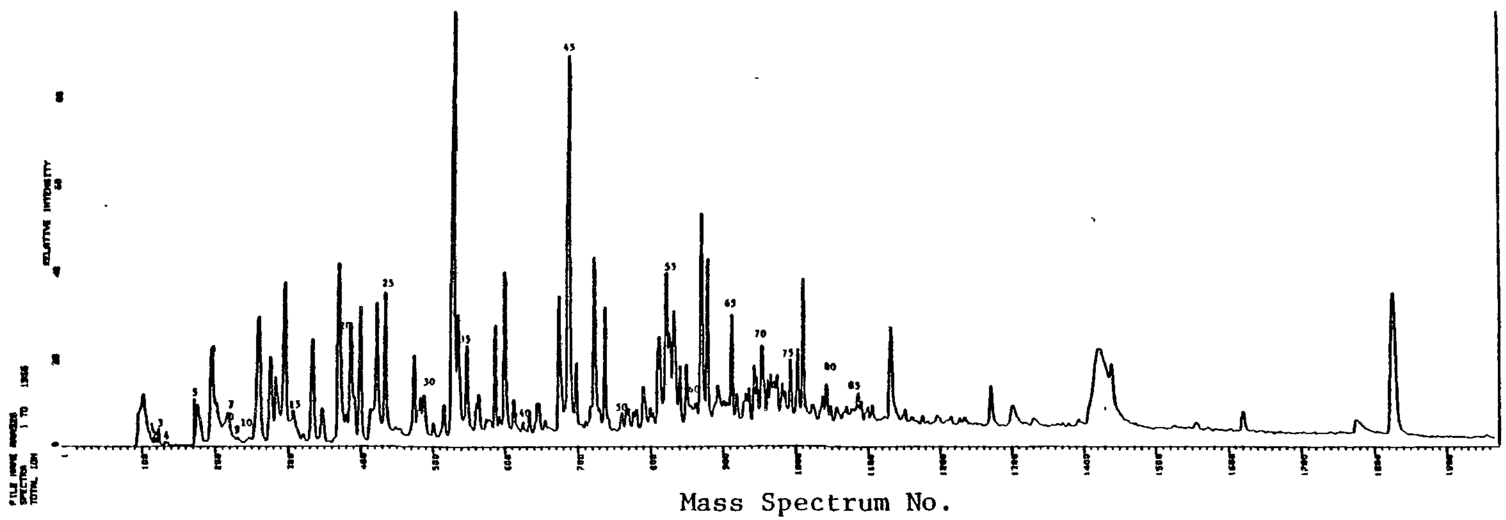


Figure A-28. GC/MS/COMP profile of vapor-phase organics in ambient air at Site No. 5 in Carlstadt, NJ (P11/L4). See Table A-47.

Table A-37. VAPOR-PHASE HALOGENATED ORGANICS IDENTIFIED IN AMBIENT AIR AT SITE NO. 1 IN BOUND BROOK, NJ (P2/L4)[a]

Chromatographic Peak No.	Elution Temp. (°C)	Compound	Chromatographic Peak No.	Elution Temp. (°C)	Compound
2	55.7	Freon 12 (BKG)	19	95.7	CCl_4
5	65.7	Freon 11 (BKG)	22	102.7	trichloroethylene
7	70.7	CH_2Cl_2	33	127.0	tetrachloroethylene
8	71.7	Freon 113	36	134.0	chlorobenzene
11	83.0	PFB (I)	49	143.3	C_3H_3Br
13	85.0	$CHCl_3$	51	165.7	dichlorobenzene isomer
15	88.3	PFT (I)	53	170.3	dichlorobenzene isomer
17	91.3	1,1,1-trichloroethane			

[a]See Table A-31 for sampling protocol.

Table A-38. VAPOR-PHASE HALOGENATED ORGANICS IN AMBIENT AIR AT SITE NO. 1 IN BOUND BROOK, NJ (P1/L1)[a]

Chromatographic Peak No.	Elution Temp. (°C)	Compound	Chromatographic Peak No.	Elution Temp. (°C)	Compound
2	55.3	Freon 12 (BKG)	19	97.0	PFT (I)
9	71.9	Freon 11 (BKG)	21	100.0	1,1,1-trichloroethane
11	77.4	CH_2Cl_2	23	103.7	CCl_4
12	79.6	Freon 113	27	109.3	trichloroethylene
15	91.6	PFB (I)	38	121.3	tetrachloroethylene
17	93.3	$CHCl_3$	40	137.3	chlorobenzene
			50	167.3	dichlorobenzene isomer

[a]See Table A-31 for sampling protocol.

Table A-39. VAPOR-PHASE HALOGENATED ORGANICS IDENTIFIED IN AMBIENT AIR AT SITE NO. 5 IN RAHWAY, NJ (P3/L7)[a] - TRIP 2

Chromato-graphic Peak No.	Elution Temp. (°C)	Compound	Chromato-graphic Peak No.	Elution Temp. (°C)	Compound
5	71.3	CF_2Cl_2 (Freon 12)	18	103.0	1,1,1-trichloroethane
6,7	74.5	$CFCl_3$ (Freon 11)	20	107.0	CCl_4
9	82	methylene chloride	26	114.6	trichloroethylene
10	86.2	$CF_2ClCFCl_2$ (Freon 113)	42	142.8	tetrachloroethylene
15	94	PFB (I)	69	190.2	dichlorobenzene isomer
16	96.4	$CHCl_3$	72	195.3	dichlorobenzene isomer
17	99.0	PFT (I)	95	226.6	trichlorobenzene isomer
17a	101.4	1,2-dichloroethane	99	233.8	trichlorobenzene isomer

[a]See Table A-32 for sampling protocol.

Table A-40. VAPOR-PHASE HALOGENATED ORGANICS IDENTIFIED IN AMBIENT AIR AT SITE NO. 2 IN RAHWAY, NJ (P4/L2)[a]

Chromato-graphic Peak No.	Elution Temp. (°C)	Compound	Chromato-graphic Peak No.	Elution Temp. (°C)	Compound
4	71.9	Freon 12 (BKG)	22	105.2	CCl_4
6	74.6	Freon 11 (BKG)	27	113.2	trichloroethylene
9	79.8	CH_2Cl_2	40	141.7	tetrachloroethylene
10	80.4	Freon 113	44	149.7	chlorobenzene
16	91.9	PFB (I)	71	189.2	dichlorobenzene isomer
17	94.2	$CHCl_3$	75	195.0	dichlorobenzene isomer
19	97.7	PFT (I)	102	226.2	trichlorobenzene isomer
20	100.2	1,1,1-trichloroethane			

[a]See Table A-32 for sampling protocol.

Table A-41. VAPOR-PHASE HALOGENATED ORGANICS IDENTIFIED IN AMBIENT AIR AT SITE NO. 2 IN RAHWAY, NJ (P3/L3)[a]

Chromato-graphic Peak No.	Elution Temp. (°C)	Compound	Chromato-graphic Peak No.	Elution Temp. (°C)	Compound
2	63.4	Freon 12 (BKG)	18	102.6	1,1,1-trichloroethane
7	76.0	Freon 11 (BKG)	20	107.3	CCl_4
9	81.2	CH_2Cl_2	24	114.8	trichloroethylene
10	82.3	Freon 113	34	127.0	1,1,2-trichloroethane
15	93.8	PFB (S)	38	142.6	tetrachloroethylene
16	96.1	$CHCl_3$	42	150.6	chlorobenzene
17	99.6	PFT (S)	66	190.0	dichlorobenzene isomer
17a	101.7	1,2-dichloroethane	70	195.4	dichlorobenzene isomer
			86	227.0	trichlorobenzene isomer

[a]See Table A-32 for sampling protocol.

Table A-42. VAPOR-PHASE HALOGENATED ORGANICS IDENTIFIED IN AMBIENT AIR AT SITE NO. 3 IN EDISON, NJ (P6/L5)[a]

Chromatographic Peak No.	Elution Temperature (°C)	Compound	Chromatographic Peak No.	Elution Temperature (°C)	Compound
2	66.3	Freon 11 (BKG)	16	96.3	CCl_4
4	74.9	CH_2Cl_2 (BKG)	19	103.2	trichloroethylene
5	72.9	Freon 113	29	126.7	tetrachloroethylene
8	82.9	PFB (S)	31	133.7	chlorobenzene
11	85.9	$CHCl_3$	46	164.6	dichlorobenzene isomer
12	89.6	PFT (S)	49	168.8	dichlorobenzene isomer
14	92.3	1,1,1-trichloroethane			

[a]See Table A-34 for sampling protocol.

Table A-43. VAPOR-PHASE HALOGENATED ORGANICS IDENTIFIED IN AMBIENT AIR AT SITE NO. 4 IN EDISON, NJ (P6/L6)[a]

Chromatographic Peak No.	Elution Temp. (°C)	Compound	Chromatographic Peak No.	Elution Temp. (°C)	Compound
1	56	Freon 12 (BKG)	14	91.6	1,1,1-trichloroethane
3	64.6	Freon 11 (BKG)	16	95.6	CCl_4
5	70	CH_2Cl_2	20	102.6	trichloroethylene
6	71	Freon 113	31	106.9	tetrachloroethylene
9	82.2	PFB (S)	33	133.9	chlorobenzene
11	84.6	$CHCl_3$	48	165.9	dichlorobenzene isomer
12	88.3	PFT (S)	52	170.2	dichlorobenzene isomer
13	90.0	1,2-dichloroethane (tent.)			

[a]See Table A-34 for sampling protocol.

Table A-44. VAPOR-PHASE HALOGENATED ORGANICS IDENTIFIED IN AMBIENT AIR AT SITE NO. 4 IN FORDS, NJ (P8/L1)[a] - TRIP 2

Chromato-graphic Peak No.	Elution Temp. (°C)	Compound	Chromato-graphic Peak No.	Elution Temp. (°C)	Compound
3	55.7	Freon 12	19	92.0	1,1,1-trichloroethane
6	65.7	Freon 11	21	96.0	carbon tetrachloride
9	70.7	methylene chloride	25	102.7	trichloroethylene
10	72.0	Freon 113	36	127.0	tetrachloroethylene
13	82.7	PFB (I)	55	166.0	dichlorobenzene isomer
15	85.3	chloroform	58	170.3	dichlorobenzene isomer
17	88.7	PFT (I)			

[a]See Table A-35 for sampling protocol.

Table A-45. VAPOR-PHASE HALOGENATED ORGANICS IDENTIFIED IN AMBIENT AIR AT SITE NO. 4 IN FORDS, NJ (P9/L3)[a]

Chromato-graphic Peak No.	Elution Temp. (°C)	Compound	Chromato-graphic Peak No.	Elution Temp. (°C)	Compound
4	55.7	Freon 12 (BKG)	22	91.7	1,1,1-trichloroethane
8	66.0	Freon 11 (BKG)	25	96.0	CCl_4
11	71.0	CH_2Cl_2	29	102.7	trichloroethylene
12	72.3	Freon 113	41	126.3	tetrachloroethylene
16	83.3	PFB (I)	57	164.3	dichlorobenzene isomer
18	85.3	$CHCl_3$	59	168.7	dichlorobenzene isomer
20	89.0	PFT (I)			

[a]See Table A-35 for sampling protocol.

Table A-46. VAPOR-PHASE HALOGENATED ORGANICS IDENTIFIED IN AMBIENT AIR AT SITE NO. 5 IN CARLSTADT, NJ (P10/L7)[a]

Chromato- graphic Peak No.	Elution Temp. (°C)	Compound	Chromato- graphic Peak No.	Elution Temp. (°C)	Compound
2	63.3	Freon 12 (BKG)	20	106.0	CCl_4
3	63.6	dichloroethylene	25	113.4	trichloroethylene
8	74.5	Freon 11	35	141.2	tetrachloroethylene
10	80.9	CH_2Cl_2	40	149.2	chlorobenzene
11	81.5	Freon 113	56	187.8	dichlorobenzene isomer
15	92.7	PFB (S)	59	192.9	dichlorobenzene isomer
17	99.3	PFT (S)	69	223.1	trichlorobenzene isomer
18	101.2	1,1,1-trichloroethane			

[a]See Table A-36 for sampling protocol.

Table A-47. VAPOR-PHASE HALOGENATED ORGANICS IDENTIFIED IN AMBIENT AIR AT SITE NO. 5 IN CARLSTADT, NJ (P11/L4)[a]

Chromato- graphic Peak No.	Elution Temp. (°C)	Compound	Chromato- graphic Peak No.	Elution Temp. (°C)	Compound
1	63.4	Freon 12 (BKG)	18	100.9	1,1,1-trichloroethane
5	74.6	Freon 11 (BKG)	20	106.2	CCl_4
7	80.6	methylene chloride	24	113.8	trichloroethylene
8	81.2	Freon 113	31	126.8	1,1,2-trichloroethane (tent.)
14	92.7	PFB (S)	38	141.7	tetrachloroethylene
15	94.6	$CHCl_3$	63	189.5	dichlorobenzene isomer
17	98.8	PFT (S)	67	194.3	dichlorobenzene isomer
17a	100.6	1,2-dichloroethane	88	224.9	trichlorobenzene isomer

[a]See Table A-36 for sampling protocol.

Table A-48. ESTIMATED LEVELS OF VAPOR-PHASE HALOGENATED HYDROCARBONS IN AMBIENT AIR AT SITE NO. 1 IN BOUND BROOK, NJ (9/18 - 19/78)[a]

Category	Compound	P1/L1	P1/L2	P1/L3	P1/L4	P1/L5	P1/L6	P1/L7	P1/L8
Ubiquitous	1,1-dichloroethane	T[b]	ND	T	237 26	ND	ND	ND	ND
	chloroform	2,895	5,210 ± 1,605	4,421 ± 816	6,842 ± 184	6,842 ± 184	4,132	12,421 ± 1,421	7,921 ± 171
	1,2-dichloroethane	390	756 ± 49	1,463 ± 243	1,829 ± 170	1,341	1,195 ± 268	1,341 ± 122	1,098 ± 244
	1,1,1-trichloroethane	18,500	22,000 ± 1,222	24,556 ± 3,944	53,833 ± 3,667	111,167	51,833 ± 5,111	36,389 ± 2,333	36,389 ± 2,333
	carbon tetrachloride	2,185	3,370 ± 0	3,259 ± 333	5,852 ± 667	16,000	5,407 ± 0	3,926 ± 333	4,592 ± 2,333
	trichloroethylene	19,522	17,194 ± 1,060	15,492 ± 2,761	25,045 ± 8,060	40,746	42,448 ± 6,373	11,672 ± 209	4,592 ± 1,000
	tetrachloroethylene	6,156	10,530 ± 809	11,569 ± 2,220	30,024 ± 3,988	19,505	38,585 ± 15,252	10,314 ± 1,702	1,851 ± 403
	chlorobenzene	T	T	T	393 ± 59	467	1,545 ± 301	6,072 ± 685	--
	m-dichlorobenzene	261	678 ± 43	1,092 ± 64	1,250 ± 83	1,047	2,602 ± 772	806 ± 97	--
	o-dichlorobenzene	61	174 0	T	345 ± 36	523	1,496 ± 350	2,105 ± 56	--

[a]See Table A-31 for sampling protocol.

[b]Values are in ng/m^3, ND = not detected, T = trace.

Table A-49. ESTIMATED LEVELS OF VAPOR-PHASE HALOGENATED HYDROCARBONS IN AMBIENT AIR AT SITE NO. 1 IN BOUND BROOK, NJ (9/19-20/78)[a]

Category	Compound	P2/L1	P2/L2	P2/L3	P2/L4	P2/L5	P2/L6	P2/L8
Ubiquitous	1,1-dichloroethane	ND[b]	ND	ND	ND	T	ND	ND
	chloroform	5,111 ± 555	3,694 ± 472	10,750 ± 4,083	2,278	3,694 ± 667	3,611	6,167 ± 278
	1,2-dichloroethane	612 ± 97	581 ± 64	742 ± 161	355 ± 0	452 ± 32	581 ± 32	323 ± 97
	1,1,1-trichloroethane	6,415 ± 512	5,756 ± 49	5,439 ± 561	4,854 ± 439	8,634 ± 293	8,634 ± 34	2,537 ± 732
	carbon tetrachloride	2,333 ± 370	1,778 ± 0	1,519 ± 74	1,259 ± 0	2,333 ± 148	2,296 ± 667	1,000 ± 259
	trichloroethylene	7,457 ± 629	3,075 ± 552	5,179 ± 1,612	3,925 ± 567	6,149 ± 627	3,881 ± 149	1,672 ± 194
	tetrachloroethylene	10,286 ± 1,057	5,051 ± 627	--	8,429	7,436 ± 802	8,075 ± 591	1,274 ± 168
	chlorobenzene	2,343 ± 286	746 ± 85	--	2,071 ± 536	158 ± 59	366 ± 86	263 ± 105
	_m_-dichlorobenzene	800 ± 143	661 ± 51	--	821 ± 0	327 ± 9.9	613 ± 22	147 ± 21
	_o_-dichlorobenzene	657 ± 86	390 ± 34	--	893 ± 36	99 ± 9.9	140 ± 0	95 ± 21

[a]See Table A-31 for sampling protocol.

[b]Values are in ng/m^3, ND = not detected, T = trace, -- not determined.

Table A-50. ESTIMATED LEVELS OF VAPOR-PHASE HALOGENATED HYDROCARBONS IN AMBIENT AIR AT SITE NO. 2 IN RAHWAY, NJ (9/20 - 21/78)[a]

Category	Compound	P3/L1	P3/L2	P3/L3	P3/L4	P3/L5	P3/L6	P3/L7
Ubiquitous	chloroform	10,091 ± 1,227[b]	7,409	17,318	10,181	20,409 ± 1,864	8,727 ± 3,318	38,636 ± 3,136
	1,2-dichloroethane	1,345 ± 275	2,000 ± 137	1,586 ± 207	1,379 ± 517	1,810 ± 275	2,034 ± 172	1,241 ± 655
	1,1,1-trichloroethane	14,923 ± 3,000	20,000 ± 1,153	19,115 ± 153	15,615 ± 2,615	22,692 ± 3,385	31,461 ± 8,154	24,154 ± 846
	carbon tetrachloride	2,789 ± 579	3,842 ± 105	3,181 ± 105	2,579 ± 684	2,737 ± 421	3,684 ± 789	3,368 ± 158
	trichloroethylene	8,114 ± 2,083	11,520 ± 1,646	12,000 ± 1,562	9,583 ± 4,208	48,646 ± 6,250	21,354 ± 1,208	16,375 ± 417
	tetrachloroethylene	19,660 ± 7,094	21,181 ± 1,771	9,691 ± 587	9,747 ± 3,198	13,876 ± 2,213	21,469 ± 901	33,050 ± 2,555
	chlorobenzene	283 ± 123	578 ± 217	670 ± 391	98	550 ± 292	1,222 ± 518	414 ± 71
	_m_-dichlorobenzene	170 ± 113	410 ± 24	484 ± 0	132	696 ± 135	580 ± 86	525 ± 40
	_o_-dichlorobenzene	207 ± 38	337 ± 156	299 ± 123	88	1,438 ± 326	1,506 ± 309	11,555 ± 768
Site-Specific	trichlorobenzene	179 ± 132	156 ± 24	113 ± 21	33	180 ± 45	222 ± 25	353 ± 50

[a]See Table A-22 for sampling protocol.

[b]Values in ng/m^3, - = not detected, T = trace.

Table A-51. ESTIMATED LEVELS OF VAPOR-PHASE HALOGENATED HYDROCARBONS IN AMBIENT AIR AT SITE NO. 2 IN RAHWAY, NJ (9/21-22/78)[a]

Category	Compound	Site No. 2						
		P4/L1	P4/L2	P4/L3	P4/L4	P4/L5	P4/L6	P4/L7
Ubiquitous	chloroform	98,625 ± 2,815	32,750 ± 5,000	34,000 ± 17,312	22,250 ± 11,750	17,125 ± 625	29,125 ± 16,500	38,812 ± 11,062
	1,2-dichloroethane	3,200 ± 0	4,300 ± 0	3,050 ± 50	2,400 ± 100	3,900 ± 200	4,800	3,375 ± 9
	1,1,1-trichloroethane	47,100 ± 3,300	38,400 ± 600	46,200 ± 3,100	31,150 ± 3,900	51,200 ± 11,200	53,900	41,400 ± 200
	carbon tetrachloride	4,071 ± 71	4,000 ± 0	3,571 ± 143	4,143 ± 500	5,643 ± 2,000	8,214	29,571 ± 143
	trichloroethylene	173,886 ± 2,600	48,743 ± 1,514	38,914 ± 3,400	26,600 ± 285	121,886 ± 4,857	178,229	103,057 ± 8,028
	tetrachloroethylene	35,198 ± 1,077	44,446 ± 277	32,108 ± 13,807	20,000 ± 301	25,510 ± 2,964	39,881	38,359 ± 4,180
	chlorobenzene	747 ± 0	807 ± 24	711 ± 72	518 ± 205	1,132 ± 181	1,505	888 ± 90
	_m_-dichlorobenzene	967 ± 0	951 ± 24	915 ± 12	651 ± 132	1,855 ± 385	1,752	904 ± 112
	_o_-dichlorobenzene	2,154 ± 374	446 ± 12	361 ± 72	253 ± 12	9,807 ± 1,638	2,604	10,438 ± 1,438
Site-specific	trichlorobenzene	450 ± 33	554 ± 24	373 ± 217	102 ± 6	415 ± 108	495	494 ± 67

[a]See Table A-32 for sampling protocol.

[b]Values in ng/m^3, -- = not detected, T = trace.

Table A-52. ESTIMATED LEVELS OF VAPOR-PHASE HALOGENATED HYDROCARBONS IN AMBIENT AIR AT SITE NO. 3 IN EDISION, NJ (9/22-23/78)[a]

Category	Compound	P5/L1	P5/L2	P5/L3	P5/L4	P5/L5	P5/L6	P5/L7
Ubiquitous	1,1-dichloroethane	ND[b]	T	ND	ND	ND	T	ND
	chloroform	3,429	5,613 ± 1871	2,871 ± 1,065	T	3,516 ± 419	6,839 ± 3,322	5,290 ± 1,097
	1,2-dichloroethane	2,143	1,143 ± 250	964 ± 36	ND	1,714 ± 428	4,571 ± 1,035	ND
	1,1,1-trichloroethane	8,306	8,194 ± 389	15,437 ± 625	T	9,889 ± 1,500	10, 679 ± 678	1,500 ± 71
	carbon tetrachloride	4,292	4,167 ± 667	3,292 ± 0	ND	5,083 ± 250	4,542 ± 250	T
	trichloroethylene	10,855	151,062 ± 32,000	26,364 ± 0	T	14,218 ± 4,167	27,250 ± 2,375	T
	tetrachloroethylene	8,151	5,677 ± 698	282 ± 59	T	10,074 ± 852	8,232 ± 3,000	421 ± 0
	chlorobenzene	172	T	282 ± 59	ND	210 ± 0	305 ± 94	T
	m-dichlorobenzene	978	516 ± 107	671 ± 35	T	600 ± 158	368 ± 74	158 ± 0
	o-dichlorobenzene	301	150 ± 22	212 ± 12	T	274 ± 21	242 ± 11	ND

[a]See Table A-34 for sampling protocol.

[b]Values are in ng/m^3, ND = not detected, T = trace.

Table A-53. ESTIMATED LEVELS OF VAPOR-PHASE HALOGENATED HYDROCARBONS IN AMBIENT AIR AT SITE NO. 3 IN EDISON, NJ (9/23-24/78)[a]

Category	Compound	P6/L1	P6/L2	P6/L3	P6/L4	P6/L5	P6/L6	P6/L7
Ubiquitous	1,1-dichloroethane	ND[b]	ND	T	ND	ND	ND	ND
	chloroform	9,086 ± 2,028	6,943 ± 2,828	8,600	5,857 ± 1,171	4,314 ± 0	6,443 ± 1,457	7,714 ± 1,257
	1,2-dichloroethane	3,839 ± 484	3,742 ± 548	7,226	710 ± 64	806 ± 32	772 ± 64	1,484 ± 290
	1,1,1-trichloroethane	18,195 ± 1,171	5,829 ± 512	7,756	9,219 ± 634	6,707 ± 244	6,732 ± 927	7,610 ± 1,341
	carbon tetrachloride	12,852 ± 667	3,370 ± 222	3,852	2,926 ± 444	2,259 ± 518	4,259 ± 889	8,444 ± 1,000
	trichloroethylene	89,985 ± 3,388	5,089 ± 0	6,373	2,970 ± 44	5,940 ± 0	5,522 ± 850	5,507 ± 418
	tetrachloroethylene	8,752 ± 705	7,163 ± 571	8,031	18,857 ± 2,000	6,647 ± 952	5,745 ± 1,649	5,699 ± 1,438
	chlorobenzene	2,971 ± 114	2,306 ± 61	2,354	536 ± 71	529 ± 82	564 ± 0	1,041 ± 301
	m-dichlorobenzene	790 ± 95	1,418 ± 408	1,123	2,107 ± 0	647 ± 153	904 ± 85	767 ± 232
	o-dichlorobenzene	1,333 ± 124	1,163 ± 0	1,646	T	247 ± 0	308 ± 53	493 ± 96

[a]See Table A-34 for sampling protocol.

[b]Values are in ng/m^3, ND = not detected, T = trace.

Table A-54. ESTIMATED LEVELS OF VAPOR-PHASE HALOGENATED HYDROCARBONS IN AMBIENT AIR AT SITE NO. 4 IN FORDS, NJ (9/25-26/78)[a]

Category	Compound	P8/L1	P8/L2	P8/L3	P8/L4	P8/L5	P8/L6	P8/L7
Ubiquitous	1,1-dichloroethane	ND[b]	ND	ND	ND	T	ND	342 ± 79
	chloroform	11,419 ± 6,000	12,677 ± 2,742	7,290 ± 0	21,871	3,742 ± 452	28,258 ± 12,129	14,710 ± 4,774
	1,2-dichloroethane	609 ± 97	439 ± 49	244 ± 0	366 ± 0	512 ± 195	1,049 ± 73	1,000 ± 146
	1,1,1-trichloroethane	10,555 ± 3,722	6,722 ± 111	1,111 ± 222	7,889 ± 500	8,944 ± 3,167	9,944 ± 2,167	18,278 ± 6,167
	carbon tetrachloride	3,889 ± 1,167	2,778 ± 167	703 ± 185	1,926 ± 333	1,741 ± 333	3,370 ± 0	2,926 ± 0
	trichloroethylene	5,940 ± 418	2,253 ± 253	985 ± 238	8,522 ± 2492	4,746 ± 1612	7,209 ± 418	14,209 ± 1,478
	tetrachloroethylene	2,179 ± 189	1,653 ± 63	368 ± 10	-	2,734 ± 596	4,426 ± 1,228	5,703 ± 838
	chlorobenzene	263 ± 105	326	147 ± 63	-	T	T	392 ± 94
	_m_-dichlorobenzene	432 ± 179	253 ± 74	158 ± 21	-	362 ± 74	T	3,392 ± 945
	_o_-dichlorobenzene	189 ± 74	326 ± 221	T	-	213 ± 96	T	5,513 ± 1,257

[a]See Table A-35 for sampling protocol.

[b]Values are in ng/m^3, ND = not detected, T = trace, - = not determined.

Table A-55. ESTIMATED LEVELS OF VAPOR-PHASE HALOGENATED HYDROCARBONS IN AMBIENT AIR AT SITE NO. 4 IN FORDS, NJ (9/26-27/78)[a]

Category	Compound	P9/L1	P9/L2	P9/L3	P9/L5	P9/L6	P9/L7
Ubiquitous	1,1-dichloroethane	ND[b]	ND	ND	ND	T	272 ± 0
	chloroform	5,312 ± 1,958	3,208 ± 354	13,125 ± 583	8,417 ± 146	33,104 ± 2,000	13,979 ± 1,270
	1,2-dichloroethane	1,741 ± 52	724 ± 34	4,121 ± 172	10,379 ± 121	139,121 ± 23,793	4,190 ± 500
	1,1,1-trichloroethane	14,577 ± 500	10,888 ± 1,192	13,423 ± 769	35,461 ± 6,577	50,808 ± 13,692	78,231 ± 3,846
	carbon tetrachloride	3,297 ± 162	6,486 ± 1,378	4,027 ± 81	9,297 ± 5,811	19,649 ± 6,486	42,378 ± 2,702
	trichloroethylene	16,076 ± 2,761	15,761 ± 304	16,543 ± 1,391	17,619 ± 4,022	28,587 ± 6,022	5,250 ± 609
	tetrachloroethylene	8,301 ± 53	7,722 ± 411	12,947 ± 689	19,366 ± 4409	170,282 ± 22,768	7,632 ± 1,069
	chlorobenzene	274 ± 18	155 ± 44	443 ± 122	817 ± 107	525 ± 151	241 ± 57
	m-dichlorobenzene	434 ± 44	367 ± 44	755 ± 55	1,602 ± 398	2,444 ± 272	598 ± 103
	o-dichlorobenzene	283 ± 0	278 ± 44	500 ± 67	860 ± 75	2,192 ± 707	482 ± 57

[a] See Table A-35 for sampling protocol.

[b] Values in ng/m^3, ND = not detected, T = trace.

Table A-56. ESTIMATED LEVELS OF VAPOR-PHASE HALOGENATED HYDROCARBONS IN AMBIENT AIR AT SITE NO. 5 IN CARLSTADT, NJ (9/28-29/78)[a]

		Site No. 5						
Category	Compound	P10/L1	P10/L2	P10/L3	P10/L4	P10/L5	P10/L6	P10/L7
Ubiquitous	chloroform	5,296 ± 1,333[b]	30,629	27,889	25,556	18,556 ± 6,481	37,296	34,111
	1,2-dichloroethane	-	314	371	657	-	-	-
	1,1,1-trichloroethane	22,625 ± 0	1,812	10,062 ± 62	21,062 ± 5,687	25,437 ± 5,562	13,687 ± 2,187	19,375 ± 1,438
	carbon tetrachloride	2,560 ± 200	460	1,344	2,840 ± 880	2,320 ± 400	1,880 ± 480	2,280 ± 680
	trichloroethylene	14,058 ± 633	1,067	23,838 ± 5,467	30,800 ± 3,600	17,883 ± 833	6,950 ± 467	17,050 ± 3,350
	tetrachloroethylene	2,689 ± 289	670	2,080 ± 589	7,465 ± 2,148	24,895 ± 1,565	4,625 ± 87	7,951 ± 768
	chlorobenzene	422 ± 33	48	732 ± 285	1,762 ± 99	1,223 ± 423	4,637 ± 87	1,622 ± 134
	m-dichlorobenzene	95 ± 0	27	89 ± 22	287 ± 59	235 ± 70	100 ± 6	305 ± 37
	o-dichlorobenzene	211 ± 22	23	259 ± 71	891 ± 287	306 ± 47	72 ± 12	256 ± 24
Site-specific	trichlorobenzene	-	23	19	89 ± 39	88 ± 18	-	109 ± 12
	vinyl chloride	1,225	ND	68	247	635	T	122

[a]See Table A-36 for sampling protocol.

[b]Values in ng/m^3, - = not detected, T = trace.

Table A-57. ESTIMATED LEVELS OF VAPOR-PHASE HALOGENATED HYDROCARBONS IN AMBIENT AIR AT SITE NO. 5 IN CARLSTADT, NJ (9/29-3/78)[a]

		Site No. 5								
Category	Compound	P11/L1	P11/L2	P11/L3	P11/L4	P11/L5	P11/L6	P11/L7	P12/L8	P12/L9
Ubiquitous	chloroform	72,444[b]	47,148 ± 11,778	33,740 ± 1,407	96,926	1,637 ± 440	18,148 ± 222	36,185 ± 10,778	54,555	12,963 ± 4,852
	1,2-dichloroethane	-	6,333 ± 333	2,833 ± 333	3,389 ± 55	4,472 ± 889	-	T	-	T
	1,1,1-trichloroethane	35,529	19,470	9,000 ± 3,059	16,588 ± 9,294	46,235 ± 11,059	41,388	101,235 ± 60,941	3,118	1,118 ± 118
	carbon tetrachloride	4,583	13,791	6,375 ± 2,167	5,875 ± 708	7,208 ± 1,625	3,125	114,958	792	389 ± 0
	trichloroethylene	76,534	41,465	56,620 ± 6,552	90,396 ± 16,103	89,448 ± 14,845	38,862	37,862 ± 638	2,690	724 ± 190
	tetrachloroethylene	15,699	21,618	12,402 ± 972	28,072 ± 7,229	45,895 ± 10,151	39,430	37,056 ± 380	130,886	2,443 ± 143
	chlorobenzene	193	338	252 ± 37	350 ± 175	383 ± 23	342	732	228	143 ± 8
	m-dichlorobenzene	968	706	757 ± 234	2,732 ± 897	2,593 ± 360	1,468	830	386	74 ± 6
	o-dichlorobenzene	839	382	467 ± 75	1,134 ± 412	2,384 ± 453	671	704	128	66 ± 8
Site-Specific	trichlorobenzene	215	125	121 ± 0	360 ± 175	575 ± 105	228	577	8	-
	vinyl chloride	1,581	3,132	1,071	732	964	316	169	ND	ND

[a]See Table A-36 for sampling protocol.

[b]Values in ng/m^3, - = not detected, T = trace.

Table A-58. SAMPLING PROTOCOL FOR CENTRAL AND NORTHERN NEW JERSEY

Site	Sampling Location	Sampling Time (min)	Sampling Volume (ℓ)	Remarks	
Paterson, NJ (S1)	12th St. & 4th Ave.	42	300	3/22/76 40°F	1231-1313 hr 300-360°/3 mph
Clifton, NJ (S2)	Dyer Ave. & Wheeler St.	39	300	3/22/76 45°F	1528-1607 hr 320°/2 mph
Passaic, NJ (S3)	First St. & Essex St.	39	300	3/22/76 40°F	1715-1754 hr 320°/5 mph
Hoboken, NJ (S4)	New County Rd. U. S. Post Office Depot	39	300	3/23/76 51°F	1223-1302 hr 280°/0-10 mph
Fords, NJ (S8)	North of Tenneco plant	44	300	3/26/76 72°F	1559-1643 hr 200°/0-2 mph

[a]See reference A-2.

Table A-59. ESTIMATED LEVELS OF VAPOR-PHASE HALOGENATED ORGANICS IN NEW JERSEY[a]

	City					
Chemical	Paterson	Hoboken	Clifton	Fords	Passaic	Sayreville
methylene chloride	1091[b]	<454	1545	9286	400	14444
carbon tetrachloride	<59	833	T(59)	334	<50	555
1,2-dichloroethane	<212	<58	<213	<334	<192	<263
1,1-dichloroethane	<200	<160	<160	<285	<145	<228
1,1,2-trichloroethane	<167	<167	<167	<250	<167	<217
1,1,1,2-tetrachloroethane	<20	<20	<20	<24	<20	<22
1,1,2,2-tetrachloroethane	<20	<20	<20	<24	<20	2872
pentachloroethane	<17	<17	<17	<17	<17	<10
hexachloroethane	<17	<17	<17	<17	<17	<10
_o_-dichlorobenzene	<33	T(33)	<33	<34	<33	106
_m_-dichlorobenzene	T(33)	T(33)	<33	<34	T(33)	157
_p_-dichlorobenzene	<30	<30	<30	<34	<30	<9

[a]See Table A-58 for sampling protocol (reference A-2).

[b]Values in ng/m^3, T = trace, ( ) and < indicate limits of detection.

Table A-60. SAMPLING PROTOCOL FOR KIN-BUC DISPOSAL SITE

Period	Location	Distance from Site[a]	Sampling Time	Sampling Volume[b]	Meteorological Conditions			
					T(°F)	%RH	Wind Dir./ Speed	in Hg
6/29/76 (P1)	L1 (Tower Marina)	255°/1.65 km	1207-1359	112.5	82	69	255°/2-7 mph	30.19
	12 (Meadow Rd.)	~345°/0.4 km	1206-1355	134	82	69	240°/3-7 mph	30.19
	L3 (N of Site)	25°/0.41 km	1207-1359	156	82	69	240°/3-7 mph	30.19
	L4 (N of Site)	35°/0.29 km	1207-1359	140	82	69	210-255°/ 2-8 mph	30.19
(P2)	L1 (Tower Marina)	255°/1.65 km	1607-1737	111.4	86	57	270°/2-7 mph	30.18
	L2 (Meadow Rd.)	~345°/0.36 km	1607-1737	175	86	57	220-240°/ 0-3 mph	30.18
	L3 (E of Site)	40°/0.18 km	1607-1737	183.4	86	57	-	30.18
	L4 (E of Site)	35°/0.22 km	1607-1737	187.2	86	57	245°/0-2 mph	30.18
6/30/76 (P3)	L1 (Sayreville)	2.01 km ESE from site	1029-1229	138.5	82	76	70°/2-7 mph	30.12
	L2 (Meadow Rd.)	45 m downwind of chemical plant	1030-1230	187.5	82	76	100→140°/ 2-7 mph	30.12
	L3 (Meadow Rd.)	350°/0.46 km	1029-1229	175.9	82	76	-	30.12
	L4 (W of Site)	305°/0.34 km	1029-1229	191.2	82	76	95→120°/ 5-9 mph	30.12

(continued)

Table A-60 (cont'd.)

Period	Location	Distance from Site[a]	Sampling Time	Sampling Volume[b]	T (°F)	%RH	Wind Dir./ Speed	in Hg
					Meteorological Conditions			
(P4)	L1 (Tower Marina)	255°/1.65 km	1457-1646	117.7	88	57	180→200°/ 5-12, 20-35, 10-20	30.07
	L2 (Meadow Rd.)	21 m from chemical plant	1458-1646	248	88	57	190°/5-15 mph	30.07
	L3 (N of Site)	0°/0.73	1457-1646	200.3	88	57	190°/5-20 mph	30.07
	L4 (NE, then N of site)[c]	25°/0.41 km 345°/0.91 km	1457-1528 1537-1648	0.104 0.269	88	57	180→200°/ 5-35 mph	30.07
7/1/76 (P5)	L1 (Tower Marina)	255°/1.65 km	1006-1206	114.4	79	57	270°/5-9 mph	30.10
	L2 (Meadow Rd.)	~76 m from chemical plant	1006-1206	204.2	79	57	230-260°/ 4-12 mph	30.10
	L3 (On-Site)	-	1015-1038	19.8	79	57	260°/4-9 mph	30.10
	L4 (E of Site)	40°/0.18 km	1006-1206	230	79	57	230-250°/ 4-12 mph	30.10
(P6)	L1 (Tower Marina)	255°/1.65 km	1425-1625	120	84	43	270°/2-5 mph	30.12
	L2 (Meadow Rd.)	345°/0.36 km	1425-1625	181	84	43	230-260°/ 2-5 mph	30.12
	L3 (On-Site)	-	1444-1458	19.8	84	43	230-260°/ 2-5 mph	30.12

(continued)

Table A-60 (cont'd.)

Period	Location	Distance from Site[a]	Sampling Time	Sampling Volume[b]	Meteorological Conditions			
					T(°F)	%RH	Wind Dir./ Speed	in Hg
	L4 (E of Site)	40°/0.18 km	1425-1625	208.4	84	43	230-260°/ 2-8 mph	30.12

[a]Approximate magnetic bearing and distances relative to Kin-Buc (reference A-2).

[b]Volume in liters.

[c]Sampler was moved to new site during sampling period.

Table A-61. ESTIMATED LEVELS OF VAPOR-PHASE HALOGENATED ORGANICS IN AMBIENT AIR FROM KIN-BUC DISPOSAL SITE, EDISON, NJ (PERIODS 1 & 2)[a]

	Sampling Period/Location[b]							
Chemical	P1/L1	P1/L2	P1/L3	P1/L4	P2/L1	P2/L2	P2/L3	P2/L4
methylene chloride	<1000	<1000	<1000	T(1000)	T(3750)	T(3750)	T(3750)	T(3750)
chloroform	6389	T(230)	T(230)	T(230)	1999	T(230)	T(230)	<230
carbon tetrachloride	<111	<153	1312	750	12687	13687	7250	1937
vinyl chloride	<18750	<15000	<15000	<15000	<18750	<18750	<18750	<18750
vinylidine chloride	<555	<454	<454	<454	<555	<555	<555	<555
1,2-dichloroethylene	<555	<454	<454	<454	4947	4500	5263	T(565)
1,1-dichloroethane	<470	<364	<364	<364	<470	<470	<470	<470
1,2-dichloroethane	<348	<381	<381	217	T(150)	434	T(347)	2173
1,1,1-trichloroethane	T(417)	NQ	T(417)	T(417)	T(555)	T(417)	T(417)	T(417)
1,1,2-trichloroethane	<294	<294	294	294	<357	<357	<357	<357
trichloroethylene	T(131)	210	1315	10052	4947	4500	5263	T(178)
tetrachloroethylene	354	1527	T(45)	T(45)	1187	T(49)	2896	T(49)
1,1,1,2-tetrachloroethane	<53	<45	<38	<38	<54	<34	<32	<32
1,1,2,2-tetrachloroethane	<53	<45	<38	<38	<54	<34	<32	<32
pentachloroethane	<45	<37	<32	<36	<45	<28	<27	<26
hexachloroethane	<45	<37	<32	<36	<45	<28	<27	<26
chlorobenzene	170	112	<96	507	T(135)	T(85)	T(82)	1127
_o_-dichlorobenzene	<89	1873	<64	77	<90	T(57)	<55	<53
_m_-dichlorobenzene	205	33783	244	<64	T(90)	205	<55	<53
_p_-dichlorobenzene	<80	<67	<58	<58	<81	<51	<49	<48

(continued)

Chemical	Sampling Period/Location							
	P1/L1	P1/L2	P1/L3	P1/L4	P2/L1	P2/L2	P2/L3	P2/L4
1,2,4-trichlorobenzene	<53	<45	<38	<58	<54	<34	<32	<32
1,3,5-trichlorobenzene	<45	<37	<32	<36	<45	<28	<27	<26
1,2,5-trichlorobenzene	<53	<45	<38	<38	<54	<34	<32	<32

[a]See Table A-60 for sampling protocol.

[b]T = trace, ( ) and < indicates limit of detection. All values in ng/m^3.

Table A-62. ESTIMATED LEVELS OF VAPOR-PHASE HALOGENATED ORGANICS IN AMBIENT AIR FROM KIN-BUC DISPOSAL SITE, EDISON, NJ (PERIODS 3 & 4)[a]

	Sampling Period/Location[b]						
Chemical	P3/L1	P3/L2	P3/L3	P3/L4	P4/L2	P4/L3	P4/L4
methylene chloride	7600	T(1000)	T(1000)	T(1000)	T(1250)	T(1250)	T(1250)
chloroform	9000	1944	12333	3445	5834	8999	2778
carbon tetrachloride	T(125)	T(125)	T(125)	2000	1875	7625	T(153)
vinyl chloride	<15000	<15000	<15000	<15000	<18750	<18750	<18750
vinylidine chloride	<454	<454	<454	T(454)	<588	<588	<555
1,2-dichloroethylene	<454	<454	<454	<454	<588	<588	<555
1,1-dichloroethane	<476	<476	<476	<476	<470	<470	<470
1,2-dichloroethane	37913	<347	T(347)	347	T(444)	1130	<444
1,1,1-trichloroethane	<417	<417	19167	158	T(556)	7684	T(555)
1,1,2-trichloroethane	3500	<294	<294	<294	<357	<357	<357
trichloroethylene	3737	T(178)	6895	10315	394	5289	T(214)
tetrachloroethylene	<50	291	2847	<49	527	9173	1389
1,1,1,2-tetrachloroethane	<43	<32	<34	<34	<34	<30	<40
1,1,2,2-tetrachloroethane	<43	<32	<34	<34	<34	<30	<40
pentachloroethane	<36	<27	<28	<26	<20	<25	<27
hexachloroethane	<36	<27	<28	<26	<20	<25	<27
chlorobenzene	<109	167	480	1807	T(60)	607	610
o-dichlorobenzene	<72	<53	341	942	<40	150	T(54)
m-dichlorobenzene	T(72)	<53	376	895	T(40)	410	T(54)
p-dichlorobenzene	<65	<48	<48	<47	<36	<45	<49

(continued)

Table A-62 (cont'd.)

	Sampling Period/Location						
Chemical	P3/L1	P3/L2	P3/L3	P3/L4	P4/L2	P4/L3	P4/L4
1,2,4-trichlorobenzene	<43	<32	<34	<34	<34	<30	<32
1,3,5-trichlorobenzene	<36	<27	<28	<26	<20	<25	<27
1,2,5-trichlorobenzene	<43	<32	<34	<34	<34	<30	<32

[a] See Table A-60 for sampling protocol.

[b] Values are in ng/m^3, T = trace, ( ) and < indicates limit of detection.

Table A-63. ESTIMATED LEVELS OF VAPOR-PHASE HALOGENATED ORGANICS IN AMBIENT AIR FROM KIN-BUC DISPOSAL SITE, EDISON, NJ (PERIODS 5 & 6)[a]

	Sampling Period/Location[b]							
Chemical	P5/L1	P5/L2	P5/L3	P5/L4	P6/L1	P6/L2	P6/L3	P6/L4
methylene chloride	T(1000)	T(1000)	40000	100000	3000	T(1000)	260000	42000
chloroform	17222	11111	19444	8334	944	2500	27200	28334
carbon tetrachloride	<125	<125	<125	7000	3125	625	10600	7000
vinyl chloride	<15000	<15000	<15000	<15000	<15000	<16667	<16667	<16667
vinylidine chloride	<454	<454	<454	<454	<454	<500	<500	<500
1,2-dichloroethylene	<454	<454	<454	<454	<454	<500	<500	<500
1,1-dichloroethane	<380	<380	<421	<421	<421	<320	22700	<400
1,2-dichloroethane	T(348)	<348	7575	9565	T(347)	<276	27700	260
1,1,1-trichloroethane	T(417)	T(417)	3417	∿150000	T(417)	<417	121000	75000
1,1,2-trichloroethane	<294	<294	<263	4467	<294	<444	<263	<312
trichloroethylene	T(132)	T(132)	18,940	3684	T(132)	T(132)	T(263)	10606
tetrachloroethylene	1360	152	25560	34632	694	1229	394000	12500
1,1,1,2-tetrachloroethane	<52	<29	<29	<34	<50	<33	<315	<29
1,1,2,2-tetrachloroethane	<52	<29	<29	22285	<50	<33	15000	1389
pentachloroethane	<44	<25	<25	<22	<42	<28	<263	<24
hexachloroethane	<44	<25	<25	<22	<42	<28	<263	<24
chlorobenzene	T(132)	T(74)	T(74)	12791	T(77)	T(83)	2656	918
o-dichlorobenzene	<88	T(49)	1526	5087	1500	T(55)	9899	300
m-dichlorobenzene	T(88)	T(49)	789	839	659	T(55)	3526	T(48)
p-dichlorobenzene	<79	<45	<45	<39	75	<50	474	<43

(continued)

Table A-63 (cont'd.)

Chemical	Sampling Period/Location							
	P5/L1	P5/L2	P5/L3	P5/L4	P6/L1	P6/L2	P6/L3	P6/L4
1,2,4-trichlorobenzene	<52	<30	<30	T(26)	<50	<33	<315	<29
1,3,5-trichlorobenzene	<44	<25	<25	<22	<42	<28	<263	T(24)
1,2,5-trichlorobenzene	<52	<30	<30	<26	<50	<33	<315	<29

[a] See Table A-60 for sampling protocol.

[b] Values in ng/m^3, T = trace, ( ) and < indicate limits of detection.

Table A-64. AMBIENT AIR SAMPLING PROTOCOL FOR INVESTIGATING CHEMICAL DUMP/LANDFILL IN EDISON, NJ

Sampling Period	Location (No.)[a]	Bearing°/distance[b] (mi)	Sampling Time (min)	m^3/cartridge	Remarks
1	Parkland (1)	180-260/0.25	36	0.317	3/24/76 - 12:47 pm-1:23 pm 65°F 35% RH Clear 30.48" Hg Wind ∿230°, 3-8 mph
2	Tower Marina (2) Schoolhouse Rd. East Brunswick, NJ	065-909/∿1	38	0.300	3/24/76 - 4:47 pm-5:25 pm 64°F 38% RH Clear 30.42" Hg Wind 200-230°, 5-13 mph (upwind sample)
	Parkland (1)	180-260/0.25	38	0.290 0.032	As above (downwind samples)
3	Tower Marina (2)	065-090/∿1	40	0.300	3/25/76 - 11:15 am-11:55 am 60°F 43% RH 3/4 Cloud 30.22" Hg Wind 225°, 3-8 mph (upwind sample)
	Parkland (1)	180-260/0.25	39	0.300	As above (downwind sample)
4	Tower Marina (2)	065-090/∿1	45	0.300	3/25/76 - 3:08 pm-3:53 pm As above (upwind sample)
	Parkland (1)	160-275/∿0.06	41	0.300	3/25/76 - 3:05 pm-3:46 pm As above (downwind sample)

(continued)

Table A-64 (cont'd.)

Sampling Period	Location (No.)[a]	Bearing°/distance[b] (mi)	Sampling Time (min)	m^3/cartridge	Remarks
	Top of KB Mound	--	11	0.060 0.060	3/2576 - 3:06 pm-3:17 pm 64°F 38% RH Overcast 30.11" Hg Wind 265-285°, 5-10 mph
	Meadow Rd. (5) (between Stauffer and KB)	145°/0.5	42	0.300	3/25/76 - 4:20 pm-5:02 pm 63°F 45% RH 9/10 Cloudy 30.14" Hg Wind 245°, 2-8 mph (upwind sample)
5	NJ Turnpike (3) at Mill Rd.	140°/∿0.75	130	0.914	3/26/76 - 10:48 am-12:59 pm 60°F 34% RH Clear 30.41" Hg Wind 300-320°, 0-10 mph Shifting to 230° at 12:45 pm (upfield sample)
	Sayreville, NJ (4) at St. Stanislaus School Rd.	315-325/1.25	130	0.958 0.117	3/26/76 - 10:49 am-12:59 pm As above (downwind sample)

[a] See map (Fig. A-29) for location number (reference A-4).

[b] Relative to dump site.

Table A-65. ESTIMATED LEVELS OF VAPOR-PHASE HALOGENATED ORGANICS IN AMBIENT AIR FROM KIN-BUC DISPOSAL SITE[a]

Chemical	Period/Location[b]					
	P1/L1	P2/L2	P3/2	P4/KB	P4/L5	P5/4
vinyl chloride	<10714	<10000	<10714	T(11538)	<10000	<10000
1,1-dichloroethane	<250	<228	<267	<444	<195	<195
1,1,1,2-tetrachloroethane	<22	<20	<20	<22	<20	<20
1,1,2,2-tetrachloroethane	<22	<20	<20	<22	<20	<20
pentachloroethane	<17	<17	<17	<84	<17	<8
hexachloroethane	<17	<17	<17	<84	<17	<8
o-dichlorobenzene	6320	T(33)	250	12433	<33	58
m-dichlorobenzene	<33	T(33)	143	26583	<33	126
p-dichlorobenzene	7000	<30	<30	<150	<30	<10
1,2,4-trichlorobenzene	167	<20	<20	<100	<20	<20
1,3,5-trichlorobenzene	1160	<17	<17	<84	<17	<8
1,2,3-trichlorobenzene	<22	<20	<20	<100	<20	<20
vinylidene chloride	<294	<263	<294	<294	<285	<263
1,1,2-trichloroethane	17571	<217	<238	11435	<217	<217

[a] See Table A-64 and Figure A-29 for sampling protocol and locations (reference A-4).

[b] Values in ng/m^3, T = trace, ( ) and < indicate limits of detection.

Table A-66. ESTIMATED LEVELS OF PURGEABLE HALOGENATED HYDROCARBONS IN DRINKING WATER FROM NEW JERSEY[a]

		Site No. 1	Site No. 2		Site No. 3						
Category	Compound	P2/L5	P3/L6	P4/L2	P6/L4	P6/L5	P6/L6	P7/L2	P7/L3	P7/L7	P8/L1
Ubiquitous	1,1-dichloroethane	-	-	-	-	-	-	-	-	-	-
	chloroform	32,075[b]	97,655	82,683	57,542	68,058	28,933	73,308	98,192	2,825	37,633
	1,2-dichloroethane	96	167	-	-	-	125	-	-	117	75
	1,1,1-trichloroethane	67	117	2,667	158	158	121	100	158	125	157
	carbon tetrachloride	125	108	85	145	125	575	225	358	317	283
	trichloroethylene	3,967	7,667	13,625	12,808	13,750	1,267	12,317	1,533	7,333	757
	tetrachloroethylene	183	825	458	183	242	87	45	183	200	86
	chlorobenzene	42	75	67	25	-	-	42	38	22	T
	m-dichlorobenzene	9	21	21	17	21	-	13	8	8	T
	o-dichlorobenzene	29	23	50	17	-	-	42	48	-	-
	bromodichloromethane	49,317	104,250	99,525	69,333	95,457	51,971	77,879	90,967	1,725	24,358
	chlorodibromomethane	11,408	16,558	17,350	12,500	17,825	11,017	8,975	92,592	5,392	3,150
	bromoform	25	33	100	43	61	37	25	16	1,592	-
Site-Specific	trichlorobenzene	-	-	-	-	-	-	-	-	-	-

[a]See Tables A-31, A-32 and A-33 for sampling protocol.

[b]Values in ng/ℓ, - = not detected, T = trace.

Table A-67. ESTIMATED LEVELS OF PURGEABLE HALOGENATED HYDROCARBONS IN DRINKING WATER AT SITE NO. 4 IN FORDS, NJ[a]

		Site No. 4					
Category	Compound	P8/L2	P8/L3	P8/L4	P8/L5	P8/L6	P8/L7
Ubiquitous	1,1-dichloroethane	-	-	-	-	142	105
	chloroform	37,633[b]	35,217	32,758	5,383	2,750	4,200
	1,2-dichloroethane	75	-	125	200	73	208
	1,1,1-trichloroethane	157	183	87	208	208	258
	carbon tetrachloride	283	347	77	122	300	347
	trichloroethylene	757	8,625	9,175	14,650	9,725	15,058
	tetrachloroethylene	86	250	192	240	215	275
	chlorobenzene	T	25	32	35	25	32
	_m_-dichlorobenzene	T	12	8	-	11	15
	_o_-dichlorobenzene	-	16	-	-	12	-
	bromodichloromethane	24,358	2,033	40,325	11,925	642	2,392
	chlorodibromomethane	3,150	214	4,433	7,708	1,067	6,633
	bromoform	-	-	16	250	275	1,750
Site-Specific	trichlorobenzene	-	-	-	-	-	-

[a]See Table A-34 for sampling protocol.

[b]Values in ng/ℓ, – = not detected, T = trace.

Table A-68. ESTIMATED LEVELS OF PURGEABLE HALOGENATED HYDROCARBONS IN DRINKING WATER AT SITE NO. 5 IN CARLSTADT, NJ[a]

		Site No. 5					
Category	Compound	P10/L2	P10/L4	P10/L5	P10/L6	P10/L7	P11/L1
Ubiquitous	1,1-dichloroethane	-	-	-	-	-	78
	chloroform	110,775[b]	64,933	81,583	96,825	64,992	120,458
	1,2-dichloroethane	172	93	95	385	-	112
	1,1,1-trichloroethane	405	64	88	143	371	586
	carbon tetrachloride	183	87	94	172	197	431
	trichloroethylene	18,017	6,908	4,767	12,633	1,372	3,883
	tetrachloroethylene	717	167	192	307	114	1,183
	chlorobenzene	32	20	27	36	29	40
	m-dichlorobenzene	25	7	8	T	8	21
	o-dichlorobenzene	32	10	-	13	-	47
	bromodichloromethane	112,225	83,483	93,292	13,653	86,708	146,150
	chlorodibromomethane	19,083	13,067	15,958	22,833	16,525	16,267
	bromoform	42	29	56	50	41	33
Site-Specific	trichlorobenzene	-	-	-	-	-	-

[a]See Table A-35 for sampling protocol.

[b]Values in ng/ℓ, - = not detected, T = trace.

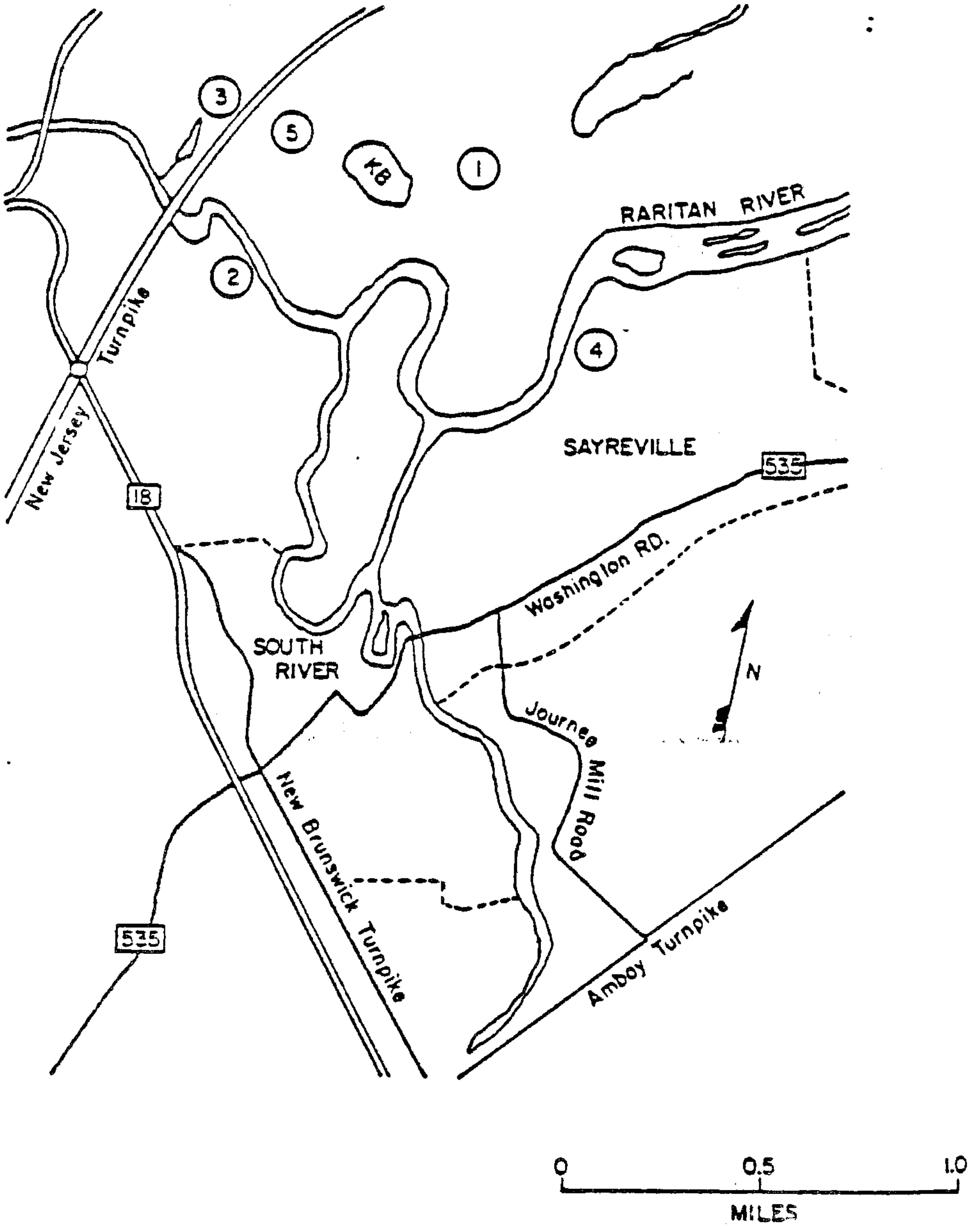


Figure A-29. Sampling locations surrounding Kin-Buc Landfill, Edison, NJ.

Table A-69. AMBIENT AIR SAMPLING PROTOCOL FOR PLAQUEMINE, LA AREA

Sampling Locations	Sampling Time (min)	Volume Sampled (ℓ)	Remarks	
Plaquemine, LA City Water Tower, Bayou Rd (L1)	1363	136	1/31-2/1/77 44°F-49% RH	1437-1320 0°/1-12 mph
St. John Evangelist Church Tower, Church and Main St. (L2)	1330	133	1/31-2/1/77 44°F-49%RH	1540-1350 0°/1-12 mph
LA 988 & Davis St. (L3)	250	439	2/1/77 44°F-47% RH	1255-1705 70°/1-12 mph
50 yd East off LA 1N (L4)	190	289	2/1/77 44°F-47% RH	1430-1740 70°/1-12 mph
East off LA 1 (L5)	190	129	2/1/77 44°F-36% RH	1445-1755 70°/1-12 mph
Off LA 1 (L6)	1095	109	2/1-2/2/77 44°F-36% RH	1600-1015 90°/1-12 mph
Off LA 1 on Ms. Armalline Caillouet Property (L7)	990	99	2/1-2/2/77 43°F-36% RH	1745-1015 90°/1-12 mph
Plaquemine Evergreen Plantation (L8)	275	191	2/2/77 57°F-55% RH	1250-1725 80°/1-3 mph
Plaquemine Evergreen Plantation (L9)	230	202	2/2/77 57°F-61% RH	1325-1715 Variable Winds

Table A-6[a] (cont'd.)

Sampling Locations	Sampling Time (min)	Volume Sampled (ℓ)	Remarks	
Plaquemine Evergreen Plantation (L10)	150	100	2/2/77 56°F-55% RH	1400-1630 90°/variable
Plaquemine Evergreen Plantation (L11)	1035	103	2/2-2/3/77 45°F-99% RH	1705-1020 90°/variable

[a]See reference A-4.

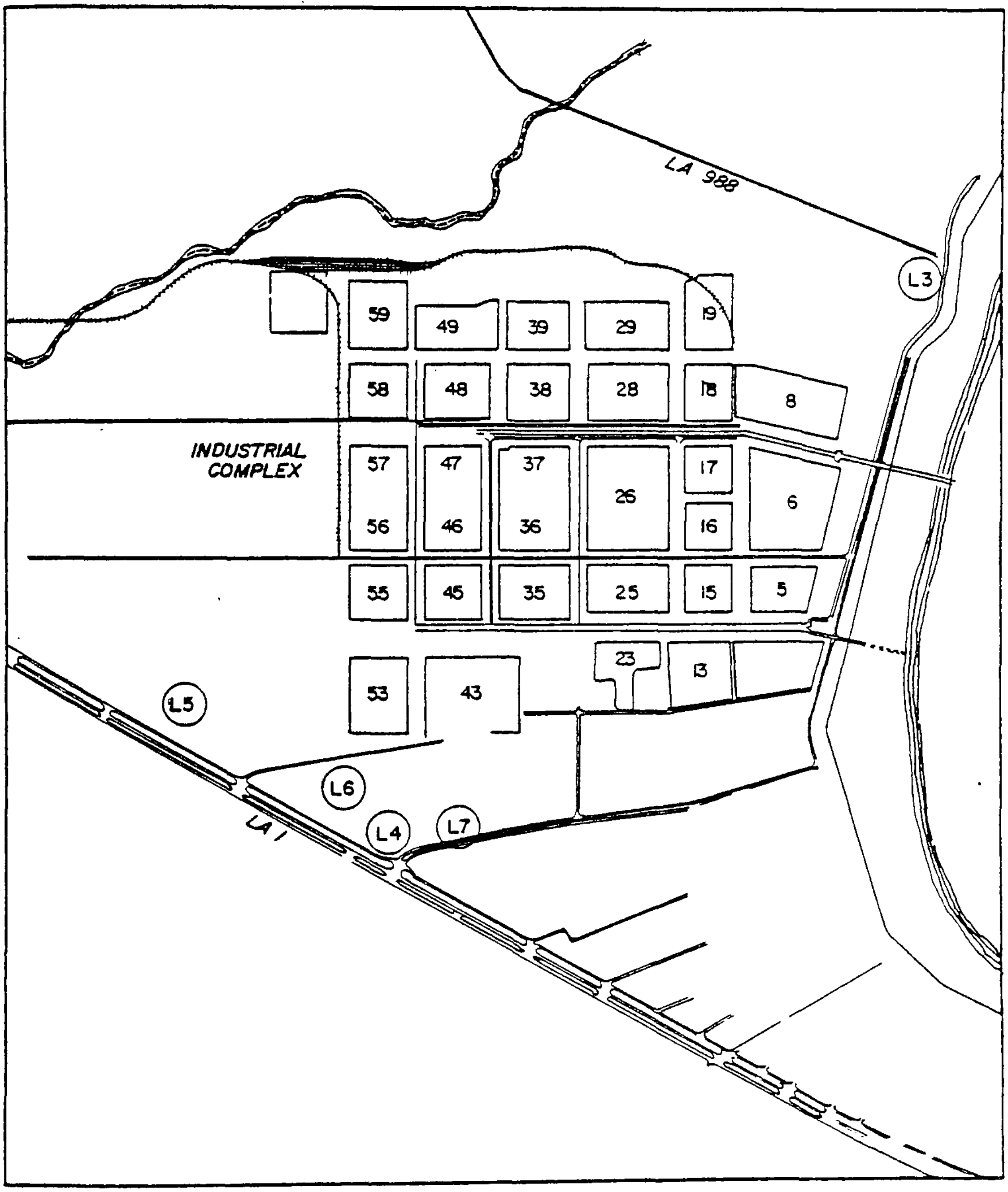


Figure A-30. Map depicting sampling locations near industrial complex in Iberville Parish, LA.

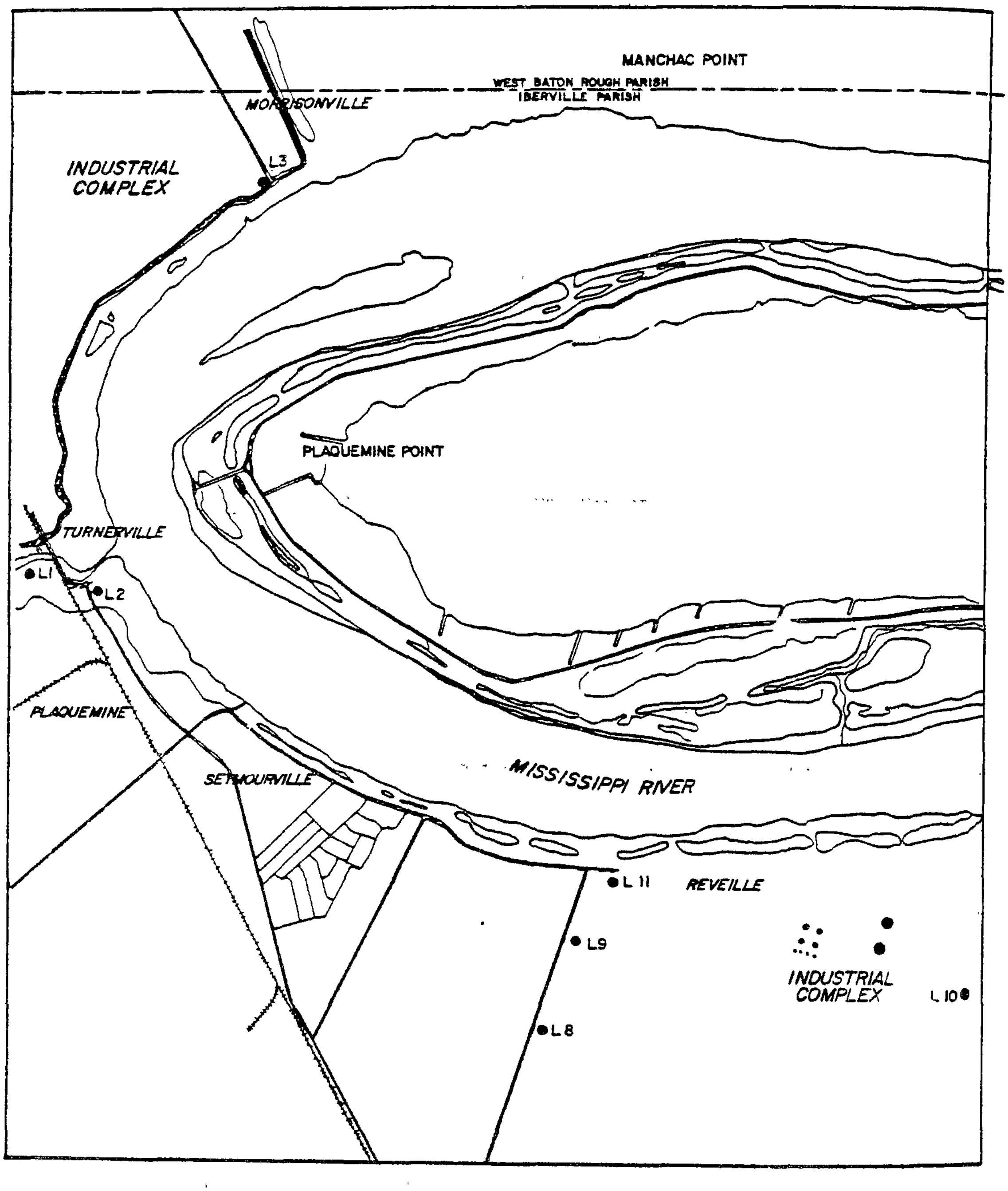


Figure A-31. Map depicting locations of ambient air sampling network in Iberville Parish, LA.

Table A-70. CONCENTRATIONS OF VAPOR-PHASE HALOGENATED ORGANICS IN IBERVILLE PARISH, LA[a]

Compound	Location											
	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	B[b]
Chloroacetylene	ND	ND	12	ND	58	ND	45	T	T	ND	ND	ND
Vinyl chloride	192	1,230	30	T	59	534	1,334	64	76	ND	ND	ND
Chloroethane	ND	ND	ND	ND	ND	ND	1,378	ND	ND	ND	ND	ND
Vinylidine chloride	128	36	ND	ND	ND	132	990	ND	ND	ND	ND	ND

[a]Pollutants which passed through the Tenax GC cartridge were collected on carbon then transferred to Tenax in the lab via thermal desorption, values are in ng/m^3.

[b]B = blank carbon cartridge.

Source: E. D. Pellizzari, "Identification and Analysis of Ambient Air Pollutants Using the Combined Techniques of Gas Chromatography and Mass Spectrometry, EPA Contract No. 68-02-2262, Quarterly Technical Progress Report No. 1, December 1, 1976 - February 28, 1977.

Table A-71. CONCENTRATIONS OF VAPOR-PHASE HALOGENATED ORGANICS IN IBERVILLE PARISH, LA[a]

Compound	Locations										
	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11
1,1,1-trichloroethane	1100±20	1820±100	68±8	1500±20	430±50	2680±0	8760±1160	1556±0	524±61	416±27	112±56
1,2-dichloroethane	1726±345	1219±0	9±7	1590±45	399±28	3727±1127	4709±200	362±4	304±36	146±24	91±30
vinyl chloride	NQ[b]	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ
carbon tetrachloride	800±800	ND	20±10	ND	ND	T	4628±1100	335±250	667±200	277±18	ND
dichlorobutane	153±70	2714±2000	71±45	ND	ND	7285±1571	1392±178	ND	54±25	ND	ND
tetrachloroethylene	82±20	977±900	ND	21±0	54±3	489±70	1224±173	159±170	27±3	30±10	16±8
1,1,2,2-tetrachloroethane	52±1	264±191	ND	ND	T	ND	1573±243	ND	148±133	ND	ND
chloroform	1988±122	419±0	ND	633±10	956±112	2433±100	6866±688	1080±468	511±327	1387±161	1113±274
1,2-dichloropropane	944±172	735±37	1015±620	ND	209±4	1363±33	2239±136	T	ND	ND	ND
chloroethane	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ
vinylidine chloride	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ	NQ
1,1-dichloroethane	ND[c]	ND	ND	ND	ND	T	478±56	ND	ND	ND	ND
dichloropropene	ND	ND	ND	ND	ND	106±4	261±92	ND	ND	ND	ND
1,1,2-trichloroethane	580±60	ND	ND	ND	36±0	260±18	1840±440	ND	ND	ND	ND
tetrachlorobutadiene	ND	139±70	ND	ND	ND	T	17±11	ND	ND	ND	ND
hexachloro-1,3-butadiene	ND	ND	ND	ND	ND	18±3	37±15	ND	ND	ND	ND
1,3-dichloropropene	10±5	ND	ND	ND	T	ND	ND	ND	ND	ND	ND
trichloropropane	ND	ND	ND	ND	ND	T	24±9	ND	ND	ND	ND
tetrachloropropane isomer	ND	32±30	ND	ND	ND	242±36	13±6	ND	ND	ND	ND
pentachloroethane	ND	ND	ND	ND	T	ND	13±5	ND	ND	ND	ND
tris-(2-chloroisopropyl) ether	66±22	ND	ND	ND	ND	T	363±152	ND	ND	ND	ND
hexachloroethane	ND	ND	ND	ND	ND	T	T	ND	ND	ND	ND
pentachlorobutadiene	ND	ND	ND	ND	ND	ND	T	ND	ND	ND	ND
chlorotoluene	ND	ND	ND	ND	ND	ND	ND	35±7	ND	ND	ND
chlorobenzene	ND	ND	ND	ND	ND	ND	ND	29±10	ND	ND	ND

[a] Values are in ng/m^3 with reproducibility for duplicate cartridge.

[b] NQ = not quantitated. These compounds were collected and analyzed from carbon cartridges.

[c] ND = not detected.

Source: E. D. Pellizzari, "Identification and Analysis of Ambient Air Pollutants Using the Combined Techniques of Gas Chromatography and Mass Spectrometry", EPA Contract No. 68-02-2262, Quarterly Technical Progress Report No. 2, March 1, 1977 - May 31, 1977.

Table A-72. AMBIENT AIR SAMPLING PROTOCOL FOR GEISMAR, LA AREA[a]

Sampling Location	Sampling Time (min)	Volume Sampled (ℓ)	Remarks	
Corner of highway 73 and 75 (L12)	1398	140	2/28-3/1/77 28→85% RH	62°F 290→240°/9 kts
Southeast of Plant R (L13)	1400	140	2/28-3/1/77 28→85% RH	62°F 290→240°/9 kts
North of Plant M (L14)-1	260	180	3/1/77 85% RH	63°F 180°/light
Northeast of Plant M and N (L15)	25	142	3/1/77 85% RH	63°F 180°/light
Northwest of Plant M off LA 73 (L14)-2	1205	120	3/1-3/2/77 52% RH	65°F 120°/light
Southwest of Plant M off LA 73 (L16)	135	91	3/2/77 52% RH	65°F 120°/light

[a]See reference A-4.

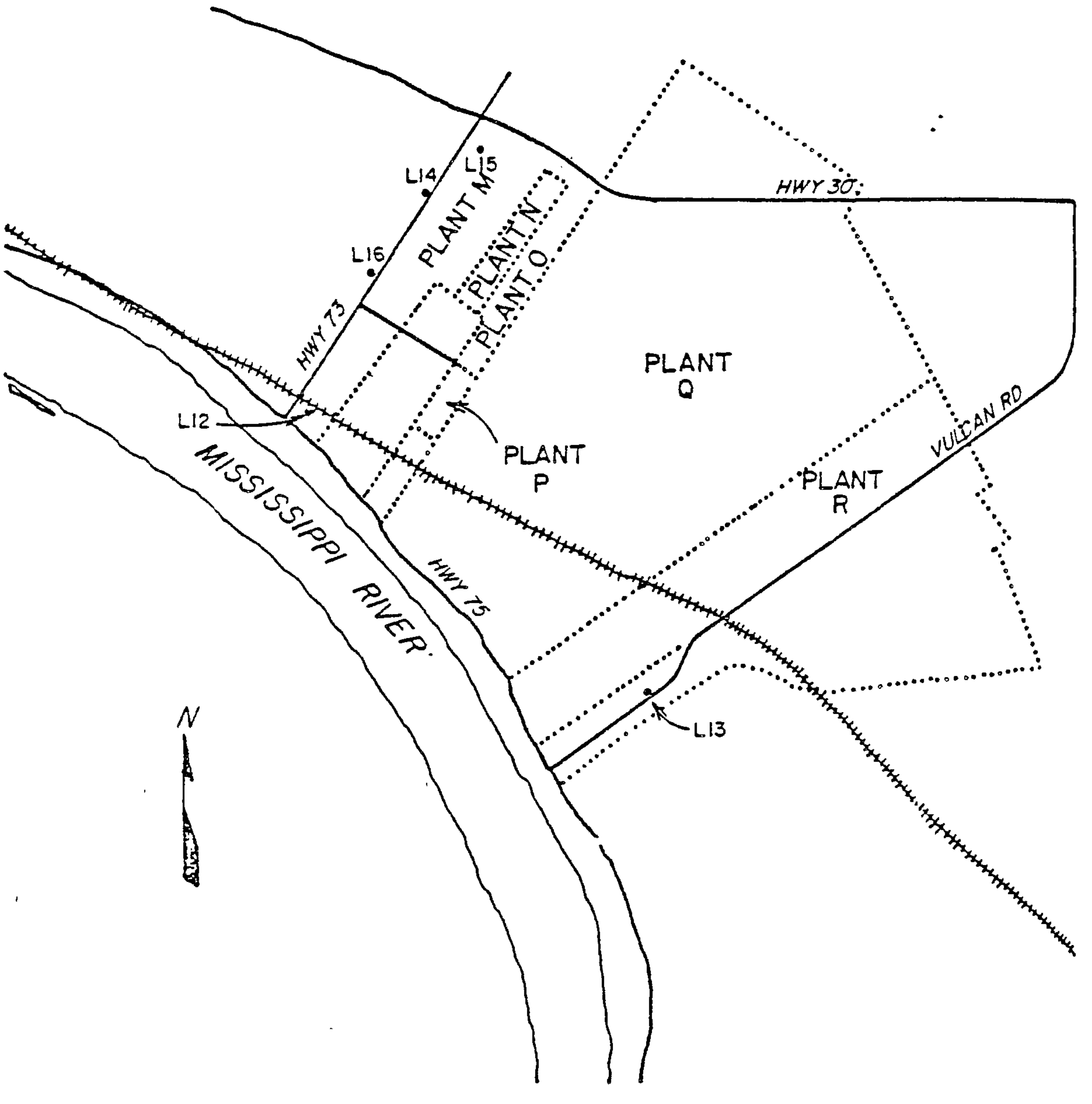


Figure A-32. Sampling site and locations in Geismar, LA area

Table A-73. ESTIMATED LEVELS OF VAPOR-PHASE HALOGENATED ORGANICS IN GEISMAR, LA AREA[a]

Compound	L-12	L-13	L-14A	L-15	L-R1	L-14B	L-16	L-R2	L-S	L-B
1,2-dichloroethane	683	ND	10333	7844	232	4689	1555	100	800	1444
carbon tetrachloride	400	1133	1433	300	183	4667	10100	300	286	2633
tetrachloroethylene	46	86	43	86	11	100	36	7	32	100
chloroform	1571	3057	3000	11742	857	9943	999	943	10355	1257
1,1,2-trichloroethane	120	150	5450	9611	ND	6900	ND	ND	320	ND
methylene chloride	1700	1909	727	1714	700	545	772	442	2333	454
1,1,1-trichloroethane	T	250	200	200	75	175	400	ND	80	675
1,2-dichloropropane	ND	1163	ND	121	ND	71	39	3999	ND	36
1,1-dichloroethane	ND	ND	235	75	ND	550	133	ND	ND	167
chlorobenzene	ND	ND	93	93	T	143	171	900	ND	ND
vinylidine chloride	ND	ND	T	ND	ND	200	ND	ND	ND	ND

[a]Values are in ng/m^3.

[b]ND = not detected.

Table A-74. AMBIENT AIR SAMPLING PROTOCOL FOR BATON ROUGE, LA AREA[a]

Sampling Location	Sampling Time (min)	Sampling Volume (ℓ)	Remarks	
Off U.S. 61 North of Plant A (L17)	1400	140	3/3-3/4/77 ~99% RH	1150-1110 120°/light
Off unpaved, unmarked rd. (L18)	1435	143	3/3-3/4/77 ~99% RH	1135-1130 120°/light
Northwest of Plant A on Mr. Ewell's ranch (L19)	235	156	3/3/77 rain	1220-1615 120°/light
Northwest of Plant A on Mr. Ewell's ranch (L20)	260	184	3/4/77 93% RH	1125-1545 90→120°/4 mph
Off unpaved, unmarked rd. (L21)	30	195	3/4/77 93% RH	1207-1237 90°/4 mph
Eastside of LA 61 (L22)	265	146	3/8/77 49% RH	1205-1630 180°/4 mph
Northwest of Plant A on Mr. Ewell's ranch (L20)	195	129	3/8/77 49% RH	1235-1550 180°/4 mph
Off of Turning Basin Rd. (L23)	1190	119	3/8-3/9/77 50% RH	1625-1215 180°/5 mph
Graveyard Area (L24)	1070	107	3/8-3/9/77 50% RH	1640-1030 180°/5 mph

Table A-74 (cont'd.)

Sampling Location	Sampling Time (min)	Sampling Volume (ℓ)	Remarks	
Mengel Rd. (L25)	190	124	3/9/77 54% RH	1330-1640 180°/7 mph
Off LA 61 (L26)	180	121	3/9/77 54% RH	1400-1700 100°/7 mph
Off Mengel Rd. (L27)	1090	109	3/9-3/10/77 54% RH	1650-1100 180°/8-9 mph
Off LA 190 (L28)	1080	108	3/9-3/10/77 54% RH	1715-1115 180°/8-9 mph
Off Mengel Rd. (L25)	190	124	3/9/77 54% RH	1330-1650 100°/7 mph
Off LA 61 (L26)	180	121	3/9/77 54% RH	1400-1700 100°/7 mph
Off Mengel Rd. (L27)	1090	109	3/9-3/10/77 78% RH	1650-1100 180°/8-9 mph
Off LA 61 (L28)	1080	108	3/9-3/10/77 78% RH	1715-1115 180°/8-9 mph
Off Mengel Rd. (L25)	240	162	3/10/77 54% RH	1105-1505 180°/7 mph
Off LA 61 (L26)	250	152	3/10/77 54% RH	1140-1550 180°/7 mph

Table A-74 (cont'd.)

Sampling Location	Sampling Time (min)	Sampling Volume (ℓ)	Remarks	
Choctow Rd. and Pholox St. (L29)	235	173	3/10/77 54% RH	1215-1610 180°/7 mph
LA 1 and LA 190 (L30)	960	96	3/10-3/11/77 75% RH	1700-0900 100°/6 mph

[a]See reference A-4.

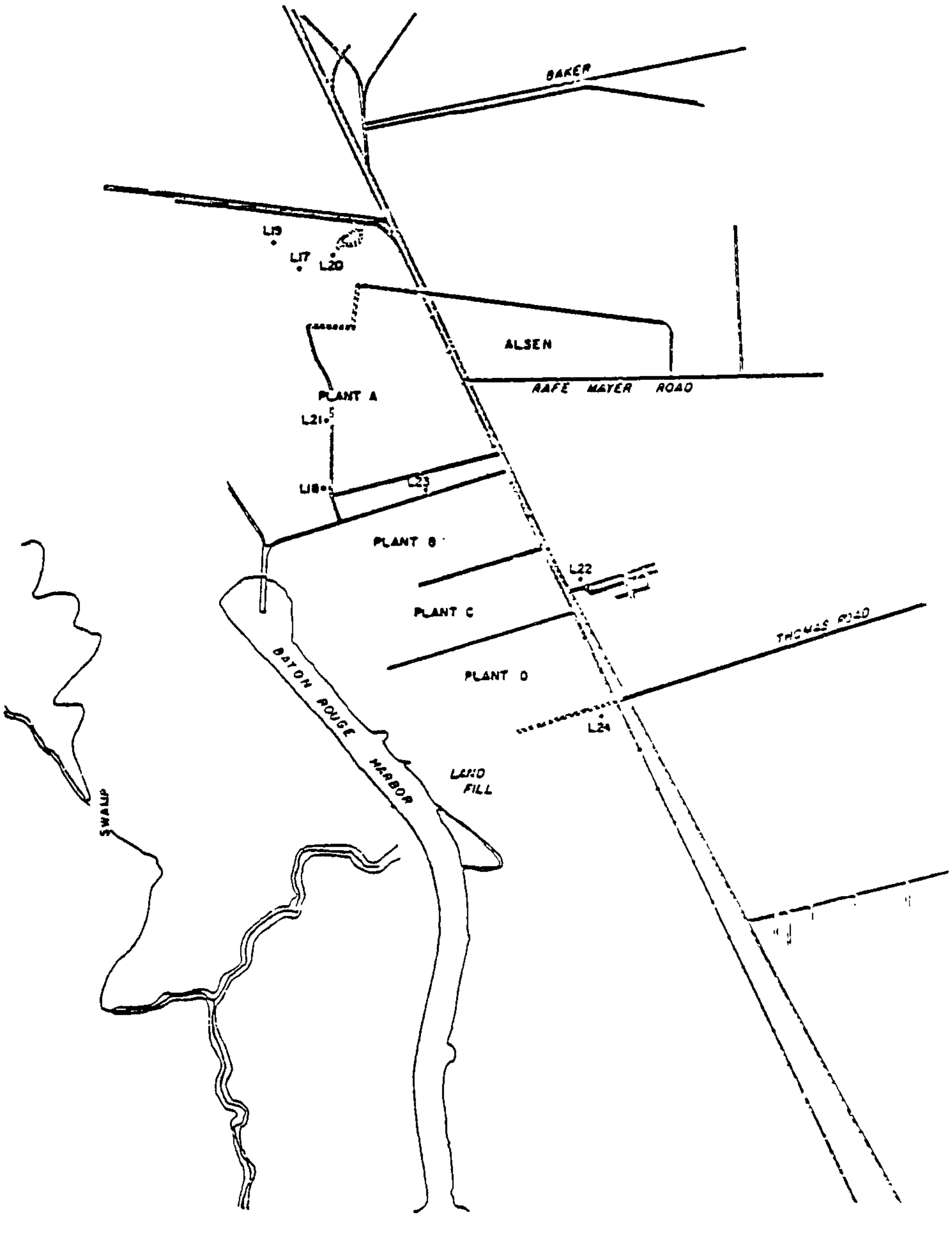


Figure A-33. Sampling site and location for Baton Rouge, LA area.

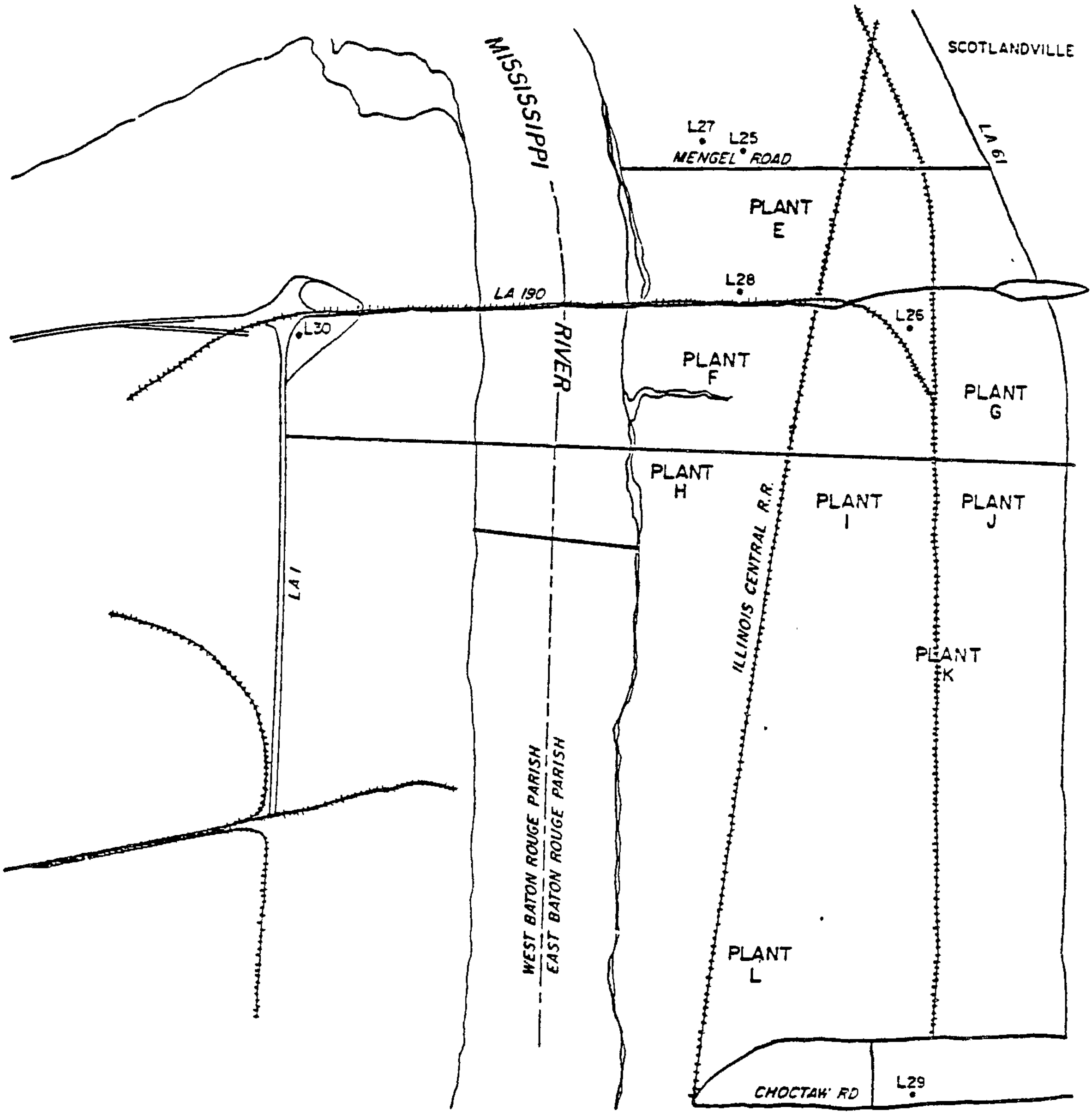


Figure A-34. Sampling site and locations in Baton Rouge, LA.

Table A-75. VAPOR-PHASE HALOGENATED AND OTHER ORGANICS ESTIMATED IN AMBIENT AIR OF BATON ROUGE, LA AND VICINITY

Chemical	Locations																	
	L17	L18	L19	L20A	L21	L22	L20B	L23	L24	L25A	L26A	L27	L28	L25B	L26B	L29	LE[a]	L30
1,1,1-trichloroethane	178	ND	ND	ND	178	ND	ND	200	178	222	ND	78 ± 24	ND	ND	ND	200	ND	167
1,2-dichloroethane	137	712	458	585	78	ND	887	731	712	10,341	751	322 ± 0	3,229	2,000	1,522	ND	5,024	302
carbon tetrachloride	874	452	289	ND	74	ND	311	592	533	311	533	148 ± 0	429	163	119	74	1,037	192
tetrachloroethylene	84	34	32	ND	60	11	44	53	43	33	64	20 ± 0	364	13	47	17	250	18
chloroform	6,710	6,968	1,290	181	4,775	387	542	1,484	1,097	560	368	568 ± 13	839	387	464	258	2,129	477
dichlorobutane	193	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	13	ND	ND	ND	ND
1,2-dichloropropane	ND	ND	ND	ND	ND	ND	ND	30	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
chloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
vinylidene chloride	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-dichloroethane	ND	ND	ND	ND	ND	ND	68	ND	ND	90	ND	ND	ND	34	64	ND	233	ND
1,1,2-trichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	80	ND	54	ND	ND	ND	ND	ND	533	ND
hexachloro-1,3-butadiene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	23	ND	117	ND
chloroprene	ND	ND	ND	ND	x	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
benzene	11,050	2,678	2,535	80	1,220	8,099	9,217	2,132	1,456	676	650	533	2,665	1,248	3,796	273	1,040	1,326
acetone	1,035	1,482	176	729	682	1,521	1,835	2,941	3,294	1,447	988	68 ± 23	729	188	423	329	1,765	329
methylene chloride	2,800	2,160	280	ND	1,999	160	280	840	440	240	160	320 ± 76	200	280	320	160	680	160
β-chlorostyrene	ND	ND	ND	ND	x	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
dichlorobenzene isomer(s)	ND	ND	ND	ND	ND	ND	ND	x	ND	ND	ND	ND	ND	ND	ND	ND	ND	x
chloroprene dimer	ND	ND	ND	ND	x	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
chlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	10	ND	ND
1,1,2,2-tetrachloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	T	ND	ND	ND	ND	ND	ND	71

[a] Downwind of several petroleum facilities.

Source: E. D. Pellizzari, "Identification and Analysis of Ambient Air Pollutants Using the Combined Techniques of Gas Chromatography and Mass Spectrometry", EPA Contract No. 68-02-2262, Quarterly Technical Progress Report No. 3, June 1 - August 31, 1977.

Table A-76. MINIMUM TOTAL HALOGENATED HYDROCARBON VAPOR IN AMBIENT AIR OF BATON ROUGE, LA

Location	ng/m^3	Location	ng/m^3
L17	10,976	L25A	11,797
L18	10,326	L26A	1,925
L19	2,349	L27	1,456
L20A	762	L28	6,517
L21	7,164	L25B	9,407
L22	558	L26B	2,559
L20B	2,132	L29	709
L23	3,930	LE	10,003
L24	3,083	L30	1,387

Source: E. D. Pellizzari, "Identification and Analysis of Ambient Air Pollutants Using the Combined Techniques of Gas Chromatography and Mass Spectrometry", EPA Contract No. 68-02-2262, Quarterly Technical Progress Report No. 3, June 1 - August 31, 1977.

Table A-77. AMBIENT AIR SAMPLING PROTOCOL FOR VAPOR-PHASE ORGANICS IN BATON ROUGE, LA[a]

Sampling Site	Code	Date	Period[a]	Volume Sampled (ℓ)	Ambient Temp. (°C)
3069	BA-1	5/12-14/77	1935-1430 hrs	98.7	26.0 → 28.2 → 27.6
3069	BA-2	5/14-16/77	1515-1530 hrs	116.6	29.3 → 28.2 → 24.7
3069	BA-3	5/16-18/77	1535-1400 hrs	115.4	28.5 → 27.6 → 28.4
3069	BA-4	5/18-20/77	1400-0900 hrs	104.5	28.7 → 24.5 → 25.5
3069	B[b]	-	-	-	-

[a]Duplicate samples were taken in all cases, see reference A-5.

[b]Four blanks were included.

Table A-78. ESTIMATED LEVELS OF VAPOR-PHASE HALOGENATED ORGANICS IN AMBIENT AIR FROM BATON ROUGE, LA[a]

	Sample Code[b]				
Chemical	BA-1	BA-2	BA-3	BA-4	B
methylene chloride	1229 ± 229	1449 ± 337	1900 ± 900	1000	<5
chloroform	1444 ± 277	1700 ± 233	1417 ± 750	1389	<3
carbon tetrachloride	187 ± 62	T(142)	T(125)	T(125)	<2
vinyl chloride	<15000	<16670	<15000	<15000	<15
1,2-dichloroethylene	<454	<526	<454	<454	<10
1,1-dichloroethane	<380	<444	<380	<380	<8
1,2-dichloroethane	<348	<424	<348	<348	<8
1,1,1-trichloroethane	500 ± 83	2250 ± 1750	T(416)	T(416)	T(5)
1,1,2-trichloroethane	<294	<334	<294	<294	<5
trichloroethylene	T(132)	T(172)	T(132)	<132	<5
tetrachloroethylene	T(59)	T(60)	T(60)	<67	<7
1,1,1,2-tetrachloroethane	<51	<52	<52	<58	<6
1,1,2,2-tetrachloroethane	<51	<52	<52	<58	<6
pentachloroethane	<42	<42	<42	<48	<5
hexachloroethane	<42	<42	<42	<48	<5
chlorobenzene	T(153)	T(128)	<130	<142	<15
o-dichlorobenzene	T(84)	T(85)	T(87)	<95	<10
m-dichlorobenzene	T(102)	T(85)	T(87)	<95	<10
p-dichlorobenzene	<76	<77	<78	<85	<9

(continued)

Table A-78 (cont'd.)

Chemical	Sample Code				
	BA-1	BA-2	BA-3	BA-4	B
1,2,4-trichlorobenzene	<51	<52	<52	<58	<6
1,3,5-trichlorobenzene	<42	<42	<42	<48	<5
1,2,3-trichlorobenzene	<51	<52	<52	<58	<6
vinylidine chloride	<454	<526	<454	<454	<10

[a]See Table A-78 for sampling protocol.

[b]Values in ng/m^3, T = trace, ( ) and < indicate limits of detection. Duplicate analyses.

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Table A-79. AMBIENT AIR SAMPLING PROTOCOL FOR HOUSTON, TX AND VICINITY

Site	Sampling Location	Sampling Time (min)	Volume Sampled (ℓ)	Remarks
Houston, TX	Milby Park (HL1)	1670-1750	188	7/27/76 93°F 60% RH 160°/3 mph
Houston, TX	Off Goodyear Rd., on unpaved St. (HL2)	1510-1515	37	7/27/76 93°F 60% RH 160°/3 mph
Houston, TX	Steelman Ave. & El Buey Way (HL3)	1620-1750	229	7/27/76 93°F 60% RH 160°/3 mph
Pasadena, TX	Between Industrial Site and Ship Channel (HL3)	1430-1600	185	7/28/76 89°F 65% RH 160°/5-10 mph
Pasadena, TX	Tenneco Property (PL2)	1430-1600	237	7/28/76 89°F 65% RH 160°/5-10 mph
Pasadena, TX	Tenneco Property (PL3)	1430-1600	191	7/28/76 89°F 65% RH 160°/5-10 mph
Deer Park, TX	Shell Property (DSL1)	1100-1200	122	7/29/76 87°F 66% RH 180°/4-9 mph
Deer Park, TX	Shell Property (DSL2)	1100-1200	136	7/29/76 87°F 66% RH 180°/4-9 mph
Deer Park, TX	Diamond Shamrock Property (DDL1)	1455-1555	137	7/29/76 94°F 54% RH 130°/4-7 mph
Deer Park, TX	Off Tidal Road (DTL1)	1020-1035	113	7/30/76 90°F 50% RH 210°/6 mph
Deer Park, TX	Off Tidal Road (DTL2)	1115-1215	147	7/30/76 90°F 60% RH 200°/6-8 mph

Table A-79 (cont'd.)

Site	Sampling Location	Sampling Time (min)	Volume Sampled (ℓ)	Remarks
Deer Park, TX	Off Tidal Road (DTL3)	1455-1555	162	7/29/76 87°F 66% RH 180°/4-9 mph
Deer Park, TX	Off Tidal Road (DTL4)	1115-1215	165	7/30/76 90°F 60% RH 200°/6-8 mph
Freeport, TX	On Dow Chem. Property (FL1)	1342-1543	116	8/9/76 90°F 65% RH 145°/5-10 mph
Freeport, TX	On Dow Chem. Property (FL2)	1348-1555	85	8/9/76 90°F 65% RH 145°/5-10 mph
Freeport, TX	On Dow Chem. Property (FL3)	1425-1508	79	8/9/76 90°F 65% RH 145°/5-10 mph
La Porte, TX	On E. I. DuPont de Nemours & Co. Property (LL1)	1645-1833	110	8/12/76 90°F 62% RH 130-150°/2-6 mph
La Porte, TX	On E. I. DuPont de Nemours & Co. Property (LL2)	1641-1824	82	8/12/76 90°F 62% RH 130-150°/2-6 mph
La Porte, TX	On E. I. DuPont de Nemours & Co. Property (LL3)	1114-1252	87	8/13/76 92°F 53% RH 240°/0-4 mph

Table A-80. AMBIENT AIR LEVELS OF VAPOR-PHASE HALOGENATED HYDROCARBONS IN HOUSTON, PASADENA, DEER PARK, FREEPORT AND LA PORTE, TX AREAS

Compound	HL1	HL2	HL3	PL1	PL2	DSL1	DSL2	DDL1	DTL1	DTL2	DTL3	DTL4	FL2	FL3	LL1	LL2	LL3
2-chloro-1,3-butadiene (chloroprene)	4,000[a]	266	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
dichloropropene isomer (tent.)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
chloroform	11,539	-	11,538	T	T	53,846	6,420	7,692	1,923	8,846	T	15,384	280	T	8,461	8,850	7,692
vinylidine chloride	-	-	-	-	-	-	-	-	-	-	-	-	-	531	-	-	-
1,1-dichloroethane	-	-	-	-	-	555	-	-	-	-	-	-	-	-	-	-	-
1,2-dichloroethane	T	-	-	-	158	66,300	-	6,722	T	4,055	T	T	3,300	4,500	778	-	-
dibromoethane	-	-	-	158	-	-	-	-	-	-	-	-	-	T	-	-	-
1,1,1-trichloroethane	522	-	900	-	T	-	144	-	-	1,000	400	400	16,600	15,200	3,889	27,700	T
carbon tetrachloride	238	114	T	T	146	846	T	T	T	T	276	69	11,538	T	T	1,230	T
dichloropropane isomer	-	-	-	-	-	T	-	-	-	2,586	-	-	69	1,478	-	-	T
trichloroethylene	75	-	39	76	5,071	321	-	2,535	-	-	-	-	107	200	-	43	T
dichlorobutane isomer	-	700	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
dichlorobutene isomer	262	-	-	-	-	-	-	-	-	T	-	-	-	-	-	-	-
1,1,2-trichloroethane	-	-	-	-	-	6,700	-	-	-	3,334	-	-	-	3,821	-	-	-
tetrachloroethylene	29	T	21	20	18	-	T	2,019	75	68	-	72	94	1,585	17	83	T
dichlorobutane isomer	52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
dichloropropene isomer(s)	-	-	-	-	-	180 90 90	-	-	T,T	241 1,293 72 1,293 345	-	T	-	-	-	-	-
1,1,1,2-tetrachloroethane	-	-	-	-	-	-	-	-	-	-	-	-	-	21	-	-	-
bis-(2-chloroisopropyl)-ether	-	-	-	-	-	-	-	-	-	-	-	-	27	333	-	-	T
hexachloro-1,3-butadiene	-	-	-	-	-	-	-	334	-	2,066	-	25	13.3	8.3	-	T	T
1,2-dibromopropane	-	-	-	-	-	-	-	-	-	-	-	-	-	T	-	-	-
1,1,2,2-tetrachloroethane	-	-	-	-	-	-	-	-	-	19	-	-	-	33	-	-	-
1,2,3-trichloropropane	-	-	-	-	-	-	-	-	-	-	-	-	-	298	-	-	-
pentachloroethane	-	-	-	-	-	-	-	-	-	-	-	-	-	3,984	-	-	-
perchloroethane	-	-	-	-	-	-	-	-	-	-	-	-	-	2,903	-	-	-

(continued)

Table A-80 (cont'd.)

Chemical Class	HL1	HL2	HL3	PL1	PL2	DSL1	DSL2	DDL1	DTL1	DTL2	DTL3	DTL4	FL2	FL3	LL1	LL2	LL3
tetrachlorobutadiene isomer	-	-	-	-	-	-	-	-	-	T	-	-	-	-	-	-	-
pentachlorobutadiene isomer(s)	-	-	-	-	-	-	-	67	-	T 100	-	-	-	-	-	-	-
vinyl chloride	-	-	-	-	-	-	-	T	-	-	-	-	-	-	-	-	-
trichloropropene isomer(s)	-	-	-	-	-	-	-	-	-	T,T	-	-	-	-	-	-	-

[a]Values are in ng/m^3; H = Houston, P = Pasadena, D = Deer Park, F = Freeport, L = LaPorte, see reference A-4.

Table A-81. ESTIMATED MINIMUM TOTAL AMBIENT AIR LEVELS OF VAPOR-PHASE ORGANIC CHEMICAL CLASSES IN HOUSTON AND VICINITIES[a]

Chemical Class	HL1	HL2	HL3	PL1	PL2	DSL1	DSL2	DDL1	DTL1	DTL2	DTL3	DTL4	FL2	FL3	LL1	LL2	LL3
Halogenated hydrocarbons	16,737	1,100	12,518	294	5,433	128,948	6,604	19,409	2,078	25,398	716	15,990	32,028	40,026	13,165	37,926	7,832
Oxygenated Compounds	370	1,966	-	20	-	134	60	6,947	3,734	120	60	1,020	2,726	2,596	4,601	9,634	6,253

[a]See reference A-4. Values in ng/m^3.

Table A-82. AMBIENT AIR SAMPLING PROTOCOL FOR VAPOR-PHASE ORGANICS IN HOUSTON, TX

Sampling Site	Code	Date	Period[a]	Volume Sampled (ℓ)	Ambient Temp. (°C)
3079	HO-1	195/77-197/77	1730-930 hrs	113.4	22.4 → 22.3 → 22.4
3079	HO-2	202/77-204/77	1000-900 hrs	113.1	16.9 → 16.5 → 17.5
3079	HO-3	204/77-206/77	1030-0915 hrs	112.2	17.5 → 17.9 → 18.3
3079	HO-4	206/77-208/77	0915-0945 hrs	120.2	18.3 → 19.2 → 28.2
3079	HO-5	208/77-210/77	1000-1015 hrs	115.2[c]	28.3 → 28.1 → 28.6
3079	B[6]	-	-	-	-

[a] Duplicate samples were taken in all cases, see reference A-5.

[b] Four blanks were included.

[c] Computer down, flow rates were approximated.

Table A-83. ESTIMATED LEVELS OF VAPOR-PHASE HALOGENATED ORGANICS IN AMBIENT AIR FROM HOUSTON, TX[a]

Chemical	Sample Code[b]					
	HO-1	HO-2	HO-3	HO-4	HO-5	B[c]
methylene chloride	T(714)	4555 ± 1555	1222 ± 111	2642 ± 1214	2250 ± 750	<5
chloroform	541 ± 166	2282 ± 162	519 ± 58	896 ± 396	795 ± 147	<3
carbon tetrachloride	T(92)	T(87)	T(87)	T(95)	T(133)	<2
vinyl chloride	<12000	<10,000	<10,000	<12000	<16667	<15
1,2-dichloroethylene	<334	<312	<312	<334	<476	<10
1,1-dichloroethane	<285	<258	<267	<285	<296	<8
1,2-dichloroethane	123 ± 10	157 ± 36	242 ± 0	242 ± 16	345 ± 63	<8
1,1,1-trichloroethane	367 ± 33	235 ± 59	T(470)	T(334)	T(454)	<5
1,1,2-trichloroethane	<250	<227	<227	<250	<312	<5
trichloroethylene	T(100)	T(100)	130 ± 10	T(100)	T(135)	<5
tetrachloroethylene	T(62)	57 ± 4	T(44)	<150	130 ± 26	<7
1,1,1,2-tetrachloroethane	<53	<53	<53	<50	<52	<6
1,1,2,2-tetrachloroethane	<53	<53	<53	<50	<52	<6
pentachloroethane	<43	<43	<43	<40	<43	<5
hexachloroethane	<43	<43	<43	<40	<43	<5
chlorobenzene	<133	T(132)	T(132)	125 ± 0	52	<15
o-dichlorobenzene	<88	T(88)	<88	T(83)	T(86)	<10
m-dichlorobenzene	<88	T(88)	T(88)	T(83)	T(87)	<10
p-dichlorobenzene	<80	<80	<80	<75	<78	<9

(continued)

Table A-83 (cont'd.)

Chemical	Sample Code					
	HO-1	HO-2	HO-3	HO-4	HO-5	B[c]
1,2,4-trichlorobenzene	<53	<53	<53	<50	<52	<6
1,3,5-trichlorobenzene	<43	T(43)	<43	<40	<43	<5
1,2,3-trichlorobenzene	<53	<53	<53	<50	<52	<6
vinylidine chloride	<334	<312	<312	<334	<476	<10

[a]See Table A-83 for sampling protocol.

[b]Values in ng/m^3, T = trace, ( ) and < indicate limits of detection. Duplicate analyses.

[c]Results from four blanks, ng/cartridge.

Table A-84. AMBIENT AIR SAMPLING PROTOCOL FOR VOLATILE ORGANICS IN HOUSTON, TX[a]

Sampling Site	Location	Code	Date	Period	Volume Sampled (ℓ)	Ambient Temp. (°F)
Texas Air Control	Aldine (Mail Rt.)	TC1	6/22/77	0945-1245 hrs	90.5	90
Houston Air Pollution Control	Clanton Dr.	HC1	6/28/77	0745-1050 hrs	65.7	80
Houston Air Pollution Control	Clanton Dr.	HC2	7/19/77	0630-0930 hrs	63.2	80
Texas Air Control	Aldine (Mail Rt.)	TC2	7/20/77	0630-0930 hrs	57.3	80
Houston Air Pollution Control	Crawford at Polk	HC3	10/19/77	0615-0915 hrs	113.4	68
Texas Air Control	Aldine (Mail Rt.)	TC3	10/20/77	1207-1510 hrs	89.3	74
Houston Air Pollution Control	Crawford at Polk	HC4	10/21/77	1546-1853 hrs	66.8	70
Houston Air Pollution Control	Clanton Dr.	HC5	10/21/77	0607-0907 hrs	108.4	72

[a]See reference A-6 .

Table A-85. ESTIMATED LEVELS OF VAPOR-PHASE HALOGENATED ORGANICS IN AMBIENT AIR FROM HOUSTON, TX

Chemical	Sample Code[b]							
	TC1	HC1	HC2	TC2	TC3	HC5	HC3	HC4	B
methylene chloride	4375 ± 3125	2736 ± 1014	1100 ± 100	1000 ± 0	3428	4500 ± 1643	4142 ± 428	1000	≤5
chloroform	3884 ± 2884	2064 ± 397	292 ± 125	400 ± 25	500 ± 333	T(125)	327 ± 77	354 ± 146	≤3
carbon tetrachloride	T(154)	217 ± 63	T(125)	T(125)	T(95)	T(95)	T(95)	T(95)	≤2
vinyl chloride	<18750	<18750	<15000	<15000	<12000	<12000	<12000	<12000	<15
1,2-dichloroethylene	<555	4525 ± 1747	T(454)	<454	297 ± 37	T(334)	<(334)	T(334)	<10
1,1-dichloroethane	<471	<471	<381	<381	<357	<285	<285	<285	<8
1,2-dichloroethane	T(444)	<348	T(348)	<348	T(258)	T(258)	209 ± 48	T(258)	<8
1,1,1-trichloroethane	T(555)	708 ± 41	533 ± 116	995 ± 5	T(533)	T(334)	T(334)	T(334)	≤5
trichloroethylene	<179	T(179(	T(132)	158 ± 26	<100	T(250)	72 ± 28	T(250)	≤5
tetrachloroethylene	T(55)	69 ± 8	T(79)	<123	252 ± 130	T(46)	262 ± 77	250 ± 0	<5
1,1,1,2-tetrachloroethane	<67	<75	<95	<105	<67	<(55)	<53	<89	<6
1,1,2,2-tetrachloroethane	<67	<75	<95	<105	<67	<55	<53	<89	<6
pentachloroethane	<55	<62	<69	<88	<56	<46	<44	<75	<5
hexachloroethane	<55	<62	<79	<88	<56	<46	<44	<75	<5
chlorobenzene	<167	<187	T(283)	<263	T(168)	T(139)	T(132)	T(224)	<15
o-dichlorobenzene	<110	<125	<159	<175	T(112)	T(92)	T(88)	<149	<10
m-dichlorobenzene	T(110)	T(127)	T(159)	T(175)	T(112)	T(92)	T(88)	T(149)	<10
p-dichlorobenzene	<99	<112	<143	<158	<101	<(83)	<80	<134	<9
1,2,4-trichlorobenzene	<67	<75	<95	<123	<67	T(55)	<53	<89	<6
1,3,5-trichlorobenzene	<55	<62	<79	<88	<56	T(46)	<44	T(75)	<5
1,2,3-trichlorobenzene	<67	<75	<95	<123	<67	<55	<53	<89	<6
vinylidene chloride	<555	<555	<454	427 ± 27	<334	<334	T(334)	<334	<10
1,1,2-trichloroethane	<357	<357	<294	<294	<250	<250	<250	<334	<5

[a] See reference A-6.

[b] Values in ng/m^3, T = trace, ( ) and < indicate limits of detection.

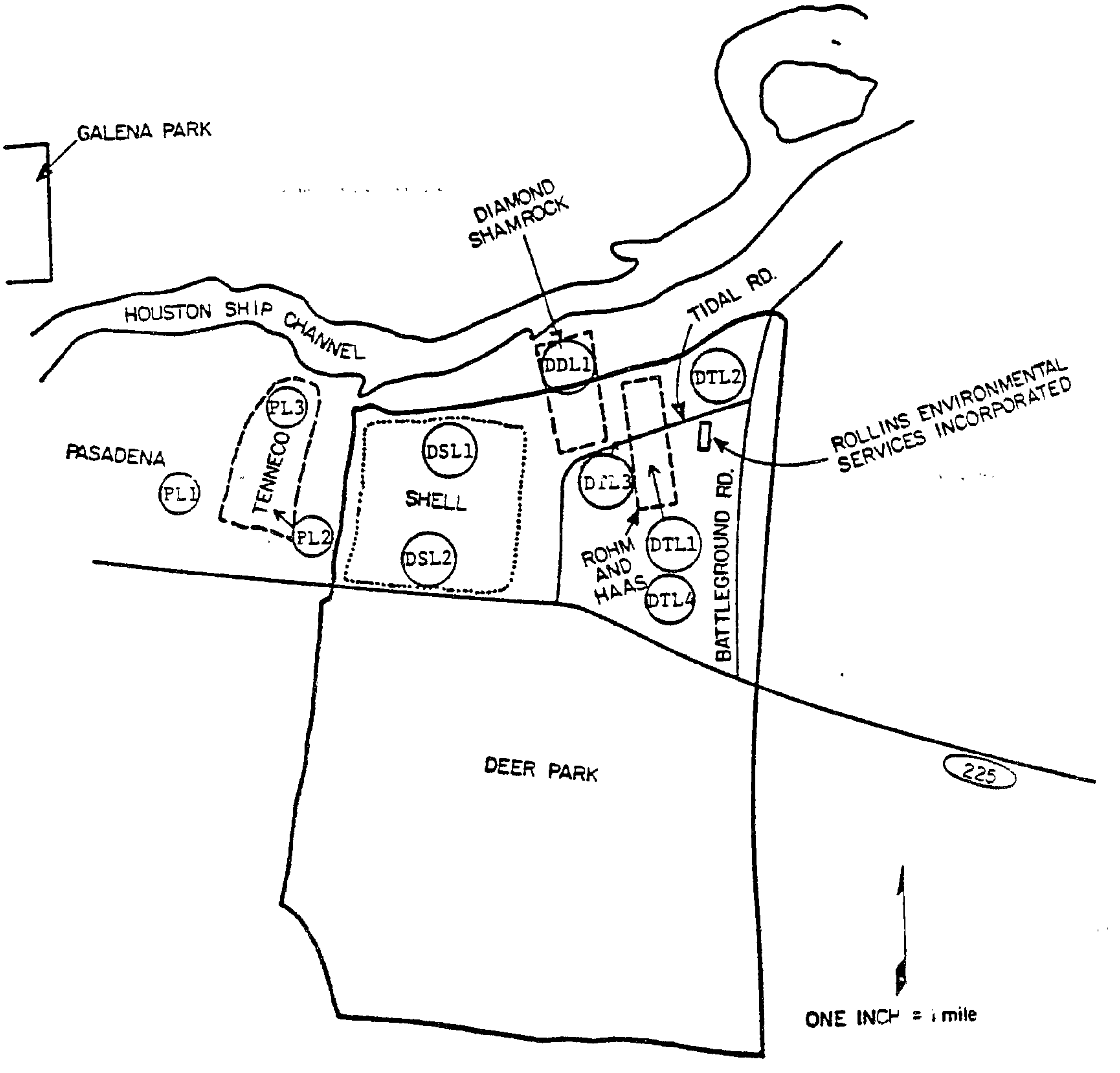


Figure A-35. Sampling locations for Deer Park and Pasadena, TX sites.

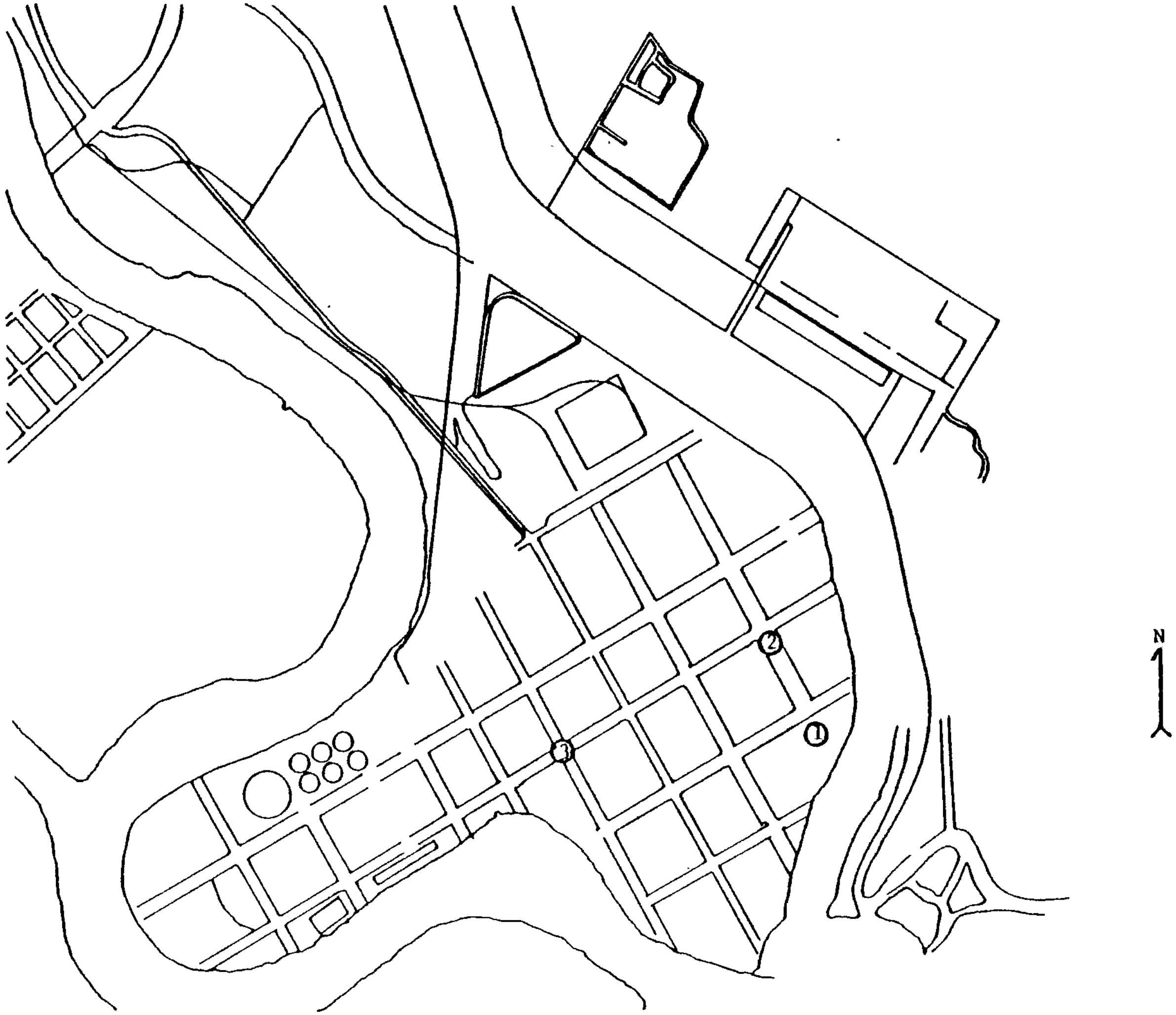


Figure A-36. Sampling locations in Freeport, TX (Dow 'A').

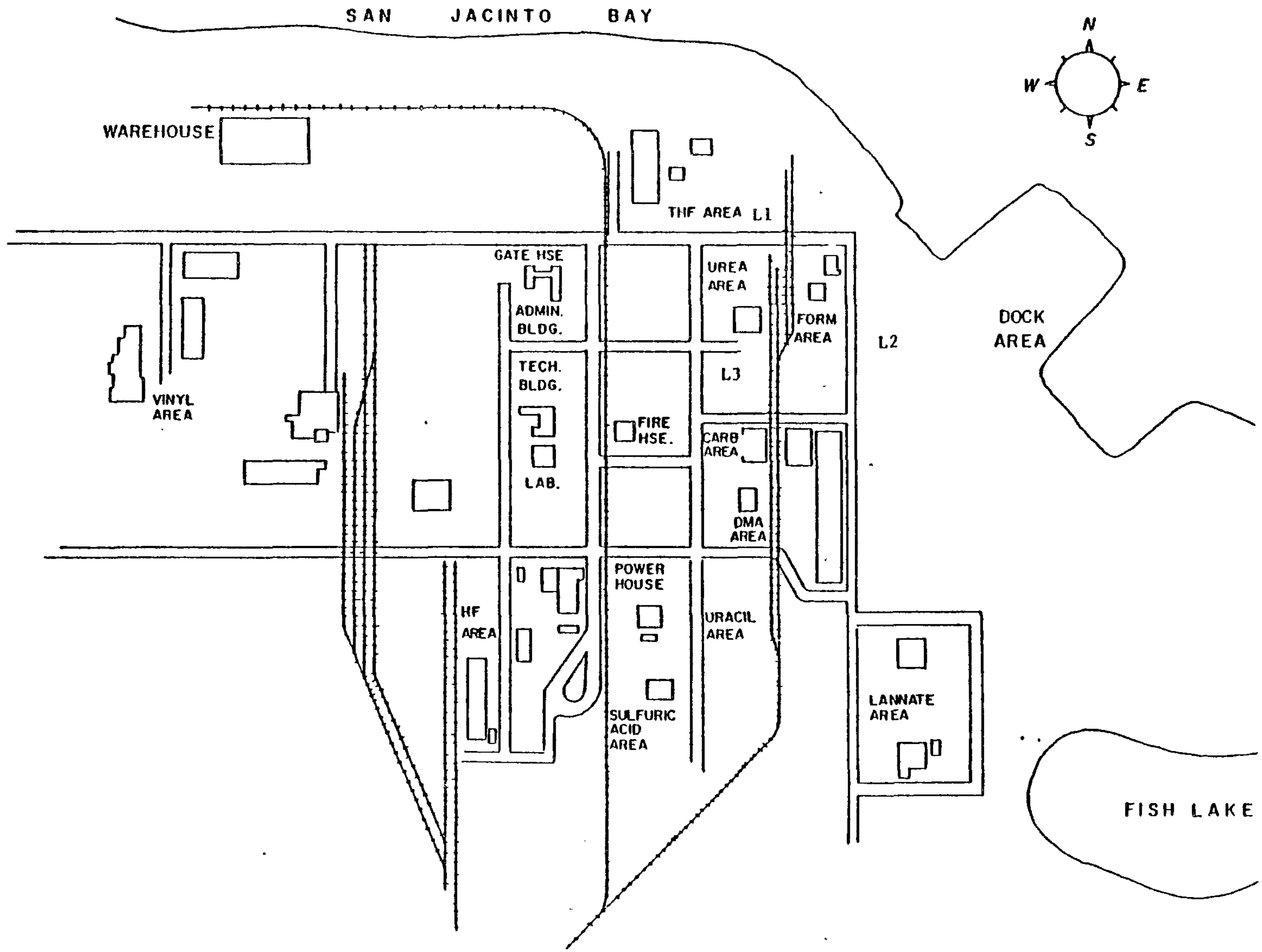


Figure A-37. Sampling site and locations in La Porte, TX (E. I. DuPont deNemours & Co.).

References

A-1 E. D. Pellizzari. "Improvement of Methodologies for the Collection and Analysis of Carcinogenic Vapors", EPA Contract No. 68-02-2764, Annual Report, submitted.

A-2 E. D. Pellizzari. "The Measurement of Carcinogenic Vapors in Ambient Atmospheres", EPA-600/7-77-055, June 1977, 288 pp.

A-3 E. D. Pellizzari. "Measurement of Carcinogenic Vapors in Ambient Atmospheres", EPA-600/7-78-062, April 1978, 273 pp.

A-4 E. D. Pellizzari. "Analysis of Organic Air Pollutants by Gas Chromatography and Mass Spectroscopy", EPA Contract No. 68-02-2262, Final Report, submitted.

A-5 E. D. Pellizzari. "Provide Information on the Characteristics of Ambient Organic Vapors in High Chemical Production", EPA Contract No. 68-02-2721, Final Report, in preparation.

A-6 Pellizzari, E. D. "Quantification of Chlorinated Hydrocarbons in Previously Collected Air Samples", EPA P.O. No. DA-8-1938J, Final Report, submitted.

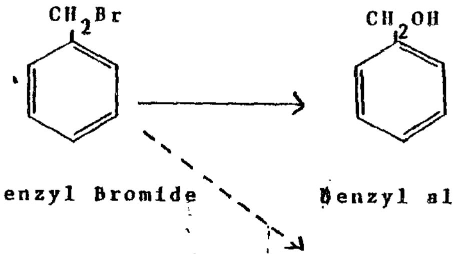
APPENDIX B

Metabolism Summaries

Table B-1. METABOLISM SUMMARIES FOR SOME HALOGENATED ORGANICS TO BE MONITORED IN THIS STUDY

Source: R. Huffman, C. Latanich, T. Collins and J. Caldwell, "Metabolism Summaries of Selected Halogenated Organic Compounds in Human and Environmental Media, A Literature Survey". EPA 560/6-79-008, June 1974.

BENZYL BROMIDE



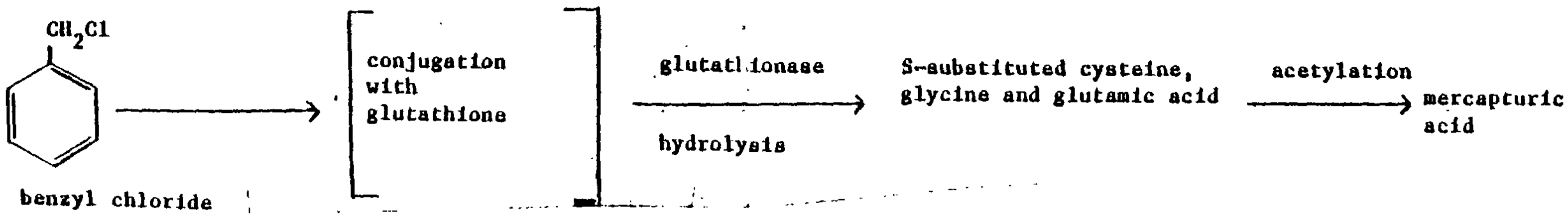
benzyl Bromide → benzyl alcohol

mercapturic acid
ethereal sulphate

Based on findings of Bray et al., (A-1)

	Breath	Urine	Blood	Comments	Ref.
Parent compound:	No data	No data	No data		
Half-life of parent compound:	No data	No data	No data		
Metabolites:	No data	No data	No data		
Half-life of metabolite:	No data	No data	No data		
Metabolite conjugates:					
mercapturic acid		19% (24 hrs)		rabbit, 0.2 g/kg, via stomach tube	A-1
ethereal sulphate		2% (24 hrs)		rabbit, 0.2 g/kg, via stomach tube	A-1

BENZYL CHLORIDE (CHLOROTOLUENE)



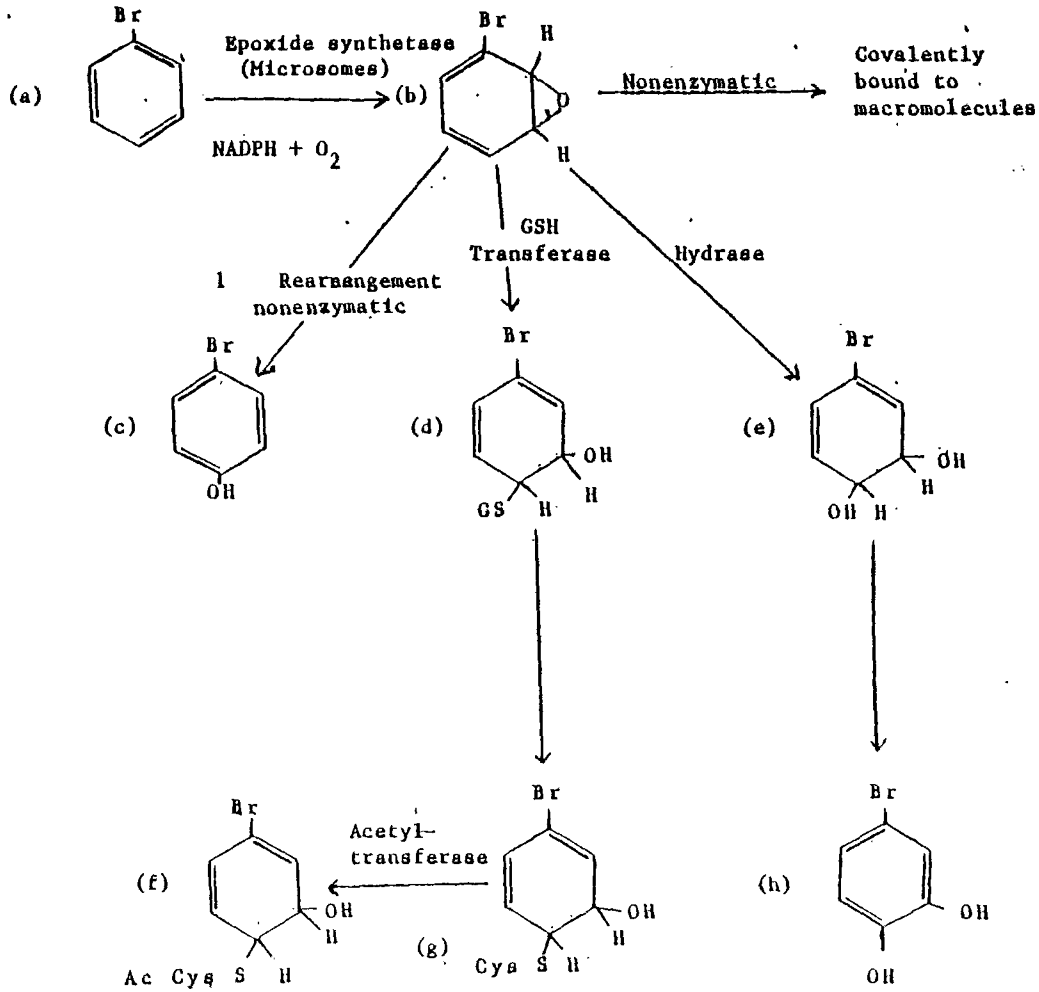
Proposed pathway for the formation of mercapturic acid Bray et al., (B-2)

	Breath	Urine	Blood	Comments	Ref.
Parent compound:	No data	No data	No data		
Half-life of parent compound:	No data	No data	No data		
Metabolites:					
benzoic or phenyl-acetic acids (unconjugated)		17% (24 hrs)		rabbit, 0.2 g/kg, by stomach tube	B-1
Metabolite conjugates:					
mercapturic acid		49% (36-67%) (24 hrs)		rabbit, 0.2 g/kg, by stomach tube	B-1
		4%		guinea pig, rate and route unspecified	B-2
		27%		rat, rate and route unspecified	B-2

Benzyl chloride (Chlorotoluene)(continued)

	Breath	Urine	Blood	Comments	Ref.
Metabolite conjugates: (cont.)					
glycine conjugate (benzoic or phenylacetic)		20% (12-16) (24 hrs)		rabbit, 0.2 g/kg, by stomach tube	B-1
glucosiduronic acid (mainly phenols)		0.4% (0-5) 24 hrs		rabbit, 0.2 g/kg, by stomach tube	B-1

Proposed metabolic pathway (Jollow et al., 1974, Pharmacol. 11: 151-169)



(a) Bromobenzene
(b) Bromobenzene epoxide
(c) p-Bromophenol
(d) 3,4-Dihydro-3-hydroxy-4-S-glutathionyl bromobenzene
(e) 3,4-Dihydro-3,4-dihydroxy-bromobenzene
(f) 3,4-Dihydro-3-hydroxy-4-S-acetyl cysteinyl bromobenzene
(g) 3,4-Dihydro-3-hydroxy-4-S-cysteinyl bromobenzene
(h) 3,4-Dihydroxy bromobenzene

Bromobenzene (continued)

	Breath	Urine	Blood	Comments	Ref.
Parent compound:	6% (1-2 days)			rabbit, 0.5 g/kg, oral dose	C-1
	6.3%			rabbit, 0.5 g/kg, stomach tube	C-2
Half-life of parent compound:	No data	No data	No data		
Metabolic half-life:				rat, 10 umol ^{14}C-bromobenzene, i.v.	C-6
9.8 min., whole body homogenate				rat, 10 umol ^{14}C-bromobenzene, i.v.	C-6
9.3 min., plasma				rat, 10 umol ^{14}C-bromobenzene, i.v.	C-6
9.5 min., liver				rat, 10 umol ^{14}C-bromobenzene, i.v.	C-6
Metabolites:					
monophenols (uncharacterized)		2-3% (1-2 days)		rabbit, 0.5 g/kg, oral dose	C-1
4-bromophenol		40% (48 hrs)		rat, dosage not stated, i.p. injection	C-7
		37% (48 hrs)		rat, 10.0 umol/kg, i.p. injection	C-6
		18% (48 hrs)		rat, 0.05 mmol/kg, i.v. injection	C-6
(a)figure shown is percent yield of metabolite obtained by extraction and purification of the ether extracts of hydrolyzed rabbit urine		1.2% (a) (10 days)		rabbit, 50 mg/kg, i.p. injection	C-5
3-bromophenol		1.0% (a) (10 days)		rabbit, 50 mg/kg, i.p. injection	C-5

Bromobenzene (continued)

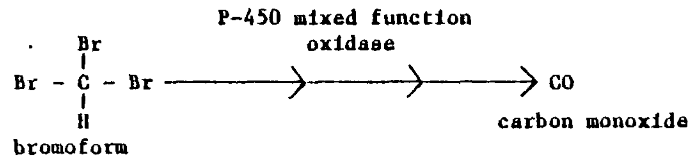
	Breath	Urine	Blood	Comments	Ref.
Metabolites (cont.)					
2-bromophenol		4% (48 hrs)		rat, dosage not stated, i.p. injection	C-7
		3% (48 hrs)		rat, 0.05 mmol/kg, i.v. injection	C-6
		3% (48 hrs)		rat, 10.0 mmol/kg, i.p. injection	C-6
bromophenyldihydrodiol		4% (48 hrs)		rat, 10.0 mmol/kg, i.p. injection	C-6
		4% (48 hrs)		rat, 0.05 mmol/kg, i.v. injection	C-6
3-4-bromophenyldihydrodiol		3% (48 hrs)		rat, dosage not stated, i.p. injection	C-7
2-3-bromophenyldihydrodiol		trace (48 hrs)		rat, dosage not stated, i.p. injection	C-7
bromocatechols (uncharacterized)		28% (1-2 days)		rabbit, 0.5 g/kg, oral dose	C-1
		6% (48 hrs)		rat, 10.0 mmol/kg, i.p. injection	C-6
		4% (48 hrs)		rat, 0.05 mmol/kg, i.v. injection	C-6

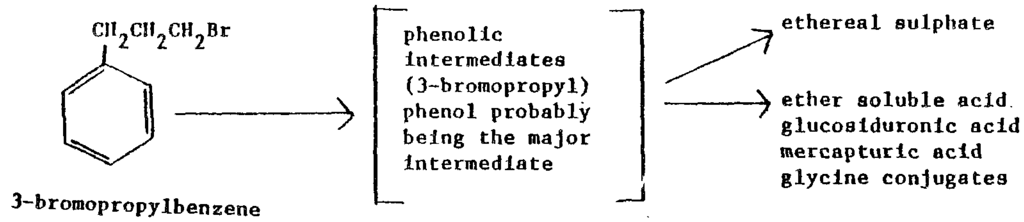
Bromobenzene (continued)

	Breath	Urine	Blood	Comments	Ref.
Metabolites (cont.)					
3,4-bromocatechol		4% (48 hrs)		rat, dosage not stated, i.p. injection	C-7
2,3-bromocatechol		trace (48 hrs)		rat, dosage not stated, i.p. injection	C-7
Metabolite conjugates:					
total o-conjugates		58% (1-2 days)		rabbit, 0.5 g/kg, oral dose	C-1
total conjugates		97.9%		rabbit, 210 mg/kg, via stomach tube	C-3
glucuronide		40.2%		rabbit, 210 mg/kg, via stomach tube	C-3
ethereal sulphate		36.8%		rabbit, 210 mg/kg, via stomach tube	C-3
mercapturic acid		20.9%		rabbit, 210 mg/kg, via stomach tube	C-3
		25% (1-2 days)		rabbit, 0.5 g/kg, oral dose	C-1
bromophenylmercapturic acid		70% (48 hrs)		rat, 0.05 mmol/kg, i.v. injection	C-6
		48% (48 hrs)		rat, 10.0 mmol/kg, i.v. injection	C-6
		22%		rabbit, 0.5 mg/kg, via stomach tube	C-4

BROMOFORM

No data were available regarding bromoform metabolites in breath, urine or blood. The following metabolic scheme represents the reduction of bromoform to carbon monoxide, based on *in vitro* studies (D-1).



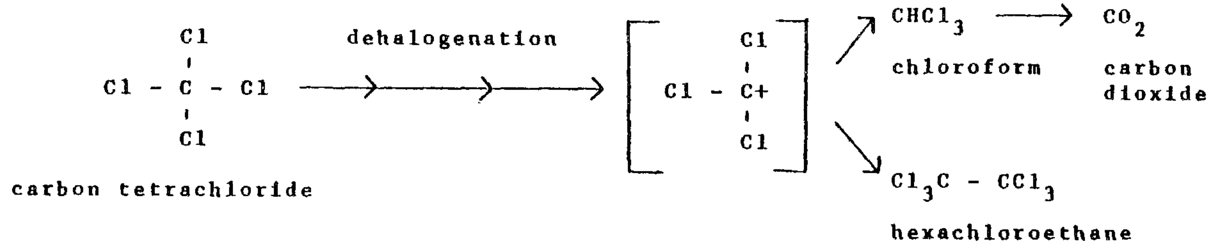


Based on findings reported by Bray et al., (E-1)

	Breath	Urine	Blood	Comments	Ref.
Parent compound:	No data	No data	No data		
Half-life of parent compound:	No data	No data	No data		
Metabolites:					
total urinary metabolites		89%		rabbit, 0.25 g/kg, via stomach tube	E-1

3-Bromopropylbenzene (continued)

	Breath	Urine	Blood	Comments	Ref.
Metabolite conjugates:					
ethereal sulphate		20%		rabbit, 0.25 g/kg, via stomach tube	E-1
ether soluble acid (primarily glucosiduronic acid; also mercapturic acid and glycine conjugates)		69%		rabbit, 0.25 g/kg, via stomach tube	E-1
phenaceturic acid		unspecified amount		rabbit, 0.25 g/kg, via stomach tube	E-1
N-acetyl-S-(3-phenyl - propyl)-L-cysteine		unspecified amount		rabbit, 0.25 g/kg, via stomach tube	E-1
phenolics (uncharacterized)		unspecified amount		rabbit, 0.25 g/kg, via stomach tube	E-1



Based on findings of Paul and Rubinsteins, (F-2)

	Breath	Urine	Blood	Comments	Ref.
Parent compound:	33% (1 hr)			human, 80 ppm ^{14}carbon tetra-chloride, single breath inhalation	F-3
	40% (1800 hrs)			monkey, 46 ppm ^{14}carbon tetra-chloride, inhalation for 344 minutes	F-4
	85% (18 hrs)			rat, 1.0 ml ^{14}carbon tetra-chloride /kg, intraduodenal	F-2
		19.2 ug total (day 1)		sheep, 0.1 mg/kg, intra-ruminal	F-6
		5.9 ug total (day 2)		sheep, 0.1 mg/kg, intra-ruminal	F-6

Carbon tetrachloride (continued)

	Breath	Urine	Blood	Comments	Ref.
Parent compound (cont.)					
		4.6 ug total (day 3)		sheep, 0.1 mg/kg, intra-ruminal	F-6
		trace-1.3 ug (day 4-7)		sheep, 0.1 mg/kg, intra-ruminal	F-6
		1.2 ug total (day 1)		sheep, 0.12 mg/kg, intra-ruminal	F-6
		1.0 ug total (day 2)		sheep, 0.12 mg/kg, intra-ruminal	F-6
		0.7 ug total (day 3)		sheep, 0.12 mg/kg, intra-ruminal	F-6
		trace-0.7 ug (day 4-7)		sheep, 0.12 mg/kg, intra-ruminal	F-6
			trace (at end of exposure)	rabbit, 110 ppm, inhalation, 4 hrs	F-7
			0.2 mg/100 ml blood (at end of exposure)	rabbit, 225 ppm, inhalation, 4 hrs	F-7
			0.6 mg/100 ml blood (at end of exposure)	rabbit, 345 ppm, inhalation, 4 hrs	F-7
			0.4 mg/100 ml blood (at end of exposure)	rabbit, 600 ppm, inhalation, 4 hrs	F-7
Half-life of parent compound:	No data	No data	No data		

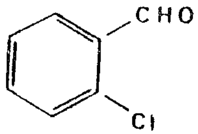
Carbon tetrachloride (continued)

	Breath	Urine	Blood	Comments	Ref.
Metabolites:					
^{14}C-carbon dioxide	11% (1800 hrs)			monkey, 46 ppm ^{14}carbon tetrachloride, inhalation, 344 minutes	F-4
	1% (18 hrs)			rat, 1.0 ml ^{14}carbon tetrachloride/kg, intraduodenal	F-2
chloroform		3.7 ug total (day 1)		sheep, 0.1 mg/kg, intra-ruminal	F-6
		2.0 ug total (day 2)		sheep, 0.1 mg/kg, intra-ruminal	F-6
		1.8 ug total (day 3)		sheep, 0.1 mg/kg, intra-ruminal	F-6
		trace-0.8 ug (day 4-7)		sheep, 0.1 mg/kg, intra-ruminal	F-6
		6.6 ug total (day 1)		sheep, 0.12 mg/kg, intra-ruminal	F-6
		1.0 ug total (day 2)		sheep, 0.12 mg/kg, intra-ruminal	F-6
		0.7 ug total (day 3)		sheep, 0.12 mg/kg, intra-ruminal	F-6
		trace-0.7 ug total (day 4-7)		sheep, 0.12 mg/kg, intra-ruminal	F-6

Carbon tetrachloride (continued)

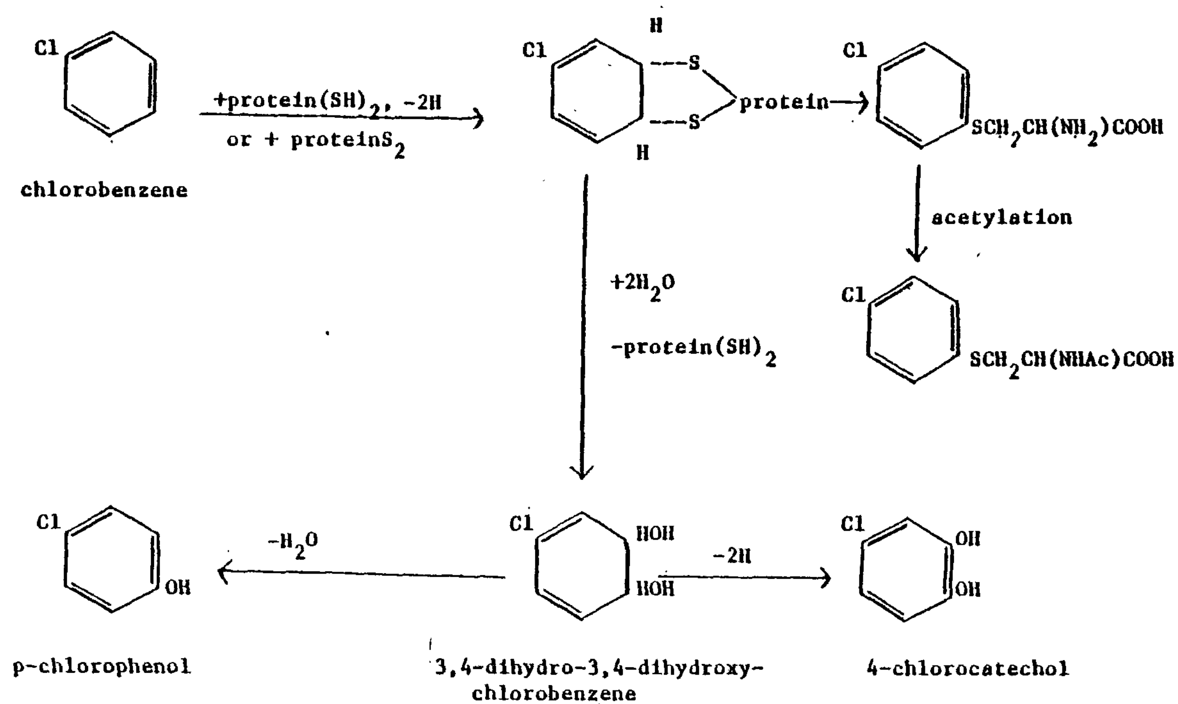
	Breath	Urine	Blood	Comments	Ref.
Metabolite conjugates:	No data	No data	No data		

o-CHLOROBENZALDEHYDE



o-chlorobenzaldehyde

	Breath	Urine	Blood	Comments	Ref.
Parent Compound:	No data	No data	No data		
Half-life of parent compound:					
			15 seconds	human, 2.65 uM, <u>in vitro</u> blood tests	G-1
			70 seconds	cat, 2.65 uM, <u>in vitro</u> blood tests	G-1
			15 seconds	rat, 2.65 uM, <u>in vitro</u> blood tests	G-1
Metabolites:	No data	No data	No data		
Metabolite conjugates:	No data	No data	No data		



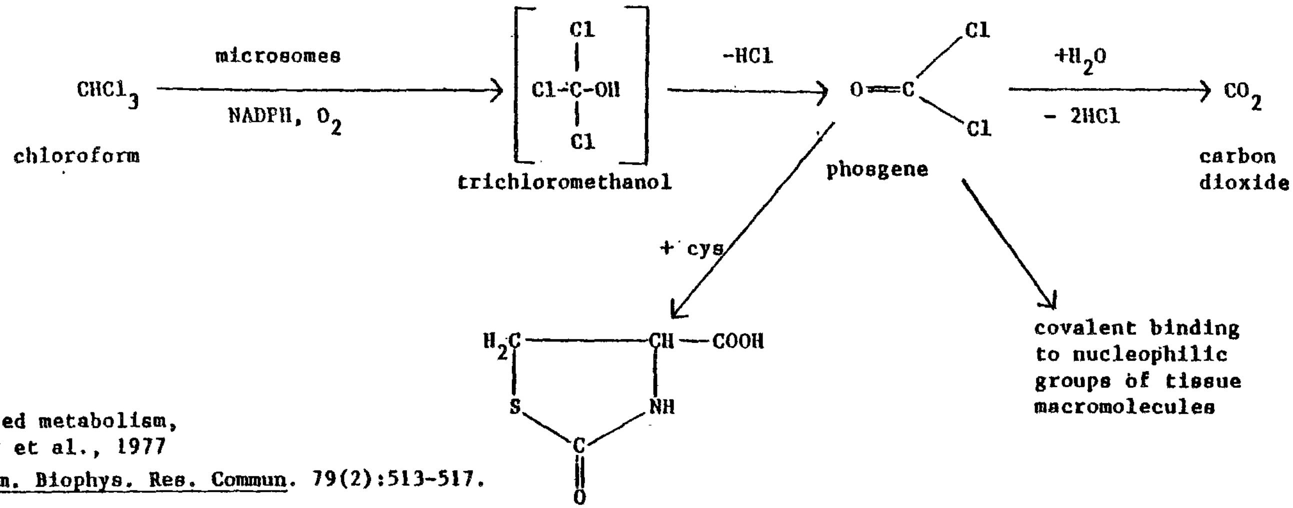
Proposed by Smith et al., 1950 (H-2)

Chlorobenzene (continued)

	Breath	Urine	Blood	Comments	Ref.
Parent compound:	27%			rabbit, 0.5 g/kg, oral	H-3
Half-life of parent compound:	No data	No data	No data		
Metabolites:					
^{14}C-activity		19.6%		rabbit, 0.5 g ^{14}C-chlorobenzene, orally, twice daily for 4 days	H-5
total urinary metabolites		72.2%		rabbit, 150 mg/kg, via stomach tube	H-1
glucuronide		25.2%		rabbit, 150 mg/kg, via stomach tube	H-1
(a) expressed as percentage of urinary ^{14}C-activity (19.6% of total ^{14}C-chlorobenzene dose)		33.57%(a)		rabbit, 0.5 g ^{14}C-chlorobenzene, orally twice daily for 4 days	H-5
ethereal sulphate		26.6%		rabbit, 150 mg/kg, via stomach tube	H-1
		33.88%(a)		rabbit, 0.5 g ^{14}C-chlorobenzene, orally, twice daily for 4 days	H-5
mercapturic acid		20.4%		rabbit, 150 mg/kg, via stomach tube	H-1
		23.80%(a)		rabbit, 0.5 g ^{14}C-chlorobenzene, orally, twice daily for 4 days	H-5
		28%		rabbit, 0.5 g/kg, oral	H-3
		27%		rabbit, 0.5 g/kg, oral	H-4
p-chlorophenylmercapturic acid		major metabolite (2 days)		rabbit, 10 or 12 g total dose, via stomach tube	H-2
catechols		27%		rabbit, 0.5 g/kg, oral	H-4

Chlorobenzene (continued)

	Breath	Urine	Blood	Comments	Ref.
Metabolites (cont.)					
catechol derivatives (uncharacterized)		37%		rabbit, 0.5 g/kg, oral	H-3
4-chlorocatechol (ethereal sulphate and glucuronide conjugates)		major metabolite (2 days)		rabbit, 10 or 12 g total dose, via stomach tube	H-2
monophenols (uncharacterized)		2.84%(a)		rabbit, 0.5 g ^{14}C-chlorobenzene, orally, twice daily for 4 days	H-5
p-chlorophenol		2-3%		rabbit, 0.5 g/kg, oral	H-3
o-chlorophenol		trace		rabbit, 0.5 g/kg, oral	H-3
p-chlorophenol and p-chlorophenol glucuronide		0.5% (2 days)		rabbit, 10 or 12 g total dose, via stomach tube	H-2
diphenols		4.17%(a)		rabbit, 0.5 g ^{14}C-chlorobenzene, orally, twice daily for 4 days	H-5
3,4-dihydro-3,4-dihychoxychlorobenzene		0.57%(a)		rabbit, 0.5 g ^{14}C-chlorobenzene, orally, twice daily for 4 days	H-5
		0.03% (2 days)		rabbit, 10 or 12 g total dose, via stomach tube	H-2



4-carboxy-thiazolidine-2-one.

Proposed metabolism,
Mansuy et al., 1977
Biochem. Biophys. Res. Commun. 79(2):513-517.

	Breath	Urine	Blood	Comments	Ref.
Parent compound:	17.8-66.6% (8 hrs)			human, 4 males, 500 mg, oral	I-3

Chloroform (continued)

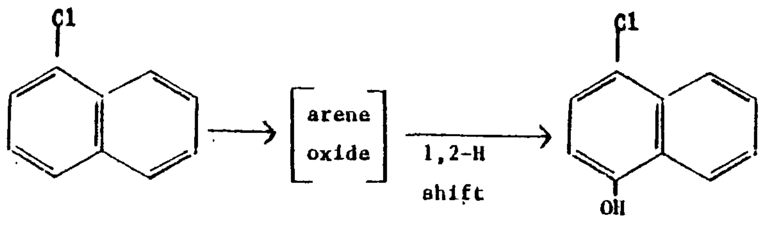
	Breath	Urine	Blood	Comments	Ref.
Parent compound (cont.)					
	25.6-40.4% (8 hrs)			human, 4 females, 500 mg, oral	I-3
	10%			human, 5 mg single breath inhalation	I-4
	78%			monkey, 60 mg/kg, oral dose daily for 5 days	I-2
	20%			rat, 60 mg/kg, oral dose daily for 5 days	I-2
(a) chloroform combined with toluene-soluble metabolites	20%(a) (24 hrs)			rat, 60 mg/kg, oral	I-1
	6%			mouse, 60 mg/kg, oral dose, daily for 5 days	I-2
Half-life of parent compound:	No data	No data	No data		
Metabolites:					
carbon dioxide	50.6% (8 hrs)			human, 4 males, 500 mg, oral	I-3
	48.5% (8 hrs)			human, 4 females, 500 mg, oral	I-3
	18% (24 hrs)			monkey, 60 mg/kg, oral	I-1
	16%			monkey, 60 mg/kg, oral dose, daily for 5 days	I-2
Metabolite conjugates:	No data	No data	No data		

Chloroform (continued)

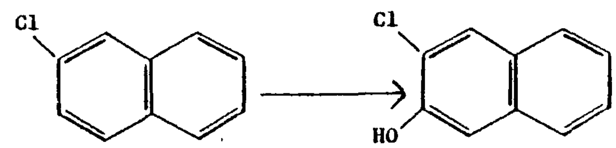
	Breath	Urine	Blood	Comments	Ref.
Metabolites (cont.)					
	66% (24 hrs)			rat, 60 mg/kg, oral dose, daily for 5 days	I-2
	80% (24 hrs)			mouse, 60 mg/kg, oral	I-1
bicarbonate/carbonate compounds	13% (24 hrs)			mouse, 60 mg/kg, oral	I-1

CHLORONAPHTHALENE

Based on findings of Ruzo et al. 1976. J. Agr Chem and Food 24(3): 581-3.



1-chloronaphthalene 4-chloro-1-naphthol



2-chloronaphthalene 3-chloro-2-napthol

	Breath	Urine	Blood	Comments	Ref.
Parent compound: 1-Cl naphthalene			5.1 ug/g after 10 min.	pig, 300 mg dose of 1-chloronaphthalene, 7.5 kg pig, retrocarotid administration	J-2
			3.4 ug/g after 20 min.		
			1.8 ug/g after 40 min.		
			0.7 ug/g after 80 min.		
			0.9 ug/g after 120 min.		
			0.3 ug/g after 160 min.		
			0.3 ug/g after 200 min.		
			0.1 ug/g after 240 min.		

Chloronaphthalene (continued)

	Breath	Urine	Blood	Comments	Ref.
Parent compound (cont.)					
2-Cl naphthalene			6.2 ug/g after 10 min.	pig, 300 mg dose of 2-chloronaphthalene, 7.5 kg pig, retrocarotial administration	J-2
			3.8 ug/g after 20 min.		
			1.9 ug/g after 40 min.		
			1.0 ug/g after 80 min.		
			1.0 ug/g after 120 min.		
			0.6 ug/g after 160 min.		
			0.2 ug/g after 200 min.		
			0.2 ug/g after 240 min.		
			0.1 ug/g after 260 min.		
Half-life of parent compound:	No data	No data	No data		
Metabolites:					
4-Cl naphthol		400 ug/g (6 hrs after administration)		Yorkshire pig, 300 mg of 1-Cl naphthalene isomer, 7.5 kg pig, retrocarotid administration	J-2

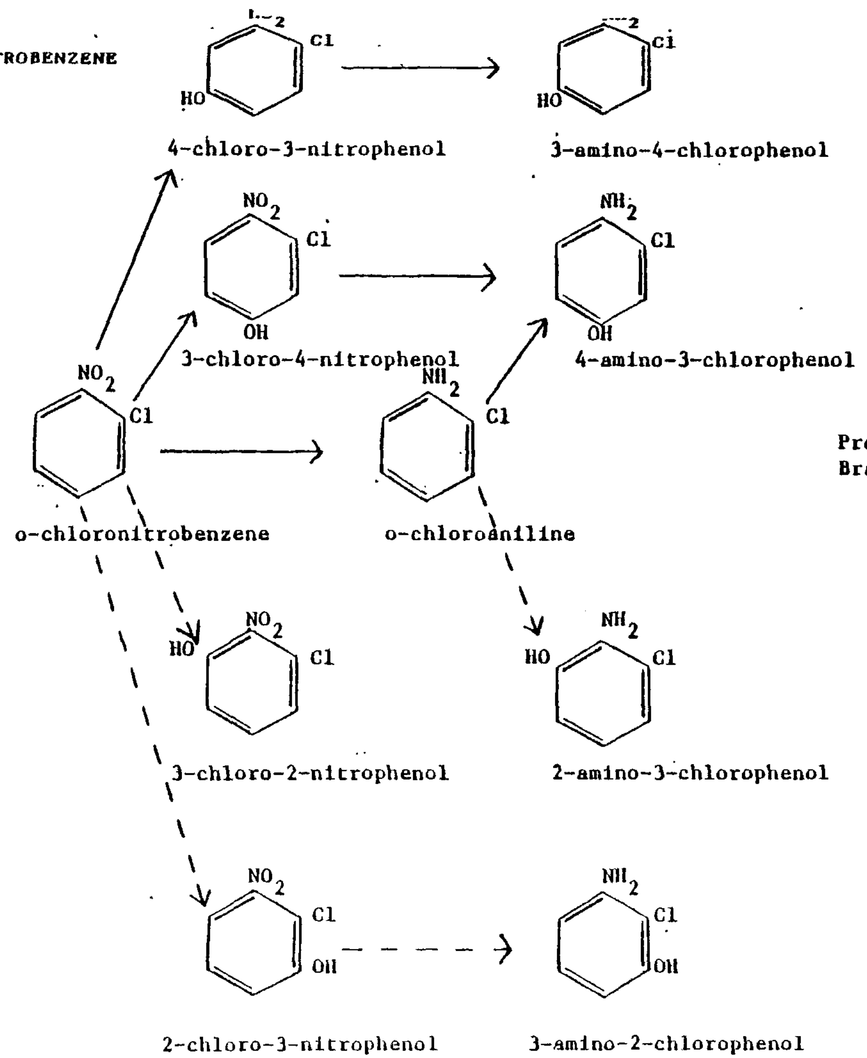
Chloronaphthalene (continued)

	Breath	Urine	Blood	Comments	Ref.
Metabolites (cont.)					
4-Cl naphthol			0.1 ug/g after 160 min.		
			0.6 ug/g after 200 min.	Yorkshire pig, 300 mg of 1-Cl naphthalene isomer, 7.5 kg pig, retrocarotid administration	(J-2)
			0.8 ug/g after 240 min.		
			1.0 ug/g after 260 min.		
			1.3 ug/g after 300 min.		
free phenolic compounds		2% (4 days)		male albino rabbit, 1 g per rabbit, by stomach tube	J-1
3-Cl-2-naphthal		60 ug/g (6 hrs after administration)		Yorkshire pig, 300 mg of 2-Cl naphthalene isomer, 7.5 kg pig, retrocarotid administration	J-2
			0.2 ug/g after 200 min.		
			0.5 ug/g after 240 min.		
			0.8 ug/g after 260 min.		
			1.0 ug/g after 300 min.		

Chloronaphthalene (continued)

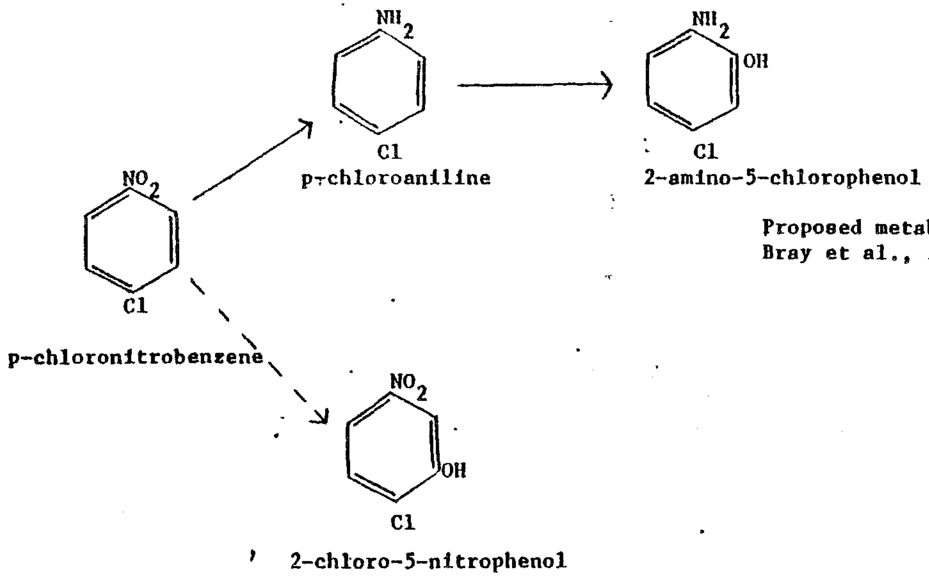
	Breath	Urine	Blood	Comments	Ref.
Metabolite conjugates of 1-chloronaphthlene:					
ethereal sulfate		10.1% (4 days)		male albino rabbits, 1 g/rabbit, by stomach tube. The rabbits weighed approximately 2 kg. Expressed as percentage of original dose	J-1
mercapturic acids		13.1% (4 days)			
glucuronic acid		53.7% (4 days)			

CHLORONITROBENZENE

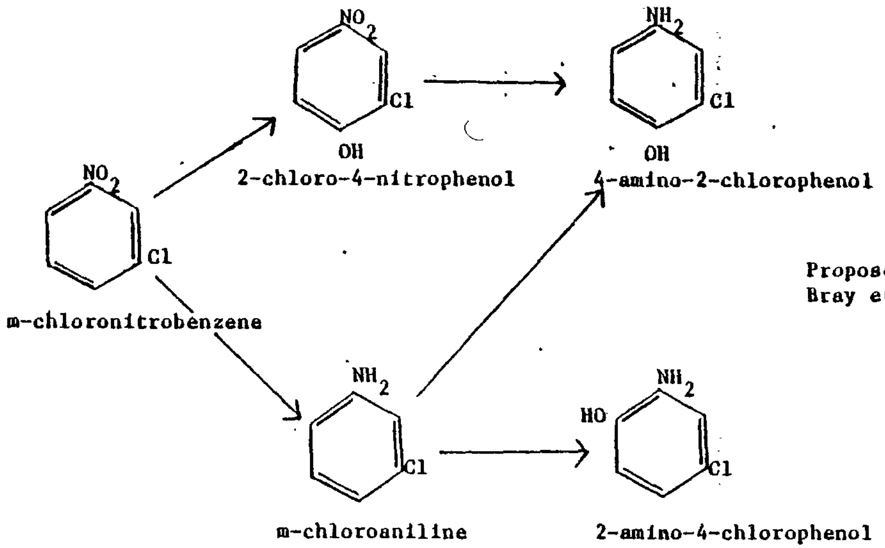


Proposed metabolism of o-chloronitrobenzene, Bray et al., 1956 (K-1)

CHLORONITROBENZENE



Proposed metabolism of p-chloronitrobenzene, Bray et al., 1956 (K-1)



Proposed metabolism of m-chloronitrobenzene, Bray et al., 1956 (K-1)

Chloronitrobenzene (continued)

	Breath	Urine	Blood	Comments	Ref.
Parent compound:	No data	Not detected	No data		
Half-life of parent compound:	No data	No data	No data		
Metabolites of o-chloronitrobenzene isomer:					
free chloroaniline		9%		rabbit, 0.1 g/kg. Expressed as percent of dose.	K-1
free phenolics		trace amounts		rabbit, 0.1 g/kg. Expressed as percent of dose.	K-1
Metabolites of m-chloronitrobenzene isomer:					
free chloroaniline		11%		rabbit, 0.2 g/kg. Expressed as percent of dose.	K-1
free phenolics		trace amounts		rabbit, 0.2 g/kg. Expressed as percent of dose.	K-1
Metabolites of p-chloronitrobenzene isomer:					
free chloroaniline		9%		rabbit, 0.2 g/kg. Expressed as percent of dose.	K-1
free phenolics		trace amounts		rabbit, 0.2 g/kg. Expressed as percent of dose.	K-1

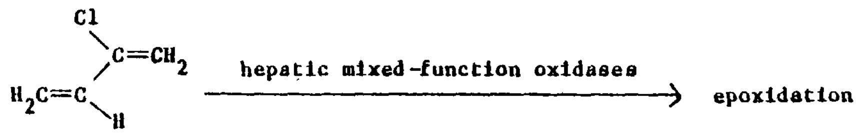
Chloronitrobenzene (continued)

	Breath	Urine	Blood	Comments	Ref.
Metabolite conjugates of o-chloronitrobenzene isomer:					
ether glucuronide		42%		rabbit, 0.1 g/kg. Expressed as percent of dose.	K-1
ethereal sulphates (aminochlorophenols and chloronitrophenols)		24%		rabbit, 0.1 g/kg. Expressed as percent of dose.	K-1
nitrophenylmercapturic acid		7%		rabbit, 0.1 g/kg. Expressed as percent of dose.	K-1
Metabolite conjugates of m-chloronitrobenzene isomer:					
ether glucuronide		33%		rabbit, 0.2 g/kg. Expressed as percent of dose.	K-1
ethereal sulphates (aminochlorophenols and chloronitrophenols)		18%		rabbit, 0.2 g/kg. Expressed as percent of dose.	K-1
nitrophenylmercapturic acid		1%		rabbit, 0.2 g/kg. Expressed as percent of dose.	K-1
Metabolite conjugates of p-chloronitrobenzene isomer:					
ether glucuronide		19%		rabbit, 0.2 g/kg. Expressed as percent of dose.	K-1
ethereal sulphate (aminochlorophenols and chloronitrophenols)		21%		rabbit, 0.2 g/kg. Expressed as percent of dose.	K-1

Chloronitrobenzene (continued)

	Breath	Urine	Blood	Comments	Ref.
Metabolite conjugates of p-chloronitrobenzene isomer (cont.)					
conjugated chloroaniline		4%		rabbit, 0.2 g/kg. Expressed as percent of dose.	K-1
nitrophenylmercapturic acid (colorimetic method)		7%		rabbit, 0.2 g/kg. Expressed as percent of dose.	K-1
nitrophenylmercapturic acid (modified Stekol method)		3%		rabbit, 0.2 g/kg. Expressed as percent of dose.	K-1

CHLOROPRENE

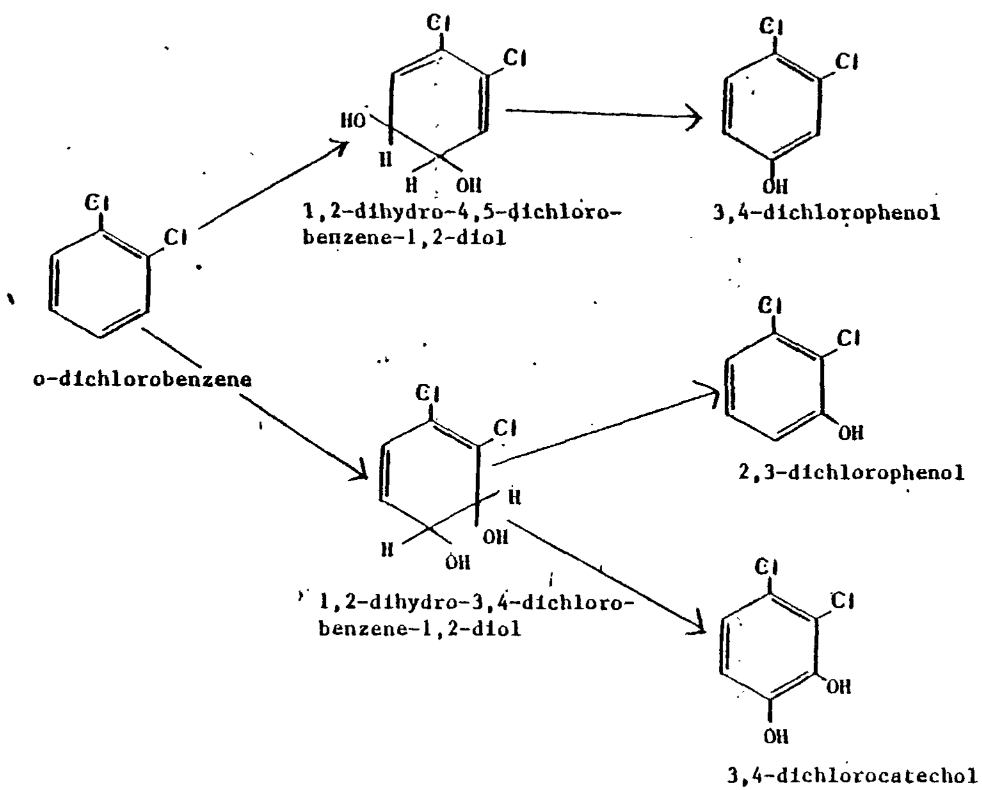


chloroprene

Based on findings of Bardodej, (L-1)

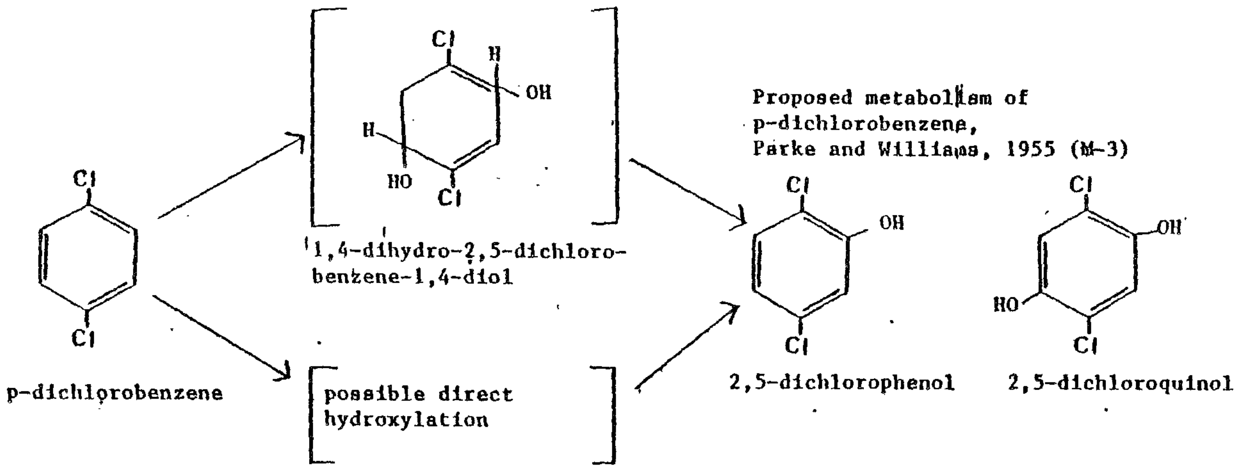
	Breath	Urine	Blood	Comments	Ref.
Parent compound:	No data	No data	No data		
Half-life of parent compound:	No data	No data	No data		
Metabolites:	No data	No data	No data		
Metabolite conjugates:	No data	No data	No data		

CHLOROTOLUENE - SEE BENZYL CHLORIDE

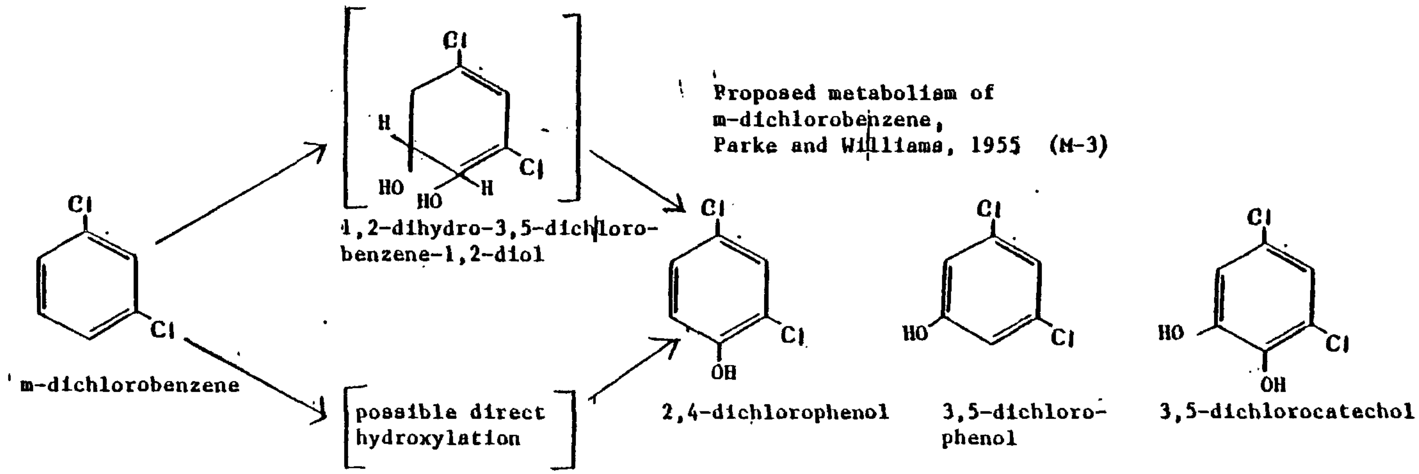


Proposed metabolism of o-dichlorobenzene, Parke and Williams, 1955 (M-3)

DICHLOROBENZENE



Proposed metabolism of p-dichlorobenzene, Parke and Williams, 1955 (M-3)



Proposed metabolism of
m-dichlorobenzene,
Parke and Williams, 1955 (M-3)

Dichlorobenzene (continued)

	Breath	Urine	Blood	Comments	Ref.
Parent compound:	No data	No data	No data		
Half-life of parent compound:	No data	No data	No data		
Metabolites of o-isomer:					
dichlorocatechol		7.8%		rabbit, 0.5 g/kg, via stomach tube	M-1
catechols		4%		rabbit, 0.5 g/kg, via stomach tube	M-2
		4%		rabbit, 0.5 g/kg, via stomach tube	M-3
quinols		0%		rabbit, 0.5 g/kg, via stomach tube	M-3
monophenols		39%		rabbit, 0.5 g/kg, via stomach tube	M-3
Metabolites of m-isomer:					
catechols		4%		rabbit, 0.5 g/kg, via stomach tube	M-2
		3%		rabbit, 0.5 g/kg, via stomach tube	M-3
quinols		0%		rabbit, 0.5 g/kg, via stomach tube	M-3
monophenols		25%		rabbit, 0.5 g/kg, via stomach tube	M-3
Metabolites of p-isomer:					
catechols		0%		rabbit, 0.5 g/kg, via stomach tube	M-2
		0%		rabbit, 0.5 g/kg, via stomach tube	M-3
quinols		6%		rabbit, 0.5 g/kg, via stomach tube	M-3
monophenols		35%		rabbit, 0.5 g/kg, via stomach tube	M-3

Dichlorobenzene (continued)

	Breath	Urine	Blood	Comments	Ref.
Metabolite conjugates of o-isomer:					
glucuronides		48%		rabbit, 0.5 g/kg, via stomach tube	M-2
		48%		rabbit, 0.5 g/kg, via stomach tube	M-3
ethereal sulfates		21%		rabbit, 0.5 g/kg, via stomach tube	M-2
		21%		rabbit, 0.5 g/kg, via stomach tube	M-3
mercapturic acid		5%		rabbit, 0.5 g/kg, via stomach tube	M-2
		5%		rabbit, 0.5 g/kg, via stomach tube	M-3
Metabolite conjugates of m-isomer:					
glucuronides		31%		rabbit, 0.5 g/kg, via stomach tube	M-2
		36%		rabbit, 0.5 g/kg, via stomach tube	M-3
ethereal sulfates		11%		rabbit, 0.5 g/kg, via stomach tube	M-2
		7%		rabbit, 0.5 g/kg, via stomach tube	M-3
mercapturic acid		9%		rabbit, 0.5 g/kg, via stomach tube	M-2
		11%		rabbit, 0.5 g/kg, via stomach tube	M-3
Metabolite conjugates of p-isomer:					
glucuronides		37%		rabbit, 0.5 g/kg, via stomach tube	M-2

Dichlorobenzene (continued)

	Breath	Urine	Blood	Comments	Ref.
Metabolite conjugates of p-isomer (cont.) (glucuronides, cont.)					
		36%		rabbit, 0.5 g/kg, via stomach tube	M-3
ethereal sulfate		27%		rabbit, 0.5 g/kg, via stomach tube	M-2
		27%		rabbit, 0.5 g/kg, via stomach tube	M-3
mercapturic acid		0%		rabbit, 0.5 g/kg, via stomach tube	M-2
		0%		rabbit, 0.5 g/kg, via stomach tube	M-3

Proposed metabolic pathway of 1,2-dichloroethane, Yllner, 1979 (N-1)

$CH_2Cl\text{-}CH_2Cl \rightarrow CH_2Cl\text{-}CH_2OH \rightarrow CH_2ClCOOH \rightarrow$ reaction with glutathione $\rightarrow$

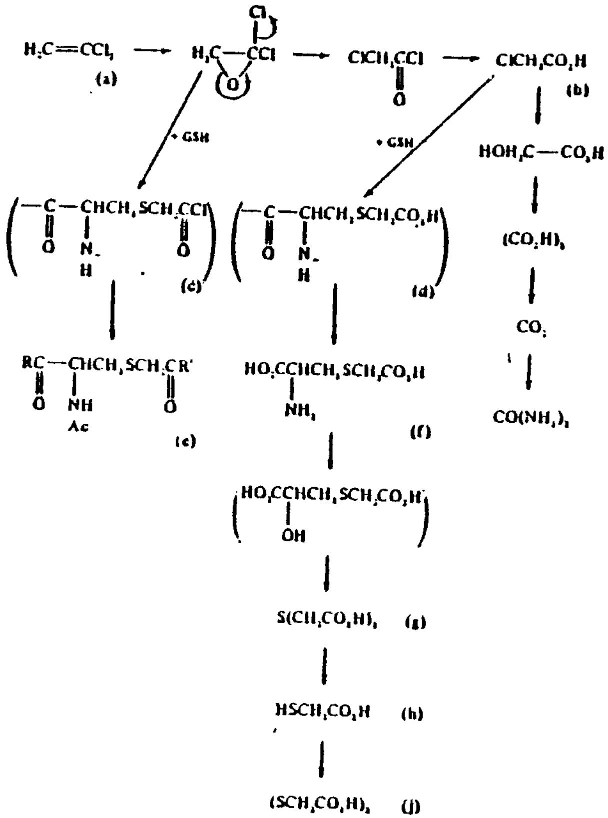
1,2-dichloroethane → chloroethanol → chloroacetic acid → reaction with glutathione →

- S-carboxymethylcysteine (free and conjugated)
- thiodiacetic acid
- S,S'-ethylene-bis-cysteine
- S-(beta-hydroxyethyl)-cysteine
- S-(beta-hydroxyethyl)-cysteine mercapturic acid

	Breath	Urine	Blood	Comments	Ref.
Parent compound:					
^{14}C-1,2-dichloroethane	10-42% of dose (3 days)			mouse, 0.05, 0.10, 0.14 and 0.17 g/kg ^{14}C-1,2-dichloroethane, i.p.	N-1
Half-life of parent compound:	No data	No data	No data		
Metabolites:					
$^{14}CO_2$	12-15% of dose (3 days)			mouse, 0.05, 0.10, 0.14 and 0.17 g/kg ^{14}C-1,2-dichloroethane, i.p.	N-1
chloroacetic acid (a) figure represents the percentage of total radioactivity in urine, rather than percentage of dose. Total 14-C urinary activity was 51-73% of dose.		6-23%(a) (3 days)		mouse, 0.05, 0.10, 0.14 and 0.17 g/kg ^{14}C-1,2-dichloroethane, i.p.	N-1

1,2-DICHLOROETHANE (continued)

	Breath	Urine	Blood	Comments	Ref.
Metabolites (cont.)					
free S-carboxymethylcysteine		44-46%(a) (3 days)		mouse, 0.05, 0.10, 0.14 and 0.17 g/kg ^{14}C-1,2-dichloroethane, i.p.	N-1
thiodiacetic acid		33-34%(a) (3 days)		mouse, 0.05, 0.10, 0.14 and 0.17 g/kg ^{14}C-1,2-dichloroethane, i.p.	N-1
2-chloroethanol		0.0-0.8%(a) (3 days)		mouse, 0.05, 0.10, 0.14 and 0.17 g/kg ^{14}C-1,2-dichloroethane, i.p.	N-1
Metabolite conjugates:					
S-carboxymethylcysteine		0.5-5%(a) (3 days)		mouse, 0.05, 0.10, 0.14 and 0.17 g/kg ^{14}C-1,2-dichloroethane, i.p.	N-1
S,S'-ethylene-bis-cysteine		0.7-1.0%(a) (3 days)		mouse, 0.05, 0.10, 0.14 and 0.17 g/kg ^{14}C-1,2-dichloroethane, i.p.	N-1
S-(beta-hydroxyethyl-mercapturic acid		major metabolite		rat, 100 mg, stomach tube	N-2
S-(beta-hydroxyethyl) cysteine		trace amounts		rat, 100 mg, stomach tube	N-2
^{14}C-activity		51-73% (total for 3 days)		mouse, 0.05, 0.10, 0.14 or 0.17 g/kg ^{14}C-1,2-dichloroethane, i.p.	N-1



a) 1,1- dichloroethylene
b) chloroacetic acid
c) S-chlorocarbonylmethylcysteinyl-glutathione
d) S-carboxymethylcysteinylglutathione
e) N-acetyl-S-cysteinyl acetyl derivative
f) S-carboxymethylcysteine
g) thiodiglycollic acid
h) thioglycollic acid
j) dithioglycollic acid

Metabolic pathway for vinylidene chloride in mammals. From Ref. 0-3

1,1-DICHLOROETHYLENE
(VINYLIDENE CHLORIDE)

	Breath	Urine	Blood	Comments	Ref.
Parent compound: unchanged 1,1-DCE	28%			rat, 50 mg (^{14}C)1,1-DCE per kg, oral	0-3
	20% (72 hrs)			rat, 50 mg (^{14}C)1,1-DCE per kg, oral	0-1
	0.9% (72 hrs)			rat, 0.5 mg (^{14}C)1,1-DCE per kg, oral	0-1
	6%			mouse, 50 mg (^{14}C)1,1-DCE per kg, oral	0-3
^{14}C-activity (a) total elimination; primarily urinary		97-99%(a) (72 hrs post-exposure)		rat, 10ppm (^{14}C) 1,1-DCE, inhalation, 6 hrs	0-2
		92%(a) (72 hrs post-exposure)		fasted rat, 200ppm (^{14}C) 1,1-DCE, inhalation, 6 hrs	0-2
		96%(a) (72 hrs post-exposure)		fed rat, 200ppm (^{14}C)1,1-DCE, inhalation, 6 hrs	0-2
		97-99%(a) (72 hrs)		rat, 1 mg (^{14}C)1,1-DCE per kg, oral dose	0-2
		60-75%(a) (72 hrs)		rat, 50 mg (^{14}C)1,1-DCE per kg, oral dose	0-2
(b) primarily thiodiglycollic acid		52%(b) (72 hrs)		rat, 0.5 mg (^{14}C)1,1-DCE per kg, oral dose	0-1
		36%(b) (72 hrs)		rat, 50 mg (^{14}C)1,1-DCE per kg, oral dose	0-1

1,1-DICHLOROETHYLENE
(VINYLIDENE CHLORIDE) (continued)

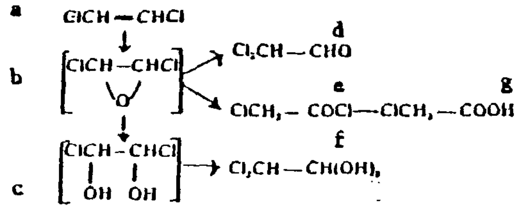
	Breath	Urine	Blood	Comments	Ref.
Half-life of parent compound:	No data	No data	No data		
Metabolites:					
$^{14}CO_2$	23% (72 hrs)			rat, 0.5 mg (^{14}C)1,1-DCE per kg, oral dose	0-1
	6% (72 hrs)			rat, 50 mg (^{14}C)1,1-DCE per kg, oral dose	0-1
	3%			mouse, 50 mg (^{14}C)1,1-DCE per kg, oral dose	0-3
	3.5%			rat, 50 mg (^{14}C)1,1-DCE per kg, oral dose	0-3
Metabolite conjugates:					
chloroacetic acid		1%		rat, 50 mg (^{14}C)1,1-DCE per kg, oral dose	0-3
dithioglycollic acid		23%		mouse, 50 mg (^{14}C)1,1-DCE per kg, oral dose	0-3
		5%		rat, 50 mg (^{14}C)1,1-DCE per kg, oral dose	0-3
N-acetyl-S-(2-carboxymethyl) cysteine		4%		rat, 50 mg (^{14}C)1,1-DCE per kg, oral dose	0-3
N-acetyl-S-cysteinyl acetyl derivative		50%		mouse, 50 mg (^{14}C)1,1-DCE per kg, oral dose	0-3
		28%		rat, 50 mg (^{14}C)1,1-DCE per kg, oral dose	0-3
thiodigylcollic acid		3%		mouse, 50 mg (^{14}C)1,1-DCE per kg, oral dose	0-3

1,1-DICHLOROETHYLENE
(VINYLIDENE CHLORIDE) (continued)

	Breath	Urine	Blood	Comments	Ref.
Metabolite conjugates (cont.)					
(thiodiglycollic acid, cont.)		22%		rat, 50 mg (^{14}C)1,1-DCE per kg, oral dose	0-3
thioglycollic acid		5%		mouse, 50 mg (^{14}C)1,1-DCE per kg, oral dose	0-3
		3%		rat, 0.5 mg (^{14}C)1,1-DCE per kg, oral dose	0-3
thioglycollyloxalic acid		3%		mouse, 50 mg (^{14}C)1,1-DCE per kg, oral dose	0-3
		2%		rat, 50 mg (^{14}C)1,1-DCE per kg, oral dose	0-3
urea		3%		mouse, 50 mg (^{14}C)1,1-DCE per kg, oral dose	0-3
		3.5%		rat, 50 mg (^{14}C)1,1-DCE per kg, oral dose	0-3

1,2-DICHLOROETHYLENE

Proposed metabolic pathway (by analogy to the metabolism of related compounds such as trichloroethylene)

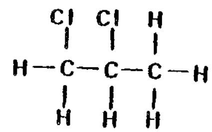


A proposed metabolic pathway of 1,2-dichloroethylene.

a) 1,2-dichloroethylene
b) 1,2-dichloroethylene epoxide
c) 1,2-dichloroglycol
d) dichloroacetaldehyde
e) monochloroacetyl chloride
f) 2,2-dichloro-1,1-ethanediol
g) monochloroacetic acid

No information was available on the distribution of 1,2-dichloroethylene in breath, urine, or blood. An <u>in vitro</u> study using rat liver homogenates reported small amounts of dichloroacetic acid and dichloroethanol after perfusion with cis or trans 1,2-DCE (P-1).

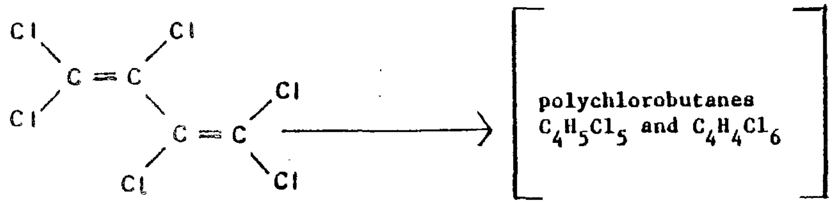
1,2-DICHLOROPROPANE



	Breath	Urine	Blood	Comments	Ref.
Parent compound:					
dichloropropane			0.6-1.1 mg/100 cc blood	rabbit, 1,500 ppm in air, 7 hrs/ day for 5 days	Q-1
			1.5-2.9 mg/100 cc blood	rabbit, 2,200 ppm in air, 7 hrs/ day for 5 days	Q-1
			1.3-1.6 mg/100 cc blood	dog, 1,000 ppm in air, 7 hrs/ day for 5 days	Q-1
volatile chlorinated hydrocarbons, probably unchanged 1,2-dichloro propane	23.1%			rat, 1.07 mg (10.3 uCi) of 1,2- dichloro-(1-^{14}C)propane, single oral dose	Q-2
Half-life of parent compound:	No data	No data	No data		
Metabolites:					
$^{14}CO_2$	19.3%			rat, 1.07 mg (10.3 uCi) of 1,2- dichloro-(1-^{14}C)propane, single dose, by stomach tube	Q-2
radioactive substances		50.2%		rat, 0.88 mg (8.5 uCi) of 1,2- dichloro-(1-^{14}C)propane, in 0.5 ml arachis oil, single oral dose	Q-2
pigment-producing substance		present, but not identified or quantitated		rat, mouse, and guinea pig; dichloro- propane vapors, concentration not stated	Q-1
Metabolite conjugates:	No data	No data	No data		

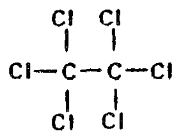
HEXACHLOROBUTADIENE

Based on findings of Murzakaev., (R-1)



hexachlorobutadiene

	Breath	Urine	Blood	Comments	Ref.
Parent compound:	No data	No data	No data		
Half-life of parent compound:	No data	No data	No data		
Metabolites:					
pentachlorobutane	No data	No data	No data		
Metabolite conjugates:	No data	No data	No data		



hexachloroethane

No data were available on the metabolic pathway of hexachloroethane.

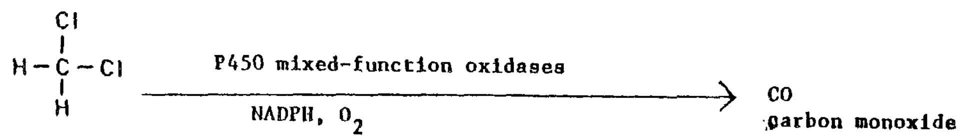
	Breath	Urine	Blood	Comments	Ref.
Parent compound:					
hexachloroethane		50-70 ug/ml (24 hours)	10-28 ug/ml (24 hours)	sheep, 0.5 g/kg, single oral dose	S-2
			0.2 ug/g (6 hrs)	sheep (anaesthetized) 0.5 g/kg, single oral dose	S-2
Half-life of parent compound:	No data	No data	No data		
Metabolites:					
trichloroethanol		1.3% (3 days)		rabbit, 0.5 g of ^{14}C-hexachloroethane/kg body wt., in diet	S-1

HEXACHLOROETHANE (continued)

	Breath	Urine	Blood	Comments	Ref.
Metabolites (cont.)					
trichloroacetic acid		1.3% (3 days)		rabbit, 0.5 g of ^{14}C-hexachloroethane/kg body wt., in diet	S-1
dichloroacetic acid		0.8% (3 days)		rabbit, 0.5 g of ^{14}C-hexachloroethane/kg body wt., in diet	S-1
monochloroacetic acid		0.7% (3 days)		rabbit, 0.5 g of ^{14}C-hexachloroethane/kg body wt., in diet	S-1
dichloroethanol		0.4% (3 days)		rabbit, 0.5 g of ^{14}C-hexachloroethane/kg body wt., in diet	S-1
oxalic acid		0.1% (3 days)		rabbit, 0.5 g of ^{14}C-hexachloroethane/kg body wt., in diet	S-1
volatile metabolites (includes CO_2, C_2Cl_6, tetrachloroethylene and 1,1,2,2-tetrachloroethane)	14-24%			rabbit, 0.5 g of ^{14}C-hexachloroethane/kg body wt., in diet	S-1
tetrachloroethylene		25-29 ug (24 hrs)	0.6-1.1 ug/ml (24 hrs)	sheep, 0.5 g/kg, single oral dose	S-2
			0.2-0.4 ug/ml (6 hrs)	sheep, 0.5 g/kg, single oral dose	S-2
pentachloroethane		20-25 ug (24 hrs)	0.06-0.5 ug/ml (24 hrs)	sheep, 0.5 g/kg, single oral dose	S-2
			0 - trace (6 hrs)	sheep, 0.5 g/kg, single oral dose	S-2
Metabolite conjugates:	No data	No data	No data		

METHYLENE CHLORIDE

Based on findings of Kubic and Anders. 1975. Metabolism of dihalomethanes to carbon monoxide II. Drug Metab. Dispos. 3(2): 104-112.



methylene chloride

	Breath	Urine	Blood	Comments	Ref.
Parent compound:					
^{14}C methylene chloride	77.0%, 92.0% (2 hrs)			rat, 412-930 mg/kg, i.p. Expressed as percentage of original dose. These are values for individual experimental animals.	T-1
	95.3%, 92.6% (8 hrs)			rat, 412-930 mg/kg, i.p. Expressed as percentage of original dose. These are values for individual experimental animals.	T-1
	91.50% (24 hrs)			rat, 412-930 mg/kg, i.p. Expressed as percentage of original dose. These are values for individual experimental animals.	T-1
Half-life for elimination of COHb after methylene chloride exposure			13 hrs.	human, 8 hrs exposure to 180 ppm methylene chloride	T-4

Methylene chloride (continued)

	Breath	Urine	Blood	Comments	Ref.
Metabolites:					
(C^{14})carbon dioxide	0.44%, 0.65% (2 hrs)			rat, 412-930 mg/kg, i.p. Expressed as percentage of original dose. These are values for individual experimental animals.	T-1
	1.44%, 1.61% (8 hrs)			rat, 412-930 mg/kg, i.p. Expressed as percentage of original dose. These are values for individual experimental animals.	T-1
	3.04% (24 hrs)			rat, 412-930 mg/kg, i.p. Expressed as percentage of original dose. These are values for individual experimental animals.	T-1
carbon dioxide	29%			rat, 0.2 mmol/kg ^{14}C-methylene chloride inhalation (8 hrs), closed rebreathing system	T-2
(C^{14})carbon monoxide	0.14%, 0.14% (2 hrs)			rat, 412-930 mg/kg, i.p. Expressed as percentage of original dose. These are values for individual experimental animals	T-1
	1.16%, 1.69% (8 hrs)			rat, 412-930 mg/kg, i.p. Expressed as percentage of original dose. These are values for individual experimental animals	T-1
	2.15% (24 hrs)			rat, 412-930 mg/kg, i.p. Expressed as percentage of original dose. These are values for individual experimental animals	T-1

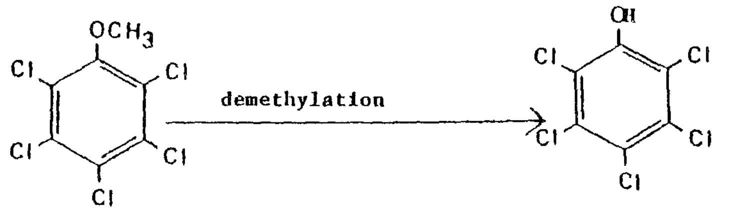
Methylene chloride (continued)

	Breath	Urine	Blood	Comments	Ref.
Metabolites (cont)					
carbon monoxide	47%			rat, 0.2 mmol/kg ^{14}C-methylene chloride inhalation (8 hrs), closed rebreathing system	T-2
			1.5% Hb saturation after 30 min. exposure	human, 213 ppm methylene chloride inhalation (60 min)	T-3
			1.75% Hb saturation after 60 min. exposure	human, 213 ppm methylene chloride inhalation (60 min)	T-3
			2.4% Hb saturation 3 hrs after exposure		
carbon monoxide as carboxyhemoglobin (COHb)			10.1% Hb saturation 1 hr post exposure	human, 986 ppm methylene chloride inhalation (2 hrs)	T-3
			9% Hb saturation	human, 180 ppm, workroom air (8 hrs)	T-4
			6% maximum Hb saturation	rat, 3.0 mmol/kg i.p. (after 2-2.5 hrs)	T-5
			7% maximum Hb saturation	rat, 440 ppm inhalation exposure (3 hrs)	T-6

Methylene chloride (continued)

	Breath	Urine	Blood	Comments	Ref.
Metabolites (cont.)					
(^{14}C)-unidentified compound	0.34%, 0.46% (2 hrs)			rat, 412-930 mg/kg i.p. Expressed as percentage of original dose. These are values for individual experimental animals.	T-1
	0.74%, 0.86% (8 hrs)			rat, 412-930 mg/kg i.p. Expressed as percentage of original dose. These are values for individual experimental animals.	T-1
	1.49% (24 hrs)			rat, 412-930 mg/kg i.p. Expressed as percentage of original dose. These are values for individual experimental animals.	T-1
(^{14}C)-activity representing parent compound and metabolites	75% (2 hrs)			rat, 412-930 mg/kg methylene chloride, i.p. Expressed as percentage of orginial dose.	T-1
	98% (24 hrs)			rat, 412-930 mg/kg methylene chloride, i.p. Expressed as percentage of orginial dose.	T-1
		1.0% (24 hrs)		rat, 412-930 mg/kg methylene chloride, i.p. Expressed as percentage of orginial dose.	T-1
Metabolite conjugates:	No data	No data	No data		

PENTACHLOROANISOLE (PGA)

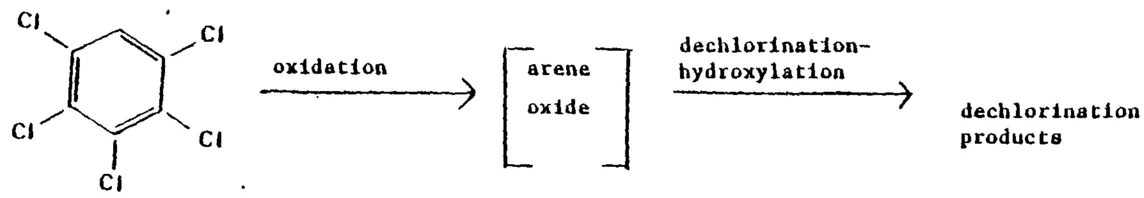


pentachloroanisole

pentachlorophenol

Based on findings of Glickman et al., (U-1)

	Breath	Urine	Blood	Comments	Ref.
Parent Compound:			approx. 1 ug/g (12 hrs)	rainbow trout, 0.024 mg ^{14}C PGA/L H_2O at 12°C for 12 hrs	U-1
Half-life of parent compound:			6.3 days	rainbow trout, 0.024 mg ^{14}C PGA/L H_2O at 12°C for 12 hrs	U-1
Metabolites:	No data	No data	No data		
Metabolite conjugates:	No data	No data	No data		



Metabolism of pentachlorobenzene, based on studies by Kohli et al., 1976 (Can. J. Biochem., 54(3): 203-208).

	Breath	Urine	Blood	Comments	Ref.
Parent Compound:	0			chinchilla doe, 0.5 mg/kg, by stomach tube	V-1
	0			chinchilla doe, 0.5 mg/kg, by subcutaneous injection	
		3% total excretion products (urine + feces)		rat, rate and route of administration unspecified	V-2
Half-life of parent compound:	No data	No data	No data		

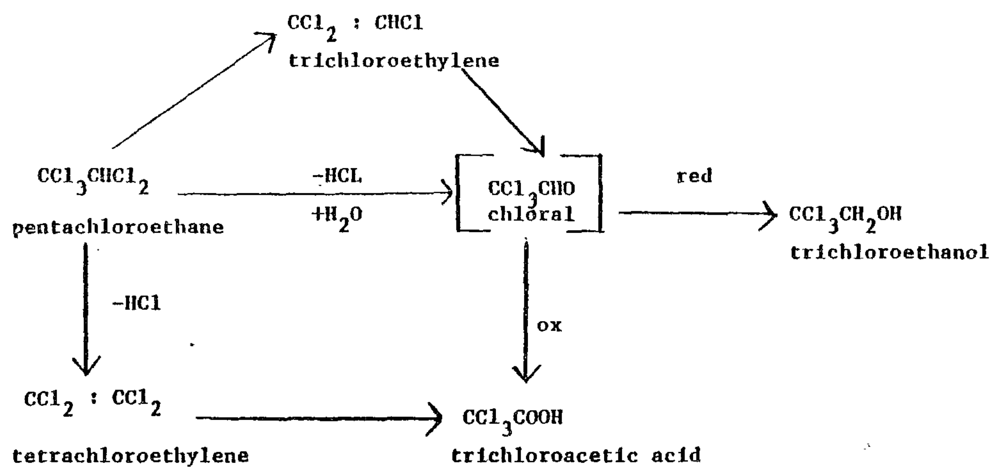
Pentachlorobenzene (continued)

	Breath	Urine	Blood	Comments	Ref.
Metabolites:					
pentachlorophenol		9% total excretion products (urine + feces)		rat, rate and route of administration unspecified	V-2
tetrachlorophenol		unspecified amount		rat, rate and route of administration unspecified	V-2
tetrachlorohydroquinone		unspecified amount		rat, rate and route of administration unspecified	V-2
alpha-hydroxylated chlorothio compound		unspecified amount		rat, rate and route of administration unspecified	V-2
tri- or penta- chlorophenol		0.2% (3 days)		chinchilla doe, 0.5 mg/kg, by stomach tube	V-1
		0.2% (4 days)		chinchilla doe, 0.5 mg/kg, by stomach tube	V-1
		0.7% (7 days)		chinchilla doe, 0.5 mg/kg, by subcutaneous injection	V-1
other phenols		1% (3 and 4 days)		chinchilla doe, 0.5 mg/kg, by stomach tube	V-1
		1% (10 days)		chinchilla doe, 0.5 mg/kg, by subcutaneous injection	V-1
other chlorohydrocarbons	9% (3 days)			chinchilla doe, 0.5 mg/kg, by stomach tube	V-1
	21% (4 days)			chinchilla doe, 0.5 mg/kg, by stomach tube	V-1

Pentachlorobenzene (continued)

	Breath	Urine	Blood	Comments	Ref.
Metabolites (cont.)					
(other chlorohydrocarbons, cont.)	2% (10 days)			chinchilla doe, 0.5 mg/kg, by subcutaneous injection	V-1
Metabolite conjugates:	No data	No data	No data		

PENTACHLOROETHANE



Metabolism of pentachloroethane, from Yllner, 1963 (W-1)

	Breath	Urine	Blood	Comments	Ref.
Parent compound:	present	present		unchanged pentachloroethane in the urine, feces and expired air accounted for approx. 30% (24 hrs) of the 20 ul dose injected subcutaneously in mice	W-1
			greater than 10^{-6} g/ml of of plasma (3 days), venous blood	sheep, 0.3 ml/kg single oral dose	W-2
	12-51% (3 days)			mouse, 1.1-1.8 g/kg injected subcutaneously	W-3

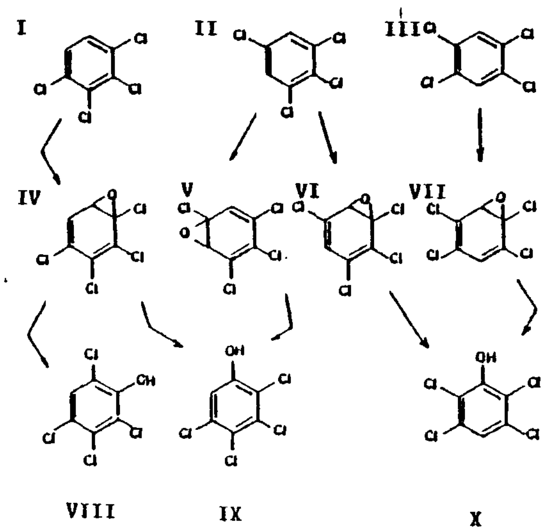
Pentachloroethane (continued)

	Breath	Urine	Blood	Comments	Ref.
Half-life of parent compound:	No data	No data	No data		
Metabolites:					
tetrachloroethylene	present	present		tetrachloroethylene in the urine, feces and expired air accounted for 5% (24 hrs) of the 20 ul dose injected subcutaneously in mice	W-1
			greater than 10^{-6} g/ml of of plasma (3 days), venous blood	sheep, 0.3 ml/kg single oral dose	W-2
	3-9% (3 days)			mouse, 1.1-1.8 g/kg injected subcutaneously	W-3
trichloroethanol	present	present		tetrachloroethanol in the urine, feces and expired air accounted for 10% (24 hrs) of the 20 ul dose injected subcutaneously in mice	W-1
		16-32% (3 days)		mouse, 1.1-1.8 g/kg injected subcutaneously	W-3
trichloroacetic acid	present	present		trichloroacetic acid in the urine, feces and expired air accounted for 5% (24 hrs) of the 20 ul dose injected subcutaneously in mice	W-1
		9-18% (3 days)		mouse, 1.1-1.8 g/kg injected subcutaneously	W-3

Pentachloroethane (continued)

	Breath	Urine	Blood	Comments	Ref.
Metabolites (cont.)					
trichloroethylene	present	present		trichloroethylene in the urine, feces and expired air accounted for less than 5% (24 hrs) of the 20 ul dose injected subcutaneously in mice. The amount was not quantitated, but appeared to be less than the amount of tetrachloroethylene eliminated.	W-1
	2-16% (3 days)			mouse, 1.1-1.8 g/kg injected subcutaneously	W-3
Metabolite conjugates:	No data	No data	No data		

TETRACHLOROBENZENE



I) 1,2,3,4-tetrachlorobenzene
II) 1,2,3,5-tetrachlorobenzene
III) 1,2,3,5-tetrachlorobenzene
IV) 2,3,4,5-tetrachlorobenzene oxide
V) 1,3,4,5-tetrachlorobenzene oxide
VI) 2,3,4,6-tetrachlorobenzene oxide
VII) 2,3,5,6-tetrachlorobenzene oxide
VIII) 2,3,4,6-tetrachlorophenol
IX) 2,3,4,5-tetrachlorophenol
X) 2,3,5,6-tetrachlorophenol

Proposed metabolism of tetrachlorobenzene isomers, from Kohli et al., 1976 (X-1)

	Breath	Urine	Blood	Comments	Ref.
Parent Compound:					
1,2,3,4-isomer	8% (6 days)			chinchilla doe rabbits, 0.5 g/kg by stomach tube	X-2
1,2,4,5-isomer	2% (6 days)			chinchilla doe rabbits, 0.5 g/kg by stomach tube	X-2
1,2,3,5-isomer	12% (6 days)			chinchilla doe rabbits, 0.5 g/kg by stomach tube	X-2

Tetrachlorobenzene (continued)

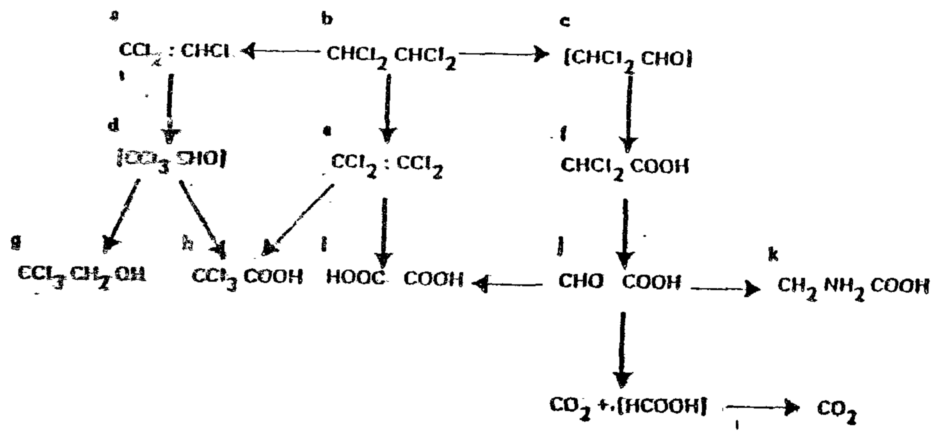
	Breath	Urine	Blood	Comments	Ref.
Half-life of parent compound:	No data	No data	No data		
Metabolites of the 1,2,3,4-isomer:					
2,3,4,5-tetrachloro-phenol		20% (10 days)		male rabbits, 300 mg/rabbit (4-5 kg), by i.p. injection	X-1
		43% (6 days)		chinchilla doe rabbits, 0.5 g/kg, by stomach tube	X-2
other phenols		less than 1% (6 days)		chinchilla doe rabbits, 0.5 g/kg, by stomach tube	X-2
mercapturic acid		less than 1% (6 days)		chinchilla doe rabbits, 0.5 g/kg, by stomach tube	X-2
other chlorobenzenes		2% (2 days)		chinchilla doe rabbits, 0.5 g/kg, by stomach tube	X-2
Metabolites of the 1,2,3,5-isomer:					
2,3,4,5-tetrachloro-phenol		3% (10 days)		male rabbits, 300 mg/rabbit (4-5 kg), by i.p. injection	X-1
2,3,5,6-tetrachloro-phenol		2% (10 days)		male rabbits, 300 mg/rabbit (4-5 kg), by i.p. injection	X-1
2,3,4,6-tetrachloro-phenol		1.5% (10 days)		male rabbits, 300 mg/rabbit (4-5 kg), by i.p. injection	X-1
tetrachlorophenols (predominantly 2,3,4,6-tetrachlorophenol		5% (6 days)		chinchilla doe rabbits, 0.5 g/kg, by stomach tube	X-2

Tetrachlorobenzene (continued)

	Breath	Urine	Blood	Comments	Ref.
Metabolites of the					
1,2,3,5-isomer (cont.)					
other phenols		5% (6 days)		chinchilla doe rabbits, 0.5 g/kg, by stomach tube	X-2
other chlorobenzenes	9% (6 days)			chinchilla doe rabbits, 0.5 g/kg, by stomach tube	X-2
Metabolites of the					
1,2,4,5-isomer:					
tetrachlorophenols		2% (6 days)		chinchilla doe rabbits, 0.5 g/kg by stomach tube	X-2
other phenols		5% (6 days)		chinchilla doe rabbits, 0.5 g/kg by stomach tube	X-2
other chlorobenzenes	10% (6 days)			chinchilla doe rabbits, 0.5 g/kg by stomach tube	X-2
Metabolite conjugates:	No data	No data	No data		

1,1,2,2-TETRACHLOROETHANE

Adapted from the findings of Yllner, (Y-3)



a) trichloroethylene
b) tetrachloroethane
c) dichloroacetaldehyde
d) trichloroacetaldehyde
e) ~~tetrachloroethylene~~
f) dichloroacetic acid
g) trichloroethanol
h) trichloroacetic acid
i) oxalic acid
j) glycine acid
k) glyceine

	Breath	Urine	Blood	Comments	Ref.
Parent compound:					
^{14}C-tetrachloroethane	4% (3 days)		-	mouse, 0.21-0.32 g ^{14}C-tetrachloroethane per kg body wt, i.p. injection	Y-3
Metabolite:					
$^{14}CO_2$	50% (3 days)			mouse, 0.21-0.32 g ^{14}C-tetrachloroethane per kg body wt, i.p. injection	Y-3

1,1,2,2-Tetrachloroethane (continued)

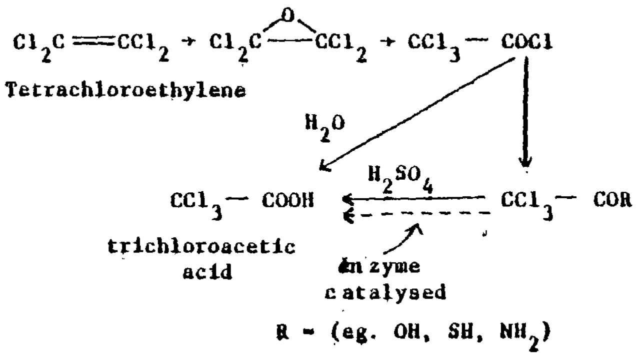
	Breath	Urine	Blood	Comments	Ref.
Metabolites (cont.)					
dichloroacetic acid		27% of urinary activity (24 hrs)		mouse, 0.16-0.32 g ^{14}C-tetrachloroethane per kg body wt, i.p. injection	Y-3
trichloroethanol		10% of urinary activity (24 hrs)		mouse, 0.16-0.32 g ^{14}C-tetrachloroethane per kg body wt, i.p. injection	Y-3
		8.2 mg/kg (48 hrs)		rat, 200 ppm, inhalation exposure (8 hrs)	Y-4
		0.8 mg/kg (48 hrs)		rat, 2.78 mmol/kg body wt, (equivalent to 467 mg/kg), i.p. injection	Y-4
		trace (96 hrs)		rat, 2.78 mmol/kg body wt, (equivalent to 467 mg/kg), i.p. injection	Y-4
oxalic acid		7% of urinary activity (24 hrs)		mouse, 0.16-0.32 g ^{14}C-tetrachloro ethane per kg body wt, i.p. injection	Y-3
trichloroacetic acid		4% of urinary activity (24 hrs)		mouse, 0.16-0.32 g ^{14}C-tetrachloro ethane per kg body wt, i.p. injection	Y-3
		1.7 mg/kg (48 hrs)		rat, 200 ppm, inhalation exposure (8 hrs)	Y-4
		1.3 mg/kg (48 hrs)		rat, 2.78 mmol/kg body wt, (equivalent to 467 mg/kg), i.p. injection	Y-4
		0.3 mg/kg (96 hrs)		rat, 2.78 mmol/kg body wt, (equivalent to 467 mg/kg), i.p. injection	Y-4

1,1,2,2-Tetrachloroethane (continued)

	Breath	Urine	Blood	Comments	Ref.
Metabolites (cont.)					
urea		2% of urinary activity (24 hrs)		mouse, 0.16-0.32 g ^{14}C-tetrachloroethane per kg body wt, i.p. injection	Y-3
glyoxylic acid		0.9% of urinary activity (24 hrs)		mouse, 0.16-0.32 g ^{14}C-tetrachloroethane per kg body wt, i.p. injection	Y-3
chlorinated hydrocarbons		0.5 mg/L of urine		dog, (dose not stated) inhalation exposure (1 hr/day, up to 20 days)	Y-2
		0.5 mg/L of urine		rat, rabbit, and guinea pig (dose not stated), subcutaneous injection	Y-2
^{14}-C activity		28% (3 days)		mouse, 0.21-0.32 g ^{14}C-tetrachloroethane per kg body wt, i.p. injection	Y-3
^{38}Cl-activity	3.3% (1 hr) of retained radioactivity			human, 2.5 mg ^{38}Cl-tetrachloroethane inhaled; 97% of the dose was retained in the lungs	Y-3
Metabolite conjugates:	No data	No data	No data		

Proposed metabolism of Tetrachloroethylene. Bonse et al., (Z-2)

TETRACHLOROETHYLENE



	Breath	Urine	Blood	Comments	Ref.
Parent compound:	1 ppm 14 days after exposure			human, 100 ppm inhalation 7 hrs/ day, 5 days	Z-7
	97.9% (48 hrs)			rat, 1.75 uCi, administered by stomach tube. Expressed as percentage of original dose.	Z-1
Half-life of parent compound:	3 days			human, 100 ppm inhalation 7 hr/ day, 5 days	Z-7
	65 hrs	144 hrs		human, occupational exposure	Z-6
Half-life of metabolites:					
total trichloro compounds		123.3 hrs		human (male), 30-100 ppm, inhalation 8 hrs/day, 5 days/week, occupational exposure	Z-6

Tetrachloroethylene (Continued)

	Breath	Urine	Blood	Comments	Ref.
Half-life of metabolites (cont.)					
(total trichloro compounds, cont.)		190.1 hrs		human (female), 10-20 ppm, inhalation 8 hrs/day, 5 days/week, occupational exposure	Z-6
Metabolites:					
trichloroacetic acid		52%		mouse, 1.3 mg/g body wt, vapor, 2 hrs, exposure. Figure represents percentage of urinary radioactivity. Urinary radioactivity was 20% of absorbed activity.	Z-3
		5.3 mg/kg body wt (48 hrs)		rat, 200 ppm inhalation exposure, 8 hrs	Z-4
		5.5 mg/kg body wt (48 hrs)		rat, 2.78 mmol/kg body wt, i.p.	Z-4
		4-35 mg/L		human, 20-70 ppm, daily, intermittent occupational exposure	Z-4
		32-97 mg/L		human, 200-400 ppm daily, intermitten occupational exposure	Z-4
		1.8% of retained tetrachloroethylene (67 hrs)		human, 87 ppm, inhalation exposure, 3 hrs	Z-5
trichloroethanol		3.2 mg/kg body wt. (48 hrs)		rat, 200 ppm, inhalation exposure, 8 hrs	Z-4

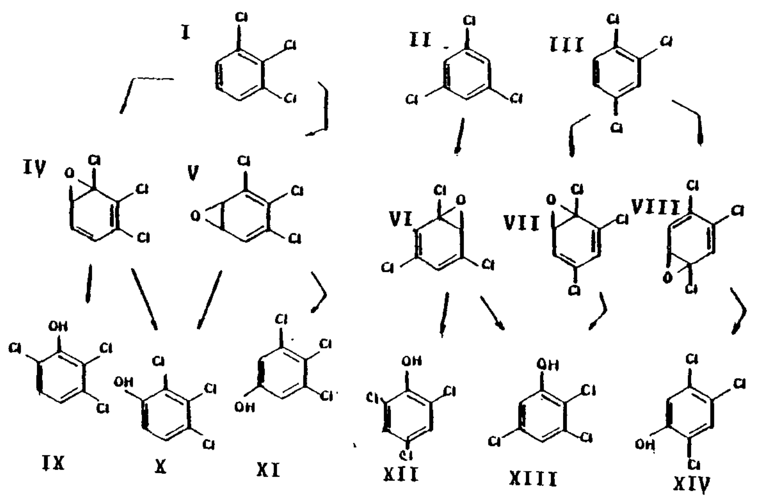
Tetrachloroethylene (continued)

	Breath	Urine	Blood	Comments	Ref.
Metabolites (cont.)					
(trichloroethanol, cont.)		0.08 mg/kg body wt (48 hrs)		rat, 2.78 mmol/kg body wt i.p.	Z-4
		4-20 mg/L		human, 20-70 ppm, daily, intermittent occupational exposure	Z-4
		21-100 mg/L		human, 200-400 ppm, daily, intermittent occupational exposure	Z-4
oxalic acid		11%		mouse, 1.3 mg/g body wt, vapor, 2 hrs exposure. Figure represents percentage of urinary radioactivity. Urinary activity was 20% of absorbed activity.	Z-3
dichloroacetic acid		trace amount		mouse, 1.3 mg/g body wt, vapor, 2 hrs exposure. Figure represents percentage of urinary radioactivity. Urinary activity was 20% of absorbed activity.	Z-3
unknown chloride		1.0% of retained tetrachloro- ethylene (67 hrs)		human, 87 ppm inhalation exposure, 3 hrs	Z-5
^{36}Cl-activity representing parent compound and/or metabolites	97.9% (48 hrs)	2.1% (48 hrs)		rat, 1.75 uCi, administered by stomach tube	Z-1

Tetrachloroethylene (continued)

	Breath	Urine	Blood	Comments	Ref.
Metabolites (cont.)					
^{14}C activity representing parent compound and/or metabolites	70% of absorbed activity	20% of absorbed activity		mouse, 1.3 mg/g body wt inhalation, 2 hrs	Z-3
Metabolite conjugates:	No data	No data	No data		

TRICHLOROBENZENE



I) 1,2,3-trichlorobenzene
II) 1,3,5-trichlorobenzene
III) 1,2,4-trichlorobenzene
IV) 2,3,4-trichlorobenzene oxide
V) 3,4,5-trichlorobenzene oxide
VI) 1,3,5-trichlorobenzene oxide
VII) 2,3,5-trichlorobenzene oxide
VIII) 2,4,5-trichlorobenzene oxide
IX) 2,3,6-trichlorophenol
X) 2,3,4-trichlorophenol
XI) 3,4,5-trichlorophenol
XII) 2,4,6-trichlorophenol
XIII) 2,3,5-trichlorophenol
XIV) 2,4,5-trichlorophenol

Metabolism of trichlorobenzene isomers based studies by Kohli et al., 1976 (AA-2).

	Breath	Urine	Blood	Comments	Ref.
1,2,3 isomer					
Parent compound:	No data	No data	No data		
Half-life of parent compound:	No data	No data	No data		
Metabolites:					
trichlorophenols (primarily 2,3,4-trichlorophenol; smaller amounts of 3,4,5-trichlorophenol and 3,4,5-trichlorocatechol)		78% (5 days)		rabbit, 0.5 g/kg, by stomach tube	AA-1
2,3,4-trichlorophenol		11% (10 days)		rabbit, 300 mg, i.p.	AA-2

Trichlorobenzene (continued)

	Breath	Urine	Blood	Comments	Ref.
Metabolites (cont.)					
2,3,6-trichlorophenol		1% (10 days)		rabbit, 300 mg, i.p.	AA-2
3,4,5-trichlorophenyl acetate		2% (10 days)		rabbit, 300 mg, i.p.	AA-2
Metabolite conjugates:					
glucuronide		50% (5 days)		rabbit, 0.5 g/kg, by stomach tube	AA-1
ethereal sulphate		12% (5 days)		rabbit, 0.5 g/kg by stomach tube	AA-1
2,3,4-trichlorophenyl-mercapturic acid		0.3% (5 days)		rabbit, 0.5 g/kg, by stomach tube	AA-1

Trichlorobenzene (continued)

	Breath	Urine	Blood	Comments	Ref.
<u>1,2,4 isomer</u>					
Parent compound;	No data	No data	No data		
Half-life of parent compound:	No data	No data	No data		
Metabolites:					
trichlorophenols (2,4,5- and 2,3,5-trichlorophenol, plus small amounts of 3,4,6-trichlorocatechol)		42% (5 days)		rabbit, 0.5 g/kg, by stomach tube	AA-1
2,4,5-trichlorophenol		5% (10 days)		rabbit, 300 mg, i.p.	AA-2
2,3,5-trichlorophenol		6% (10 days)		rabbit, 300 mg, i.p.	AA-2
Metabolite conjugates:					
glucuronide		27% (5 days)		rabbit, 0.5 g/kg, by stomach tube	AA-1
ethereal sulphate		11% (5 days)		rabbit, 0.5 g/kg, by stomach tube	AA-1
mercapturic acids (2,3,5- and 2,4,5-trichlorophenyl mercapturic acids)		0.3% (5 days)		rabbit, 0.5 g/kg, by stomach tube	AA-1

Trichlorobenzene (continued)

	Breath	Urine	Blood	Comments	Ref.
1,3,5 isomer:					
Parent compound:	12% (8 days)			rabbit, 0.5 g/kg, by stomach tube	AA-3
	8.5% (9 days)			rabbit, 0.5 g/kg, by stomach tube	AA-3
Half-life of parent compound:	No data	No data	No data		
Metabolites:					
2,4,6-trichlorophenol		9%		rabbit, 0.5 g/kg, by stomach tube	AA-1
		3% (8 days)		rabbit, 0.5 g/kg, by stomach tube	AA-3
		10% (9 days)		rabbit, 0.5 g/kg, by stomach tube	AA-3
other phenols (4-chlorophenol and 4-chlorocatechol)		1% (8 days)		rabbit, 0.5 g/kg, by stomach tube	AA-3
		4% (9 days)		rabbit, 0.5 g/kg, by stomach tube	AA-3
monochlorobenzene	1% (8 or 9 days)			rabbit, 0.5 g/kg, by stomach tube	AA-3
Metabolite conjugates:					
glucuronide		20% (5 days)		rabbit, 0.5 g/kg, by stomach tube	AA-1
ethereal sulphate		3% (5 days)		rabbit, 0.5 g/kg, by stomach tube	AA-1
mercapturic acid		0		rabbit, 0.5 g/kg, by stomach tube	AA-1

$CCl_3CH_3 \xrightarrow{\text{oxidation}} Cl_3CCH_2OH$ (trichloroethanol) $\longrightarrow Cl_3COCOOH$ (trichloroacetic acid)

Proposed formation of urinary metabolites of 1,1,1-trichloroethane, from Ikeda and Ohtsuji, 1972 (AB-2)

	Breath	Urine	Blood	Comments	Ref.
Parent compound:					
(a) alveolar air concentration of 1,1,1-trichloroethane	125 ppm (a) (at rest)			human, 250 ppm exposure, 30 min. per exposure, at rest and with consecutive work loads of 50, 100, and 150 W as measured on a bicycle ergometer	AB-5
	168 ppm (a) (50 W)			human, 250 ppm exposure, 30 min. per exposure, at rest and with consecutive work loads of 50, 100, and 150 W as measured on a bicycle ergometer	AB-5

1,1,1-Trichloroethane (continued)

	Breath	Urine	Blood	Comments	Ref.
Parent compound (cont.)					
	210 ppm (a) (100 W)			human, 250 ppm exposure, 30 min. per exposure, at rest and with consecutive work loads of 50, 100, and 150 W as measured on a bicycle ergometer	AB-5
	27 ppm (a) (150 W)			human, 250 ppm exposure, 30 min. per exposure, at rest and with consecutive work loads of 50, 100, and 150 W as measured on a bicycle ergometer	AB-5
			3.0 ppm arterial blood (at rest)	human, 250 ppm exposure, 30 min. per exposure, at rest and with consecutive work loads of 50, 100, and 150 W as measured on a bicycle ergometer	AB-5
			4.5 ppm arterial blood (50 W)	human, 250 ppm exposure, 30 min. per exposure, at rest and with consecutive work loads of 50, 100, and 150 W as measured on a bicycle ergometer	AB-5
			5.2 ppm arterial blood (100 W)	human, 250 ppm exposure, 30 min. per exposure, at rest and with consecutive work loads of 50, 100, and 150 W as measured on a bicycle ergometer	AB-5
			5.5 ppm arterial blood (150 W)	human, 250 ppm exposure, 30 min. per exposure, at rest and with consecutive work loads of 50, 100, and 150 W as measured on a bicycle ergometer	AB-5

1,1,1-Trichloroethane (continued)

	Breath	Urine	Blood	Comments	Ref.
Parent compound (cont.)					
			1.4 ppm, venous blood (at rest)	human, 250 ppm exposure, 30 min. per exposure, at rest and with consecutive work loads of 50, 100, and 150 W as measured on a bicycle ergometer	AB-5
			3.1 ppm, venous blood (50 W)	human, 250 ppm exposure, 30 min. per exposure, at rest and with consecutive work loads of 50, 100, and 150 W as measured on a bicycle ergometer	AB-5
			3.5 ppm, venous blood (100 W)	human, 250 ppm exposure, 30 min. per exposure, at rest and with consecutive work loads of 50, 100, and 150 W as measured on a bicycle ergometer	AB-5
			4.4 ppm, venous blood (150 W)	human, 250 ppm exposure, 30 min. per exposure, at rest and with consecutive work loads of 50, 100, and 150 W as measured on a bicycle ergometer	AB-5
	179 ppm, alveolar air (at rest)			human, 350 ppm exposure, 30 min. per exposure, at rest and with 50 W work load as measured on a bicycle ergometer	AB-5
	239 ppm, alveolar air (50 W)			human, 350 ppm exposure, 30 min. per exposure, at rest and with 50 W work load as measured on a bicycle ergometer	AB-5

	Breath	Urine	Blood	Comments	Ref.
Parent compound (cont.)					
			5.0 ppm, arterial blood (at rest)	human, 350 ppm exposure, 30 min. per exposure, at rest and with 50 W work load as measured on a bicycle ergometer	AB-5
			7.2 ppm, arterial blood (50 W)	human, 350 ppm exposure, 30 min. per exposure, at rest and with 50 W work load as measured on a bicycle ergometer	AB-5
			3.0 ppm, venous blood (at rest)	human, 350 ppm exposure, 30 min. per exposure, at rest and with 50 W work load as measured on a bicycle ergometer	AB-5
			4.0 ppm venous blood (50 W)	human, 350 ppm exposure, 30 min. per exposure, at rest and with 50 W work load as measured on a bicycle ergometer	AB-5
	128 ppm, alveolar air (at rest)			human, 250 ppm exposure, 30 min. per exposure; at rest, at rest plus 4% CO_2, and 50 W workload plus 4% CO_2	AB-5
	176 ppm, alveolar air (at rest plus 4% CO_2)			human, 250 ppm exposure, 30 min. per exposure; at rest, at rest plus 4% CO_2, and 50 W workload plus 4% CO_2	AB-5
	201 ppm, alveolar air (50 W plus 4% CO_2)			human, 250 ppm exposure, 30 min. per exposure; at rest, at rest plus 4% CO_2, and 50 W workload plus 4% CO_2	AB-5

1,1,1-Trichloroethane (continued)

	Breath	Urine	Blood	Comments	Ref.
Parent compound (cont.)					
			2.2 ppm, arterial blood (at rest)	human, 250 ppm exposure, 30 min. per exposure; at rest, at rest plus 4% CO_2, and 50 W workload plus 4% CO_2	AB-5
			3.3 ppm, arterial blood (at rest plus 4% CO_2)	human, 250 ppm exposure, 30 min. per exposure; at rest, at rest plus 4% CO_2, and 50 W workload plus 4% CO_2	AB-5
			3.9 ppm, arterial blood (50 W plus 4% CO_2)	human, 250 ppm exposure, 30 min. per exposure; at rest, at rest plus 4% CO_2, and 50 W workload plus 4% CO_2	AB-5
			1.0 ppm, venous blood (at rest)	human, 250 ppm exposure, 30 min. per exposure; at rest, at rest plus 4% CO_2, and 50 W workload plus 4% CO_2	AB-5
			1.2 ppm, venous blood (at rest plus 4% CO_2)	human, 250 ppm exposure, 30 min. per exposure; at rest, at rest plus 4% CO_2, and 50 W workload plus 4% CO_2	AB-5
			1.9 ppm, venous blood (50 W plus 4% CO_2)	human, 250 ppm exposure, 30 min. per exposure; at rest, at rest plus 4% CO_2, and 50 W workload plus 4% CO_2	AB-5

1,1,1-Trichloroethane (continued)

	Breath	Urine	Blood	Comments	Ref.
Parent compound (cont.)					
	98.7% (25 hrs)			rat, 700 mg 1,1,1-trichloroethane-1-C^{14} per kg, i.p.	AB-1
	2.488 mg (1st hr)			rat, 221 ppm, inhalation exposure (4 hrs); expired air level of parent compound measured hourly	AB-3
	1.156 mg (2nd hr)			rat, 221 ppm, inhalation exposure (4 hrs); expired air level of parent compound measured hourly	AB-3
	0.589 mg (3rd hr)			rat, 221 ppm, inhalation exposure (4 hrs); expired air level of parent compound measured hourly	AB-3
	0.309 mg (4th hr)			rat, 221 ppm, inhalation exposure (4 hrs); expired air level of parent compound measured hourly	AB-3
	0.191 mg (5th hr)			rat, 221 ppm, inhalation exposure (4 hrs); expired air level of parent compound measured hourly	AB-3
	0.117 mg (6th hr)			rat, 221 ppm, inhalation exposure (4 hrs); expired air level of parent compound measured hourly	AB-3
	0.073 mg (7th hr)			rat, 221 ppm, inhalation exposure (4 hrs); expired air level of parent compound measured hourly	AB-3
	0.050 mg (8th hr)			rat, 221 ppm, inhalation exposure (4 hrs); expired air level of parent compound measured hourly	AB-3

1,1,1-Trichloroethane (continued)

	Breath	Urine	Blood	Comments	Ref.
Parent compound (cont.)					
	5.719 mg (1st hr)			rat, 443 ppm, inhalation exposure (4 hrs); expired air level of parent compound measured hourly	AB-3
	3.350 mg (2nd hr)			rat, 443 ppm, inhalation exposure (4 hrs); expired air level of parent compound measured hourly	AB-3
	1.539 mg (3rd hr)			rat, 443 ppm, inhalation exposure (4 hrs); expired air level of parent compound measured hourly	AB-3
	0.793 mg (4th hr)			rat, 443 ppm, inhalation exposure (4 hrs); expired air level of parent compound measured hourly	AB-3
	0.441 mg (5th hr)			rat, 443 ppm, inhalation exposure (4 hrs); expired air level of parent compound measured hourly	AB-3
	0.259 mg (6th hr)			rat, 443 ppm, inhalation exposure (4 hrs); expired air level of parent compound measured hourly	AB-3
	0.154 mg (7th hr)			rat, 443 ppm, inhalation exposure (4 hrs); expired air level of parent compound measured hourly	AB-3
	0.098 mg (8th hr)			rat, 443 ppm, inhalation exposure (4 hrs); expired air level of parent compound measured hourly	AB-3

1,1,1-Trichloroethane (continued)

	Breath	Urine	Blood	Comments	Ref.
Parent compound (cont.)					
			0.677-1.000 ug/ml	rat, 204 ppm inhalation exposure, 8 hrs/day, 5 days/week, 14 weeks; blood concentration of parent compound determined periodically for duration of exposure	AB-3
			0.08 nmol/g (17 hrs after last exposure)	rat, 20 umol/L (500 ppm), inhalation exposure, 6 hrs/day, 4 days	AB-8
			8.5 to 13.1 nmol/g (immediately after 2-6 hrs additional exposure on day 5)	rat, 20 umol/L (500 ppm), inhalation exposure, 6 hrs/day, 4 days	AB-8
			0.15 ug/g (3 hrs)	mouse, 10 ppm inhalation exposure for 3, 6, or 24 hours	AB-9
			0.47 ug/g (6 hrs)	mouse, 10 ppm inhalation exposure for 3, 6, or 24 hours	AB-9
			0.60 ug/g (24 hrs)	mouse, 10 ppm inhalation exposure for 3, 6, or 24 hours	AB-9
			3.0 ug/g (0.5 hr)	mouse, 100 ppm inhalation exposure for various exposure periods	AB-9
			4.8 ug/g (1 hr)	mouse, 100 ppm inhalation exposure for various exposure periods	AB-9
			4.2 ug/g (2 hrs)	mouse, 100 ppm inhalation exposure for various exposure periods	AB-9

1,1,1-Trichloroethane (continued)

	Breath	Urine	Blood	Comments	Ref.
Parent compound (cont.)					
			4.5 ug/g (3 hrs)	mouse, 100 ppm inhalation exposure for various exposure periods	AB-9
			8.1 ug/g (4 hrs)	mouse, 100 ppm inhalation exposure for various exposure periods	AB-9
			5.6 ug/g (4.5 hrs)	mouse, 100 ppm inhalation exposure for various exposure periods	AB-9
			6.2 ug/g (5 hrs)	mouse, 100 ppm inhalation exposure for various exposure periods	AB-9
			6.0 ug/g (6 hrs)	mouse, 100 ppm inhalation exposure for various exposure periods	AB-9
			5.8 ug/g (16 hrs)	mouse, 100 ppm inhalation exposure for various exposure periods	AB-9
			6.3 ug/g (24 hrs)	mouse, 100 ppm inhalation exposure for various exposure periods	AB-9
			31 ug/g (0.5 hr exposure)	mouse, 1000 ppm inhalation exposure for 0.5, 1, 3, 4.5, or 6 hours	AB-9
			38 ug/g (1 hr exposure)	mouse, 1000 ppm inhalation exposure for 0.5, 1, 3, 4.5, or 6 hours	AB-9
			41 ug/g (3 hrs exposure)	mouse, 1000 ppm inhalation exposure for 0.5, 1, 3, 4.5, or 6 hours	AB-9
			48 ug/g (4.5 hrs exposure)	mouse, 1000 ppm inhalation exposure for 0.5, 1, 3, 4.5, or 6 hours	AB-9
			36 ug/g (6 hrs exposure)	mouse, 1000 ppm inhalation exposure for 0.5, 1, 3, 4.5, or 6 hours	AB-9

1,1,1-Trichloroethane (continued)

	Breath	Urine	Blood	Comments	Ref.
Parent compound (cont.)					
			103 ug/g (0.5 hr exposure)	mouse, 5,000 ppm inhalation exposure, for 0.5, 1, or 3 hours	AB-9
			144 ug/g (1 hr exposure)	mouse, 5,000 ppm inhalation exposure, for 0.5, 1, or 3 hours	AB-9
			165 ug/g (3 hrs exposure)	mouse, 5,000 ppm inhalation exposure, for 0.5, 1, or 3 hours	AB-9
			251 ug/g (0.5 hr exposure)	mouse, 10,000 inhalation exposure for 0.5, 3, or 6 hours	AB-9
			204 ug/g (3 hrs exposure)	mouse, 10,000 inhalation exposure for 0.5, 3, or 6 hours	AB-9
			404 ug/g (6 hrs exposure)	mouse, 10,000 inhalation exposure for 0.5, 3, or 6 hours	AB-9
Half-life of parent compound:		8.7 hrs (average)		human, occupational inhalation exposure to 4, 25, 28, or 53 ppm, for 8 hrs/day, 5-1/2 days/week, for at least 5 years (average)	AB-7
Metabolites:					
$^{14}CO_2$	0.5% (25 hrs)			rat, 700 mg 1,1,1-trichloroethane-1-C^{14} per kg, i.p.	AB-1
trichloroethanol		20.1 mg/24 hrs (1st day)		human, 500 ppm inhalation exposure 6 1/2-7 hrs/day, 5 days	AB-6
		30.1 mg/24 hrs (2nd day)		human, 500 ppm inhalation exposure 6 1/2-7 hrs/day, 5 days	AB-6

	Breath	Urine	Blood	Comments	Ref.
Metabolites (cont.)					
(trichloroethanol, cont.)		29.3 mg/24 hrs (3rd day)		human, 500 ppm inhalation exposure 6 1/2-7 hrs/day, 5 days	AB-6
		46.6 mg/24 hrs (4th day)		human, 500 ppm inhalation exposure 6 1/2-7 hrs/day, 5 days	AB-6
		7.0 mg/24 hrs (6th day after last exposure)		human, 500 ppm inhalation exposure 6 1/2-7 hrs/day, 5 days	AB-6
		less than 1.0 mg/24 hrs (12th day after last exposure)		human, 500 ppm inhalation exposure 6 1/2-7 hrs/day, 5 days	AB-6
		1.2 mg/L (4.3 ppm exposure)		human, occupational inhalation exposure to 4.3, 24.6, or 53.4 ppm for 8 hrs/day, 5 1/2 days/week, for at least 5 years	AB-7
		5.5 mg/L (24.6 ppm exposure)		human, occupational inhalation exposure to 4.3, 24.6, or 53.4 ppm for 8 hrs/day, 5 1/2 days/week, for at least 5 years	AB-7
		9.9 mg/L (53.4 ppm exposure)		human, occupational inhalation exposure to 4.3, 24.6, or 53.4 ppm for 8 hrs/day, 5 1/2 days/week, for at least 5 years	AB-7

	Breath	Urine	Blood	Comments	Ref.
Metabolites (cont.)					
(trichloroethanol, cont.)		3.1 mg/kg (48 hrs)		rat, 200 ppm inhalation exposure 8 hours	AB-2
		3.5 mg/kg (48 hrs)		rat, 2.78 mmol/kg, i.p.	AB-2
		126.2 ug (24 hrs)		rat, 221 ppm inhalation exposure 4 hours	AB-3
		7.5 ug (2nd 24-hr period)		rat, 221 ppm inhalation exposure, 4 hours	AB-3
		206.5 ug (24 hrs)		rat, 443 ppm inhalation exposure, 4 hrs	AB-3
		8.6 ug (2nd 24-hr period)		rat, 443 ppm inhalation exposure, 4 hrs	AB-3
			0.088 ug/ml (week 1)	rat, chronic inhalation exposure, 204 ppm for 8 hrs/day, 5 days/week for 14 weeks; trichloroethanol in blood measured periodically during exposure at 1,2,4 and 9 weeks	AB-3
			0.063 ug/ml (week 2)	rat, chronic inhalation exposure, 204 ppm for 8 hrs/day, 5 days/week for 14 weeks; trichloroethanol in blood measured periodically during exposure at 1,2,4 and 9 weeks	AB-3

1,1,1-Trichloroethane (continued)

	Breath	Urine	Blood	Comments	Ref.
Metabolites (cont.)					
(trichloroethanol, cont.)			0.059 ug/ml (week 4)	rat, chronic inhalation exposure, 204 ppm for 8 hrs/day, 5 days/week for 14 weeks; trichloroethanol in blood measured periodically during exposure at 1,2,4 and 9 weeks	AB-3
			0.071 ug/ml (week 9)	rat, chronic inhalation exposure, 204 ppm for 8 hrs/day, 5 days/week for 14 weeks; trichloroethanol in blood measured periodically during exposure at 1,2,4 and 9 weeks	AB-3
		93.0 ug/24 hrs (week 1)		rat, chronic inhalation exposure, 204 ppm for 8 hrs/day, 5 days/week for 14 weeks, trichloroethanol in urine measured weekly	AB-3
		222.9 ug/24 hrs (week 2)		rat, chronic inhalation exposure, 204 ppm for 8 hrs/day, 5 days/week for 14 weeks, trichloroethanol in urine measured weekly	AB-3
		189.8 ug/24 hrs (week 3)		rat, chronic inhalation exposure, 204 ppm for 8 hrs/day, 5 days/week for 14 weeks, trichloroethanol in urine measured weekly	AB-3
		216.3 ug/24 hrs (week 4)		rat, chronic inhalation exposure, 204 ppm for 8 hrs/day, 5 days/week for 14 weeks, trichloroethanol in urine measured weekly	AB-3

1,1,1-Trichloroethane (continued)

	Breath	Urine	Blood	Comments	Ref.
Metabolites (cont.)					
(trichloroethanol, cont.)		254.5 ug/24 hrs (week 5)		rat, chronic inhalation exposure, 204 ppm for 8 hrs/day, 5 days/week for 14 weeks, trichloroethanol in urine measured weekly	AB-3
		194.1 ug/24 hrs (week 6)		rat, chronic inhalation exposure, 204 ppm for 8 hrs/day, 5 days/week for 14 weeks, trichloroethanol in urine measured weekly	AB-3
		302.8 ug/24 hrs (week 7)		rat, chronic inhalation exposure, 204 ppm for 8 hrs/day, 5 days/week for 14 weeks, trichloroethanol in urine measured weekly	AB-3
		339.0 ug/24 hrs (week 8)		rat, chronic inhalation exposure, 204 ppm for 8 hrs/day, 5 days/week for 14 weeks, trichloroethanol in urine measured weekly	AB-3
		383.9 ug/24 hrs (week 9)		rat, chronic inhalation exposure, 204 ppm for 8 hrs/day, 5 days/week for 14 weeks, trichloroethanol in urine measured weekly	AB-3
		435.1 ug/24 hrs (week 10)		rat, chronic inhalation exposure, 204 ppm for 8 hrs/day, 5 days/week for 14 weeks, trichloroethanol in urine measured weekly	AB-3

1,1,1-Trichloroethane (continued)

	Breath	Urine	Blood	Comments	Ref.
Metabolites, (cont.)					
(trichloroethanol, cont.)		305.7 ug/24 hrs (week 11)		rat, chronic inhalation exposure, 204 ppm for 8 hrs/day, 5 days/week for 14 weeks, trichloroethanol in urine measured weekly	AB-3
		291.7 ug/24 hrs (week 12)		rat, chronic inhalation exposure, 204 ppm for 8 hrs/day, 5 days/week for 14 weeks, trichloroethanol in urine measured weekly	AB-3
		372.2 ug/24 hrs (week 13)		rat, chronic inhalation exposure, 204 ppm for 8 hrs/day, 5 days/week for 14 weeks, trichloroethanol in urine measured weekly	AB-3
		362.2 ug/24 hrs (week 14)		rat, chronic inhalation exposure, 204 ppm for 8 hrs/day, 5 days/week for 14 weeks, trichloroethanol in urine measured weekly	AB-3
trichloroacetic acid		7.5 mg/24 hrs (1st day)		human, 500 ppm, inhalation exposure, 6 1/2-7 hrs/day, 5 days	AB-6
		10.9 mg/24 hrs (2nd day)		human, 500 ppm, inhalation exposure, 6 1/2-7 hrs/day, 5 days	AB-6
		12.3 mg/24 hrs (3rd day)		human, 500 ppm, inhalation exposure, 6 1/2-7 hrs/day, 5 days	AB-6
		14.1 mg/24 hrs (4th day)		human, 500 ppm, inhalation exposure, 6 1/2-7 hrs/day, 5 days	AB-6

1,1,1-Trichloroethane (continued)

	Breath	Urine	Blood	Comments	Ref.
Metabolites (cont.)					
(trichloroacetic acid, cont.)		18.0 mg/24 hrs (6th day after last exposure)		human, 500 ppm, inhalation exposure, 6 1/2-7 hrs/day, 5 days	AB-6
		17.5 mg/24 hrs (12th day after last exposure		human, 500 ppm, inhalation exposure, 6 1/2-7 hrs/day, 5 days	AB-6
		0.6 mg/L (4.3 ppm exposure)		human, occupational inhalation exposure to 4.3, 24.6, or 53.4 ppm for 8 hrs/day, 5 1/2 days/week, for at least 5 years	AB-7
		2.4 mg/L (24.6 ppm exposure)		human, occupational inhalation exposure to 4.3, 24.6, or 53.4 ppm for 8 hrs/day, 5 1/2 days/week, for at least 5 years	AB-7
		3.6 mg/L (53.4 ppm exposure)		human, occupational inhalation exposure to 4.3, 24.6, or 53.4 ppm for 8 hrs/day, 5 1/2 days/week, for at least 5 years	AB-7
		0.5 mg/kg body wt (48 hrs)		rat, 200 ppm inhalation exposure, 8 hours	AB-2
		0.5 mg/kg body wt (48 hrs)		rat, 2.78 mmol/kg, i.p.	AB-2

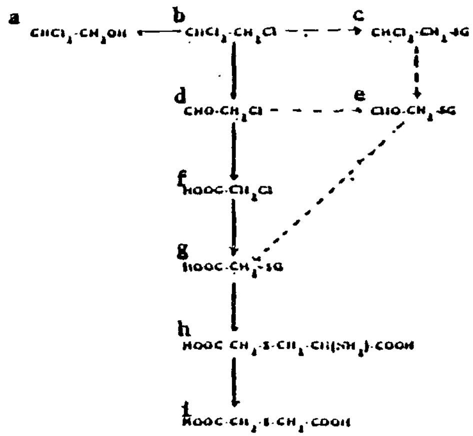
1,1,1-Trichloroethane (continued)

	Breath	Urine	Blood	Comments	Ref.
Metabolites (cont.)					
(trichloroacetic acid, cont.)		0.3 mg/kg body wt (2nd 48-) hr period)		rat, 2.78 mmol/kg, i.p.	AB-2
		3.2 ug (24 hrs)		rat, 221 ppm inhalation exposure, 4 hrs	AB-3
		8.1 ug (2nd 24-) hr period)		rat, 221 ppm inhalation exposure, 4 hrs	AB-3
		9.5 ug (24 hrs)		rat, 443 ppm inhalation exposure, 4 hours	AB-3
		10.6 ug (2nd 24- hr period)		rat, 443 ppm inhalation exposure, 4 hours	AB-3
		7.5 ug (3rd 24- hr period)		rat, 443 ppm inhalation exposure, 4 hours	AB-3
		12-20 ug (daily average)		rat, 204 ppm inhalation exposure, 8 hrs/day, 5 days/week, for 14 weeks	AB-3

1,1,1-Trichloroethane (continued)

	Breath	Urine	Blood	Comments	Ref.
Metabolite conjugates:					
^{14}C-activity, primarily 2,2,2-trichloroethanol -2-C^{14} glucuronide		0.85% (24 hrs)		rat, 700 mg 1,1,1-trichloroethane -1-C^{14} per kg, i.p.	AB-1
Other:					
^{38}Cl-activity	44%			human, 5 mg ^{38}Cl-1,1,1-trichloroethane, inhalation (single breath)	AB-4
^{14}C-activity			0.02% (25 hrs)	rat, 700 mg 1,1,1-trichloroethane-1-C^{14} per kg, i.p.	AB-1

1,1,2-TRICHLOROETHANE



a) 2,2-dichloroethanol
b) 1,1,2-trichloroethane
c) S-(2,2-dichloroethyl)-glutathione
d) chloroacetaldehyde
e) S-formylmethylglutathione
f) chloroacetic acid
g) S-carboxymethylglutathione
h) S-carboxymethylcysteine
i) thiodiacetic acid

The full arrows indicate the suggested routes and the dotted arrows the alternatives.

Metabolic fate of 1,1,2-trichloroethane. (From ref. AC-1)

	Breath	Urine	Blood	Comments	Ref.
Parent compound:	approx. 6.4-8.8% (3 days)			mouse, 0.1-0.2 g ^{14}C-1,1,2-trichloroethane per kg, i.p.	AC-1
Half-life of parent compound:	No data	No data	No data		
Metabolites:					
$^{14}CO_2$	approx. 9.6-13.2% (3 days)			mouse, 0.1-0.2 g ^{14}C-1,1,2-trichloroethane per kg, i.p.	AC-1

1,1,2-Trichloroethane (continued)

	Breath	Urine	Blood	Comments	Ref.
Metabolites (cont.)					
trichloroethanol		0.3 mg/kg body wt (48 hrs from start of exposure)		rat, 200 ppm inhalation exposure, 8 hours	AC-2
		0.2 mg/kg body wt (48 hrs from start of exposure)		rat, 2.78 mmol/kg, i.p.	AC-2
		trace (2nd 48-hr period		rat, 2.78 mmol/kg, i.p.	AC-2
2,2,2-trichloroethanol		0.2% of total urinary radiocativity; equivalent to about 0.16% of ^{14}C-1,1,2-trichloroethane dose (3 days)		mouse, 0.1-0.2 g of ^{14}C-1,1,2-trichloroethane, i.p.	AC-1
2,2,-dichloroethanol		1.4% of total urinary radiocativity; equivalent to about 1.12% of ^{14}C-1,1,2-trichloroethane dose (3 days)		mouse, 0.1-0.2 g of ^{14}C-1,1,2-trichloroethane, i.p.	AC-1

1,1,2-Trichloroethane (continued)

	Breath	Urine	Blood	Comments	Ref.
Metabolites (cont.)					
trichloroacetic acid		0.3 mg/kg body wt (48 hrs from start of exposure)		rat, 200 ppm inhalation exposure, 8 hours	AC-2
		0.4 mg/kg body wt (48 hrs)		rat, 2.78 mmol/kg, i.p.	AC-2
		0.3 mg/kg body wt (2nd 48-hr period)		rat, 2.78 mmol/kg, i.p.	AC-2
		1.9% of total urinary radioactivity; equivalent to about 1.52% of ^{14}C-1,1,2-trichloroethane dose (3 days)		mouse, 0.1-0.2 g of ^{14}C-1,1,2-trichloroethane, i.p.	AC-1
chloroacetic acid		16.% of total urinary radioactivity; equivalent to about 12.78% of ^{14}C-1,1,2-trichloroethane dose (3 days)		mouse, 0.1-0.2 g of ^{14}C-1,1,2-trichloroethane, i.p.	AC-1

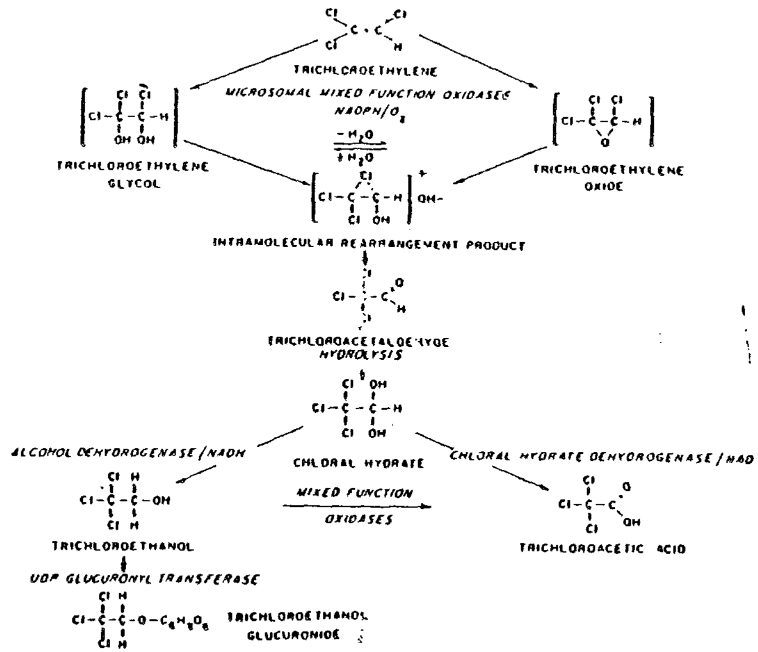
1,1,2-Trichloroethane (continued)

	Breath	Urine	Blood	Comments	Ref.
Metabolites (cont.)					
S-carboxymethylcysteine		38.% of total urinary radio-activity; equiv-alent to about 30.36% of ^{14}C-1,1,2-trichloro-ethane dose (3 days)		mouse, 0.1-0.2 g of ^{14}C-1,1,2-trichloroethane, i.p.	AC-1
conjugated S-carboxy-methylcysteine		5.% of total urinary radio-activity; equiv-alent to about 4.0% of ^{14}C-1,1,2-trichloro-ethane dose (3 days)		mouse, 0.1-0.2 g of ^{14}C-1,1,2-trichloroethane, i.p.	AC-1
thiodiacetic acid		40% of total urinary radio-activity; equiv-alent to about 31.96% of ^{14}C-1,1,2-trichloro-ethane dose (3 days)		mouse, 0.1-0.2 g of ^{14}C-1,1,2-trichloroethane, i.p.	AC-1
oxalic acid		0.4% of total urinary radio-activity; equiv-alent to about 0.32% of ^{14}C-1,1,2-trichloro-ethane dose (3 days)		mouse, 0.1-0.2 g of ^{14}C-1,1,2-trichloroethane, i.p.	AC-1

1,1,2-Trichloroethane (continued)

	Breath	Urine	Blood	Comments	Ref.
Other:					
^{38}Cl radioactivity	2.9% (1 hr)			human, about 5 mg of ^{38}Cl-1,1,2-trichloroethane, inhaled in a single breath	AC-3

TRICHLOROETHYLENE
(TCE)



Proposed intermediary metabolism of TCE. (AD-1)

	Breath	Urine	Blood	Comments	Ref.
Parent compound:	27.7% of retained TCE			human, male, inhalation exposure, concentration of TCE not stated	AD-8
	18.6% of retained TCE			human, female, inhalation exposure, concentration of TCE not stated	AD-8
	25.% of inhaled TCE concentration			human, 0.537 or 1.074 ppm inhalation, for 30 min., at rest	AD-7
	19.% of retained TCE			human, male, 27 ppm inhalation exposure, 4 hours	AD-5
	16.% of retained TCE			human, male, 81 ppm inhalation exposure, 4 hours	AD-5

Trichloroethylene (continued)

	Breath	Urine	Blood	Comments	Ref.
Parent compound (cont.)					
	13.% of retained TCE			human, male, 201 ppm inhalation exposure, 4 hours	AD-5
	19.2% of retained TCE			human, male, 320 ppm inhalation exposure, 160 min	AD-4
	12.7% of retained TCE			human, female, 320 ppm inhalation exposure, 160 min	AD-4
	10% of retained TCE			human, male, 70 or 140 ppm inhalation exposure, with or without 100 W workload, for 4 hours	AD-6
	8% of retained TCE			human, male, 54 or 97 ppm inhalation exposure, 8 hours	AD-3
	72.1%			rat, 4.0 uCi of ^{38}Cl-trichloroethylene, by stomach tube	AD-2
	82.3%			rat, 7.5 uCi of ^{38}Cl-trichloroethylene, by stomach tube	AD-2
	84.8%			rat, 8.6 uCi of ^{38}Cl-trichloroethylene, by stomach tube	AD-2
			41.3 mg% (in blood cellular components)	rat, 10 mg/L, inhalation (exposure period not stated)	AD-1

Trichloroethylene (continued)

	Breath	Urine	Blood	Comments	Ref.
Parent compound (cont.)					
			2.5 mg% in blood plasma	rat, 10 mg/L, inhalation (exposure period not stated)	AD-1
		trace amount		calf, 3 or 12 g, oral dose, daily for 4 or 5 days	AD-14 and AD-15
Half-life of parent compound:	No data	No data	No data		
Metabolites:					
trichloroethanol		50% total amount excreted (350 hrs, avg.)		humans, male and female, 500-850 ug/L inhalation exposure for 5 hours	AD-9
		45.4% (3 weeks)		humans, male and female, 1042 ug/L inhalation exposure for 8 hours	AD-10
		32.7% (several weeks)		human, male, 54 or 97 ppm inhalation exposure for 8 hours	AD-3
		48.6% of of retained TCE (6 days)		human, male, 250-380 ppm inhalation exposure, 160 minutes	AD-4
		42.7% of of retained TCE (6 days)		human, female, 250-380 ppm inhalation exposure, 160 minutes	AD-4
		53.1% (100 hrs)		human, male, 170 ppm inhalation exposure for 3 hours	AD-11

Trichloroethylene (continued)

	Breath	Urine	Blood	Comments	Ref.
Metabolites (cont.)					
(trichloroethanol, cont.)		44% (100 hrs)		human, male, 170 ppm inhalation exposure for 7 hours (with a 1-hour break)	AD-11
		46.1% (16 or 21 days)		human, female, 1 mg/L inhalation exposure for 5 hours	AD-12
		25.1 mg/L (3 ppm exposure)		human, male, occupational exposure (8 hrs/day, 6 days/week) to various concentrations of TCE, specified in parentheses	AD-13
		24.9 mg/L (5 ppm exposure)		human, male, occupational exposure (8 hrs/day, 6 days/week) to various concentrations of TCE, specified in parentheses	AD-13
		42.0 mg/L (10 ppm exposure)		human, male, occupational exposure (8 hrs/day, 6 days/week) to various concentrations of TCE, specified in parentheses	AD-13
		77.3 mg/L (25 ppm exposure)		human, male, occupational exposure (8 hrs/day, 6 days/week) to various concentrations of TCE, specified in parentheses	AD-13
		220.3 mg/L (40 ppm exposure)		human, male, occupational exposure (8 hrs/day, 6 days/week) to various concentrations of TCE, specified in parentheses	AD-13

	Breath	Urine	Blood	Comments	Ref.
Metabolites (cont.)					
(trichloroethanol, cont.)					
		256.7 mg/L (45 ppm exposure)		human, male, occupational exposure (8 hrs/day, 6 days/week) to various concentrations of TCE, specified in parentheses	AD-13
		267.3 mg/L (50 ppm exposure)		human, male, occupational exposure (8 hrs/day, 6 days/week) to various concentrations of TCE, specified in parentheses	AD-13
		307.7 mg/L (60 ppm exposure)		human, male, occupational exposure (8 hrs/day, 6 days/week) to various concentrations of TCE, specified in parentheses	AD-13
		681.8 mg/L (120 ppm exposure)		human, male, occupational exposure (8 hrs/day, 6 days/week) to various concentrations of TCE, specified in parentheses	AD-13
		973.1 mg/L (175 ppm exposure)		human, male, occupational exposure (8 hrs/day, 6 days/week) to various concentrations of TCE, specified in parentheses	AD-13
			1.7 ug/ml (1st exposure day)	human, male, 50 ppm inhalation exposure, 6 hrs/day for 5 days. Trichloroethanol level was measured daily, nonglucuronized fraction only. Figures represent maximum levels attained.	AD-16
			2.1 ug/ml (2nd exposure day)	human, male, 50 ppm inhalation exposure, 6 hrs/day for 5 days. Trichloroethanol level was measured daily, nonglucuronized fraction only. Figures represent maximum levels attained.	AD-16

	Breath	Urine	Blood	Comments	Ref.
Metabolites (cont.)					
(trichloroethanol, cont.)			2.2 ug/ml (3rd exposure day)	human, male, 50 ppm inhalation exposure, 6 hrs/day for 5 days. Trichloroethanol level was measured daily, nonglucuronized fraction only. Figures represent maximum levels attained.	AD-16
			2.3 ug/ml (4th exposure day)	human, male, 50 ppm inhalation exposure, 6 hrs/day for 5 days. Trichloroethanol level was measured daily, nonglucuronized fraction only. Figures represent maximum levels attained.	AD-16
			2.3 ug/ml (5th exposure day)	human, male, 50 ppm inhalation exposure, 6 hrs/day for 5 days. Trichloroethanol level was measured daily, nonglucuronized fraction only. Figures represent maximum levels attained.	AD-16
			1.28-2.85 ug/ml (1st exposure day)	humans, male and female, 48 ppm inhalation exposure, 4 hrs/day for 5 days. Blood levels of Trichloroethanol were determined daily during and after exposure.	AD-17
			1.44-2.91 ug/ml (2nd exposure day)	humans, male and female, 48 ppm inhalation exposure, 4 hrs/day for 5 days. Blood levels of trichloroethanol were determined daily during and after exposure.	AD-17

Trichloroethylene (continued)

	Breath	Urine	Blood	Comments	Ref.
Metabolites (cont.)					
(trichloroethanol, cont.)			2.01-2.53 ug/ml (3rd exposure day)	humans, male and female, 48 ppm inhalation exposure, 4 hrs/day for 5 days. Blood levels of trichloroethanol were determined daily during and after exposure.	AD-17
			1.57-2.58 ug/ml (4th exposure day)	humans, male and female, 48 ppm inhalation exposure, 4 hrs/day for 5 days. Blood levels of trichloroethanol were determined daily during and after exposure.	AD-17
			1.97-2.87 ug/ml (5th exposure day)	humans, male and female, 48 ppm inhalation exposure, 4 hrs/day for 5 days. Blood levels of trichloroethanol were determined daily during and after exposure.	AD-17
			0.51-2.11 ug/ml (1st day post-exposure)	humans, male and female, 48 ppm inhalation exposure, 4 hrs/day for 5 days. Blood levels of trichloroethanol were determined daily during and after exposure.	AD-17
			0.18-0.51 ug/ml (2nd day post-exposure)	humans, male and female, 48 ppm inhalation exposure, 4 hrs/day for 5 days. Blood levels of trichloroethanol were determined daily during and after exposure.	AD-17

Trichloroethylene (continued)

	Breath	Urine	Blood	Comments	Ref.
Metabolites (cont.)					
(trichloroethanol, cont.)			0.03-0.27 ug/ml (3rd day post-exposure)	humans, male and female, 48 ppm inhalation exposure, 4 hrs/day for 5 days. Blood levels of trichloroethanol were determined daily during and after exposure.	AD-17
			0.05-0.14 ug/ml (4th day post-exposure)	humans, male and female, 48 ppm inhalation exposure, 4 hrs/day for 5 days. Blood levels of trichloroethanol were determined daily during and after exposure.	AD-17
			0.03-0.08 ug/ml (5th day post-exposure)	humans, male and female, 48 ppm inhalation exposure, 4 hrs/day for 5 days. Blood levels of trichloroethanol were determined daily during and after exposure.	AD-17
			0.05 ug/ml (6th day post-exposure)	humans, male and female, 48 ppm inhalation exposure, 4 hrs/day for 5 days. Blood levels of trichloroethanol were determined daily during and after exposure.	AD-17
			0.03 ug/ml (7th day post-exposure)	humans, male and female, 48 ppm inhalation exposure, 4 hrs/day for 5 days. Blood levels of trichloroethanol were determined daily during and after exposure.	AD-17
			0.71-1.78 ug/ml (immediately after exposure)	human, female, 40 or 44 ppm inhalation exposure. Refer to reference AD-17 for additional details and data.	AD-17

Trichloroethylene (continued)

	Breath	Urine	Blood	Comments	Ref.
Metabolites (cont.)					
(trichloroethanol, cont.)			0.47-0.70 ug/ml (24 hrs from start of exposure)	human, female, 40 or 44 ppm inhalation exposure. Refer to reference AD-17 for additional details and data.	AD-17
			less than 0.12 ug/ml (96 hrs from start of exposure)	human, female, 40 or 44 ppm inhalation exposure. Refer to reference AD-17 for additional details and data.	AD-17
			0.78-1.32 ug/ml (immediately after expsoure)	human, male, 40 or 44 ppm inhalation exposure. Refer to reference AD-17 for additional details and data.	AD-17
			0.24-0.55 ug/ml (24 hrs from start of exposure)	human, male, 40 or 44 ppm inhalation exposure. Refer to reference AD-17 for additional details and data.	AD-17
			trace (96 hrs from start of exposure)	human, male, 40 or 44 ppm inhalation exposure. Refer to reference AD-17 for additional details and data.	AD-17
			2.0 ug/ml (maximum level attained during exposure)	human, male, 50 ppm inhalation exposure, 6 hours/day, 5 days	AD-18
			2.5 ug/ml (maximum level attained during exposure)	human, male, inhalation exposure, 12 mins/hrs, 6 hrs/ day 5 days	AD-18

Trichloroethylene (continued)

	Breath	Urine	Blood	Comments	Ref.
Metabolites (cont.)					
(trichloroethanol, cont.)			5.0 ug/ml (maximum level attained during exposure)	human, male, 100 ppm inhalation exposure, 6 hrs/day, 5 days	AD-18
		15-20% (4 days)		dog, dose and method not stated	AD-14
		15%		rat, oral administration, dose not stated	AD-14
		10-15%		rat, ^{38}Cl-TCE, dose not stated; administered by stomach tube	AD-14
		13-25%		calf, 3 or 12 g, oral, daily for 4 or 5 days	AD-14 and AD-15
trichloracetic acid		19%, total amount excreted (387 hrs, avg.)		humans, male and female, 500-850 ug/L inhalation exposure for 8 hours	AD-9
		31.9% (3 weeks)		humans, male and female, 1042 ug/L inhalation exposure for 8 hours	AD-10
		17.7% (several weeks)		humans, male, 54 or 97 ppm inhalation exposure for 8 hours	AD-3
		32.6% (6 days)		humans, male, 250-380 ppm inhalation exposure, 160 minutes	AD-4
		43.9% (6 days)		humans, female, 250-380 ppm inhalation exposure, 160 minutes	AD-4

Trichloroethylene (continued)

	Breath	Urine	Blood	Comments	Ref.
Metabolites (cont.)					
(trichloroacetic acid, cont.)		21.9% (100 hrs)		humans, male, 170 ppm inhalation exposure for 3 hours	AD-11
		18.1% (100 hrs)		humans, male, 170 ppm inhalation exposure for 7 hours (with a 1-hour break)	AD-11
		30.1% (16 or 21 days)		humans, female, 1 mg/L inhalation exposure for 5 hours	AD-12
		12.7 mg/L (3 ppm exposure)		humans, male, occupational exposure (8 hrs/day, 6 days/week) to various concentrations of TCE, specified in parentheses	AD-13
		20.2 mg/L (5 ppm exposure)		humans, male, occupational exposure (8 hrs/day, 6 days/week) to various concentrations of TCE, specified in parentheses	AD-13
		17.6 mg/L (10 ppm exposure)		humans, male, occupational exposure (8 hrs/day, 6 days/week) to various concentrations of TCE, specified in parentheses	AD-13
		77.2 mg/L (25 ppm exposure)		humans, male, occupational exposure (8 hrs/day, 6 days/week) to various concentrations of TCE, specified in parentheses	AD-13

	Breath	Urine	Blood	Comments	Ref.
Metabolites (cont.)					
(trichloroacetic acid, cont.)		90.6 mg/L (40 ppm exposure)		humans, male, occupational exposure (8 hrs/day, 6 days/week) to various concentrations of TCE, specified in parentheses	AD-13
		138.4 mg/L (45 ppm exposure)		humans, male, occupational exposure (8 hrs/day, 6 days/week) to various concentrations of TCE, specified in parentheses	AD-13
		146.4 mg/L (50 ppm exposure)		humans, male, occupational exposure (8 hrs/day, 6 days/week) to various concentrations of TCE, specified in parentheses	AD-13
		155.4 mg/L (60 ppm exposure)		humans, male, occupational exposure (8 hrs/day, 6 days/week) to various concentrations of TCE, specified in parentheses	AD-13
		230.1 mg/L (120 ppm exposure)		humans, male, occupational exposure (8 hrs/day, 6 days/week) to various concentrations of TCE, specified in parentheses	AD-13
		235.8 mg/L (175 ppm exposure)		humans, male, occupational exposure (8 hrs/day, 6 days/week) to various concentrations of TCE, specified in parentheses	AD-13

Trichloroethylene (continued)

	Breath	Urine	Blood	Comments	Ref.
Metabolites (cont.)					
(trichloroacetic acid, cont.)			17 ug/ml (1st exposure day)	humans, male, 50 ppm inhalation exposure, 6 hours/day for 5 days. Figures represent maximum levels attained daily in plasma.	AD-16
			30 ug/ml (2nd exposure day)	humans, male, 50 ppm inhalation exposure, 6 hours/day for 5 days. Figures represent maximum levels attained daily in plasma.	AD-16
			38 ug/ml (3rd exposure day)	humans, male, 50 ppm inhalation exposure, 6 hours/day for 5 days. Figures represent maximum levels attained daily in plasma.	AD-16
			45 ug/ml (4th exposure day)	humans, male, 50 ppm inhalation exposure, 6 hours/day for 5 days. Figures represent maximum levels attained daily in plasma.	AD-16
			52 ug/ml (5th exposure day)	humans, male, 50 ppm inhalation exposure, 6 hours/day for 5 days. Figures represent maximum levels attained daily in plasma.	AD-16
			2.4 mg/100 ml of plasma (3rd day post-exposure)	humans, male and female, 1042 ug/L inhalation exposure for 5 hours	AD-20
			0.5 mg/100 ml of red cell mass (3rd day post-exposure)	humans, male and female, 1042 ug/L inhalation exposure for 5 hours	AD-20

Trichloroethylene (continued)

	Breath	Urine	Blood	Comments	Ref.
Metabolites (cont.)					
(trichloroacetic acid, cont.)		5-8% (4 days)		dog, dose and method not stated	AD-14
		4%		rat, inhalation exposure, dose not stated	AD-14
		1%		calf, 3 or 12 g, oral dose, daily for 4 or 5 days	AD-14 and AD-15
monochloroacetic acid		4%, total amount excreted (112 hrs. avg.)		humans, male and female, 500-850 ug/L inhalation exposure for 8 hours	AD-9
total trichloro-compounds					
		39.4 mg/L (3 ppm exposure)		humans, male, occupational exposure (8 hrs/day, 6 days/week) to various concentrations of TCE, specified in parentheses	AD-13
		45.6 mg/L (5 ppm exposure)		humans, male, occupational exposure (8 hrs/day, 6 days/week) to various concentrations of TCE, specified in parentheses	AD-13
		60.5 mg/L (10 ppm exposure)		humans, male, occupational exposure (8 hrs/day, 6 days/week) to various concentrations of TCE, specified in parentheses	AD-13

Trichloroethylene (continued)

	Breath	Urine	Blood	Comments	Ref.
Metabolites (cont.)					
(total trichloro-compounds, cont.)					
		164.3 mg/L (25 ppm exposure)		humans, male, occupational exposure (8 hrs/day, 6 days/week) to various concentrations of TCE, specified in parentheses	AD-13
		324.9 mg/L (40 ppm exposure)		humans, male, occupational exposure (8 hrs/day, 6 days/week) to various concentrations of TCE, specified in parentheses	AD-13
		399.0 mg/L (45 ppm exposure)		humans, male, occupational exposure (8 hrs/day, 6 days/week) to various concentrations of TCE, specified in parentheses	AD-13
		418.9 mg/L (50 ppm exposure)		humans, male, occupational exposure (8 hrs/day, 6 days/week) to various concentrations of TCE, specified in parentheses	AD-13
		468.0 mg/L (60 ppm exposure)		humans, male, occupational exposure (8 hrs/day, 6 days/week) to various concentrations of TCE, specified in parentheses	AD-13
		915.3 mg/L (120 ppm exposure)		humans, male, occupational exposure (8 hrs/day, 6 days/week) to various concentrations of TCE, specified in parentheses	AD-13

Trichloroethylene (continued)

	Breath	Urine	Blood	Comments	Ref.
Half-life of metabolites:					
trichloroethanol		24 hours in 1st phase of excretion (first 3-4 days)		humans, male and female, 500-850 ug/L inhalation exposure for 8 hours	AD-9
		40 hours in 2nd phase of excretion (second 7-9 days)		humans, male and female, 500-850 ug/L inhalation exposure for 8 hours	AD-9
trichloroacetic acid		50 hours in 1st phase of excretion (first 5 days)		humans, male and female, 500-850 ug/L inhalation exposure for 8 hours	AD-9
		70 hours in 2nd phase of excretion (second 14 days)		humans, male and female, 500-850 ug/L inhalation exposure for 8 hours	AD-9
monochloroacetic acid		15 hours (total period of excretion was 112 hours, avg.)		humans, male and female, 500-850 ug/L inhalation exposure for 8 hours	AD-9
Metabolite conjugates:	No data	No data	No data		

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A and B

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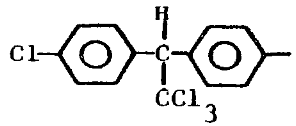
Table B-2. METABOLISM SUMMARIES FOR SOME PESTICIDES TO BE MONITORED IN THIS STUDY

 = R_2CHCCl_3

$R_2CHCCl_3 \longrightarrow R_2CHCHCl_2 \longrightarrow R_2C{=}CCl_2$

DDT — DDD (TDE) — DDE

$\downarrow$

R_2CHCHO

DDA

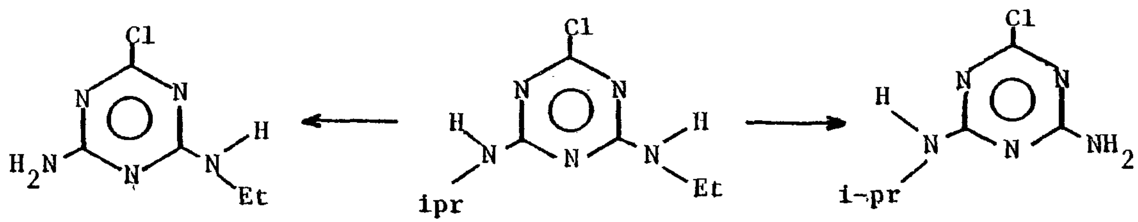
"Metabolism of Pesticides", C. M. Menzie, USDI, Special Scientific Report -- Wildlife No. 127, July 1969.

	Breath	Urine	Blood	Comments	Reference
Parent compound				In humans, environmentally exposed DDE + DDT = 95% in fat 5% in all other tissues	BA-1
Half-life of parent compound	No Data	No Data	No Data		

DDT (continued)

	Breath	Urine	Blood	Comments	Reference
Metabolites:					
DDE				Tissue Feces, bile of mammals	BA-2
DDA (free or conjugate		Present		Feces of mammals	BA-2
DDD				Tissue, Feces of mammals	BA-3

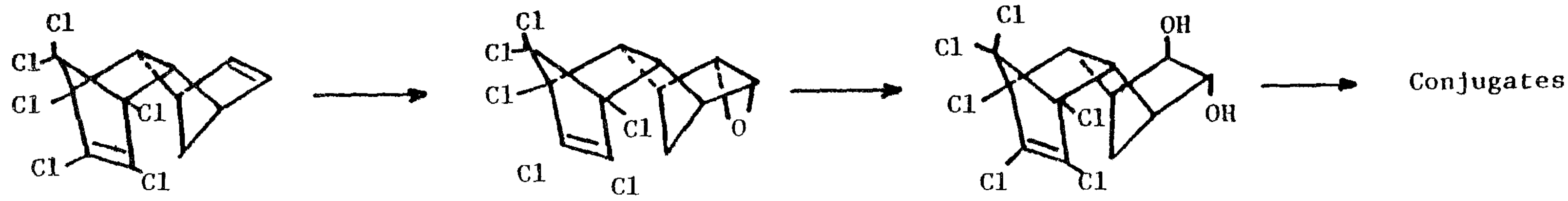
Atrazine



Deisopropylatrazine   Atrazine   Deethylatrazine

	Breath	Urine	Blood	Comments	Reference
Parent		Major		Pig	BE-1
Half-life of parent compound		<24 hr		Pig	BE-1
Metabolites:					
All (including parent	<0.1	65.5	No Data	Feces = 20.3% rat, total excretion to 72 hr-post dose	BE-2
Diethylatrazine		Minor		Pig (with respect to parent)	BE-1
Deethylatrazine		Major		Rat	BE-1, BE-3
Deisopropylatrazine		Minor		Rat	BE-1, BE-3

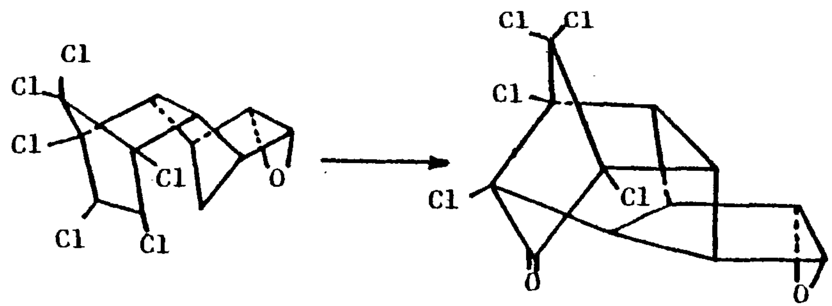
Aldrin



Aldrin — Dieldrin — 6,7-trans-dihydroxy-dihydroaldrin (aldrindiol)

	Breath	Urine	Blood	Comments	Reference
Parent	No Data	No Data	No Data	Readily Metabolized in mammals, Poultry	BC-1
Half-life of parent compound	No Data	No Data	No Data		
Metabolites:				99.5% found in all excretion modes	BC-2
All					
Dieldrin				Major Metabolites in most studies	BC-1
Aldrindiol		43%			BC-1
Aldrindiol		3%			BC-1
Aldrindiol diacetal		14%			BC-1
Dieldrin		Observed only 3-4 weeks post-dose		Rats, intravenous injection	BC-1

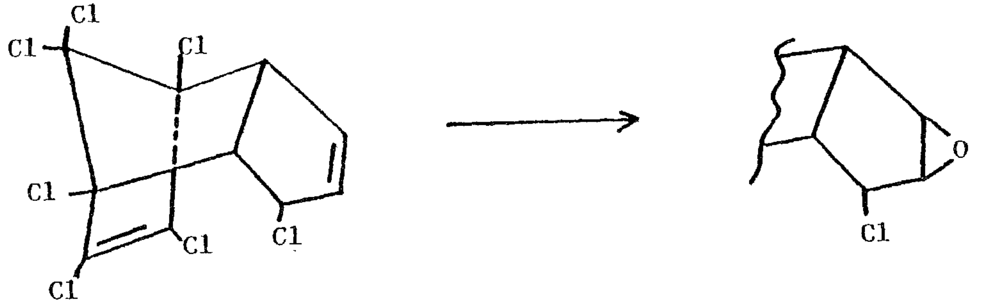
Dieldrin



Dieldrin → I + other metabolites

	Breath	Urine	Blood	Comments	Reference
Parent	No Data	8 Days Post Dose	No Data	20 mg/kg, rats, single dose	BD-1
Half-life of parent compound				47.2 days, Pigeon	BD-1
Metabolites: I (above)		100%		Rats, continuous feeding, 6 mo.	BD-2
2 unidentified, neutral		Present		Human occupational exposure	BD-1

Heptachlor



Heptachlor → Heptachlor epoxide

	Breath	Urine	Blood	Comments	Reference
Parent	0	0	0	All metabolized	BB-1
Half-life of parent compound				All metabolized in 144 hr in rabbits	BB-1
Metabolites: Heptachlor expoxide	No Data	No Data	No Data	Only metabolites in animals, flies, plants, and soil	BB-1

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APPENDIX C

Wind Roses for Study Sites

<u>Note:</u>

The length of each line indicates the frequency of wind from this direction. The width corresponds to the wind velocity. From narrow to wide, the division are: 1-3 kts, 4-6 kts, 7-10 kts, 11-16 kts, 17-21 kts and $\geq$ 22 kts.

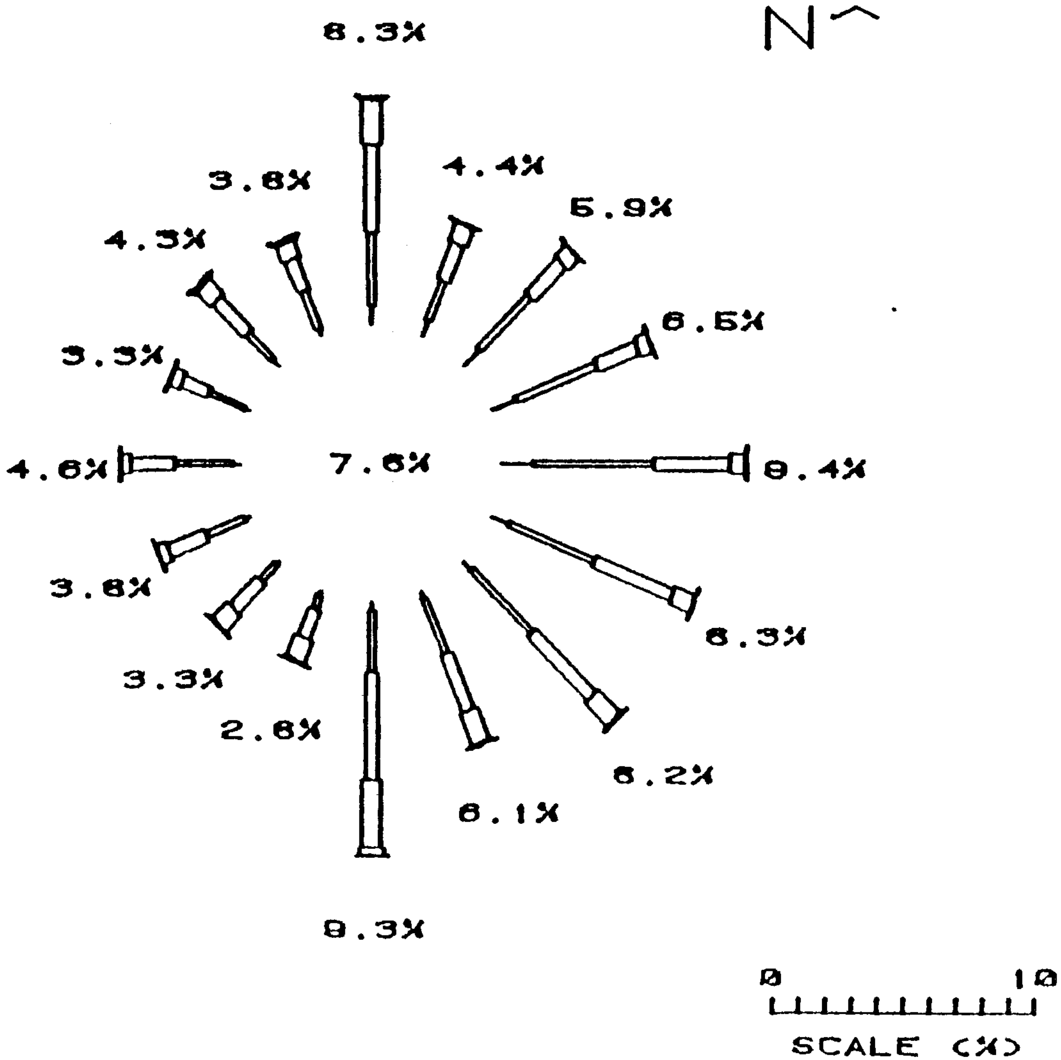


Figure C1. Wind rose for Baton Rouge, LA.

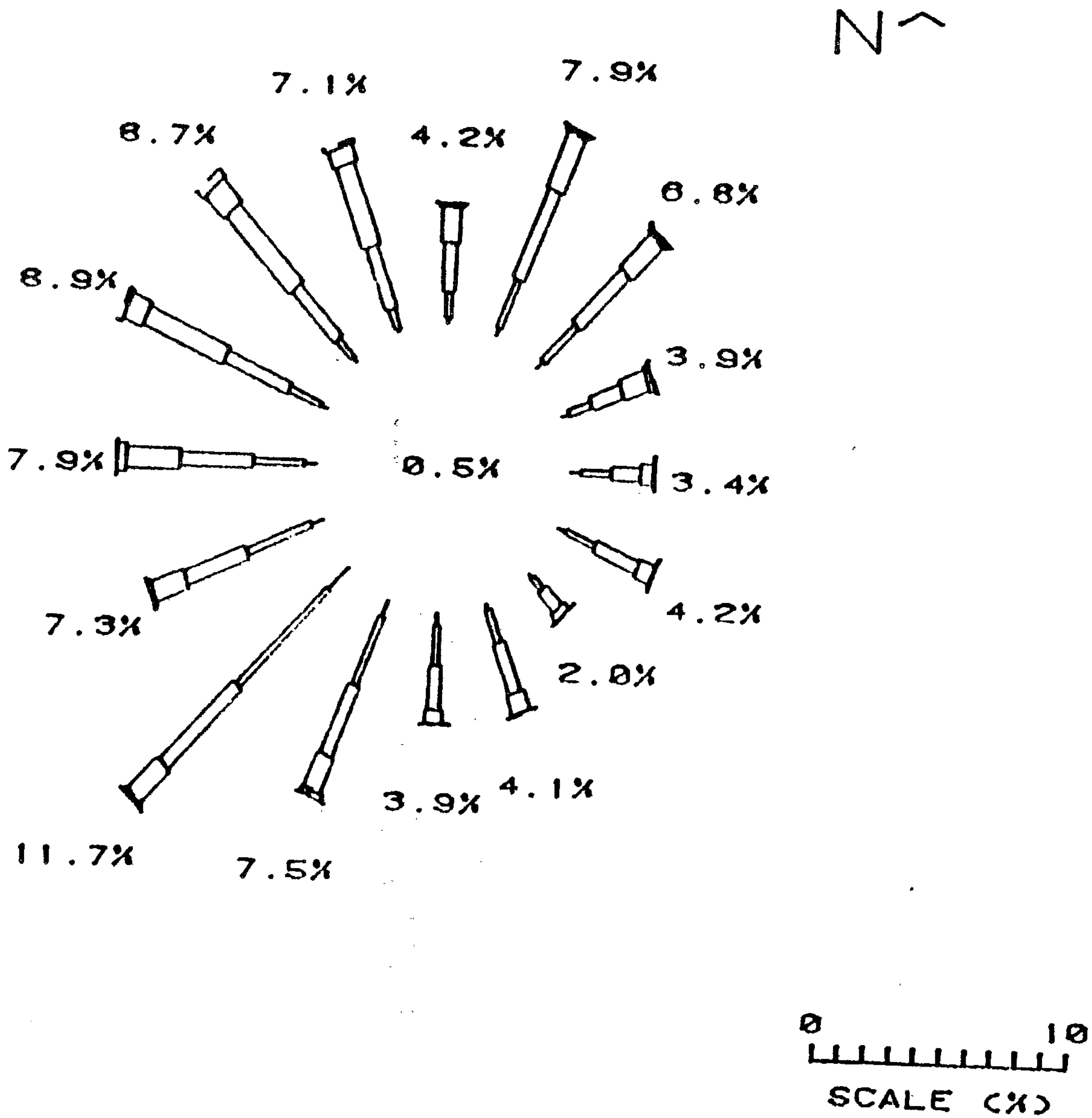


Figure C2. Wind rose for Newark, NJ.

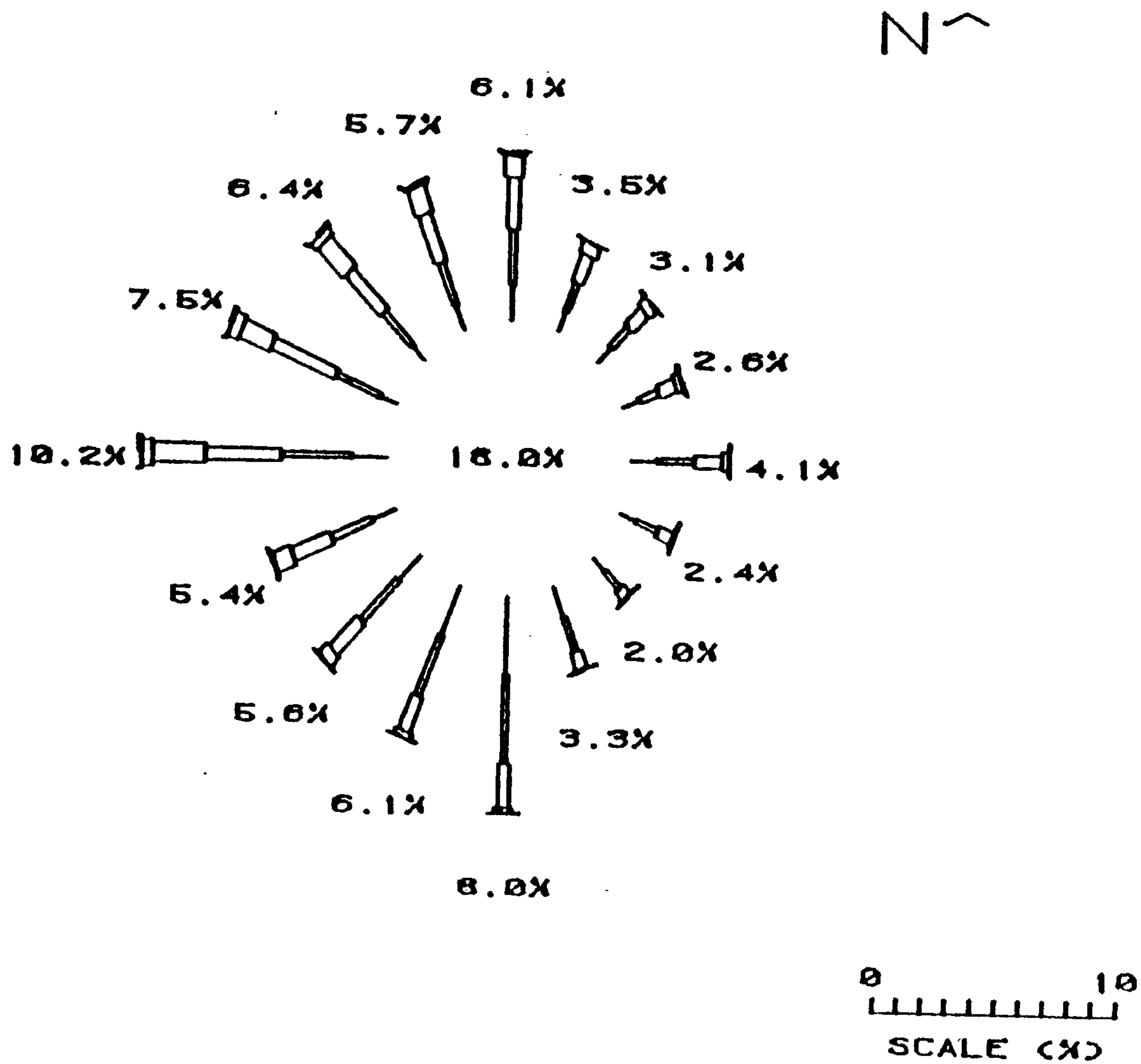


Figure C3. Wind rose for McGuire AFB, Writestown, NJ.

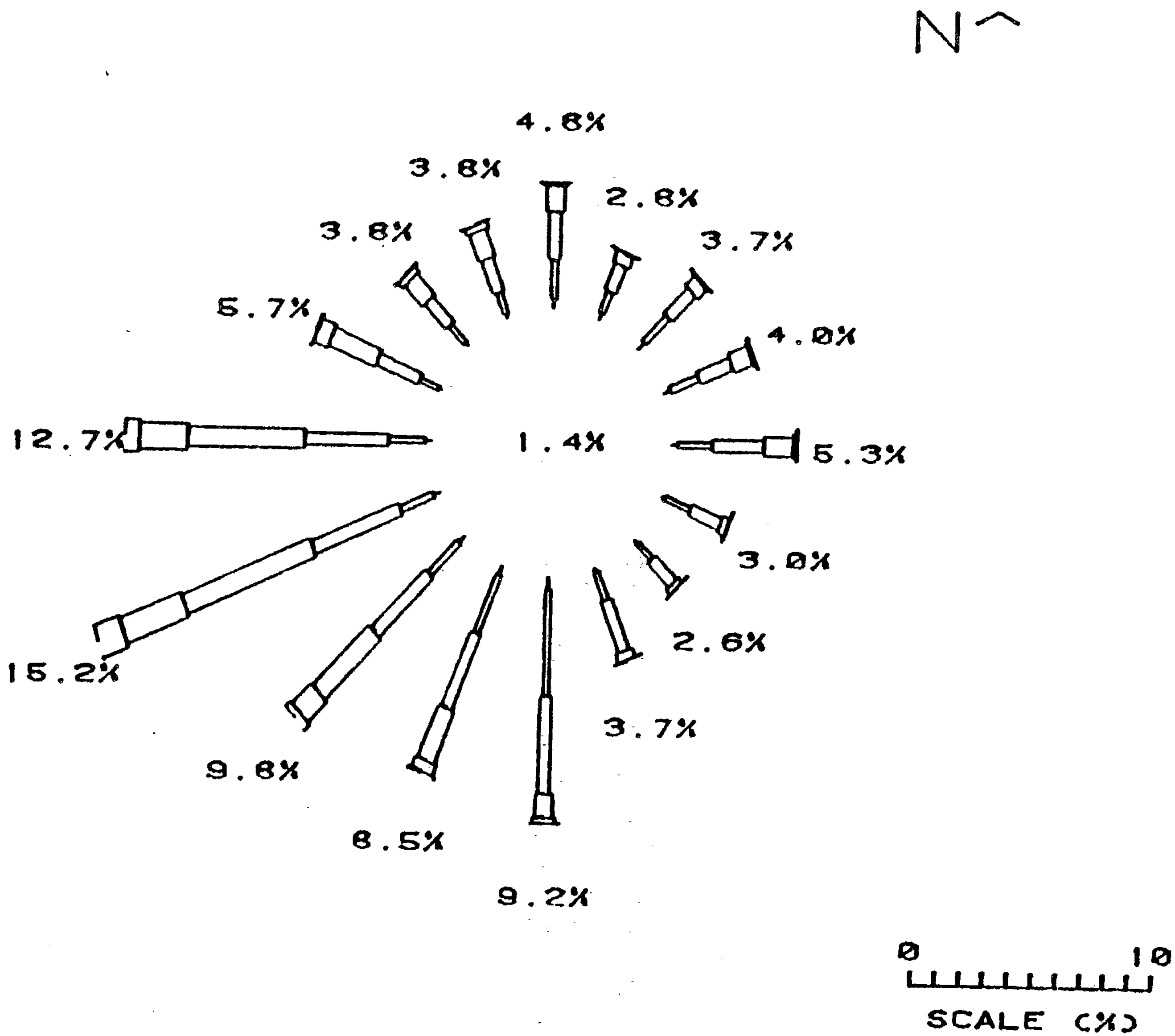


Figure C4. Wind rose for Buffalo, NY.

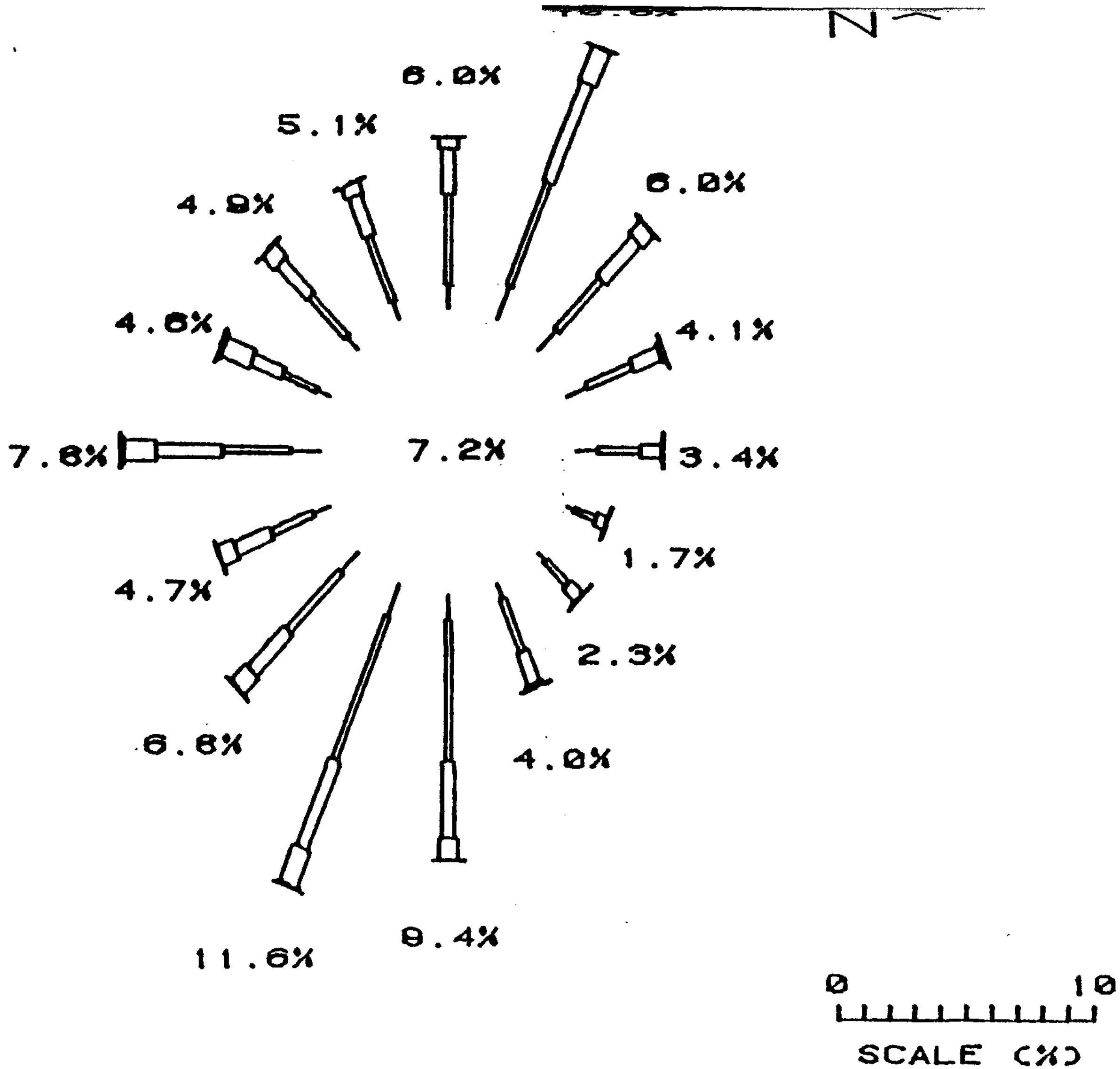


Figure C5. Wind rose for Greensboro, NC.

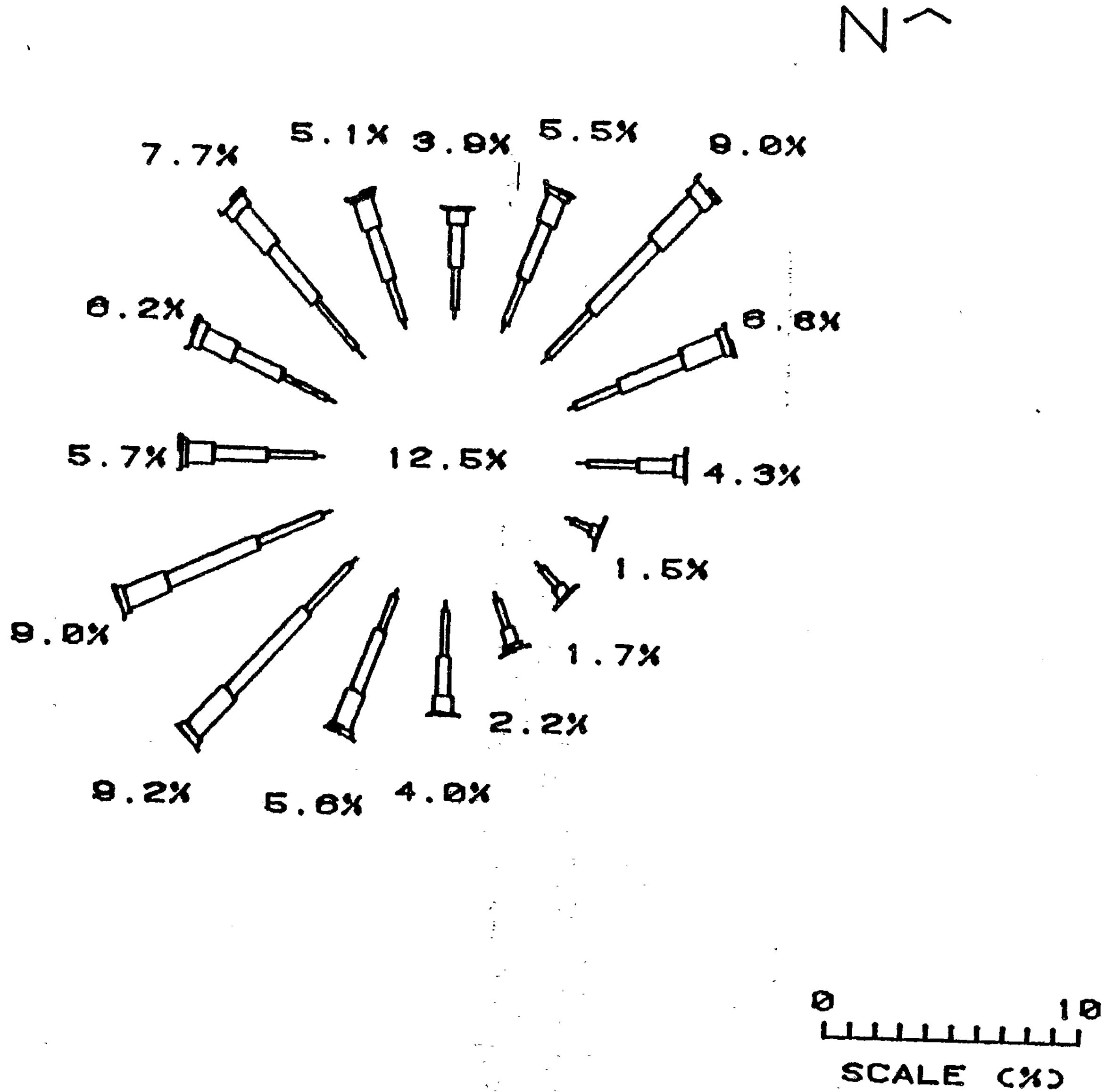


Figure C6. Wind rose for Winston-Salem, NC.

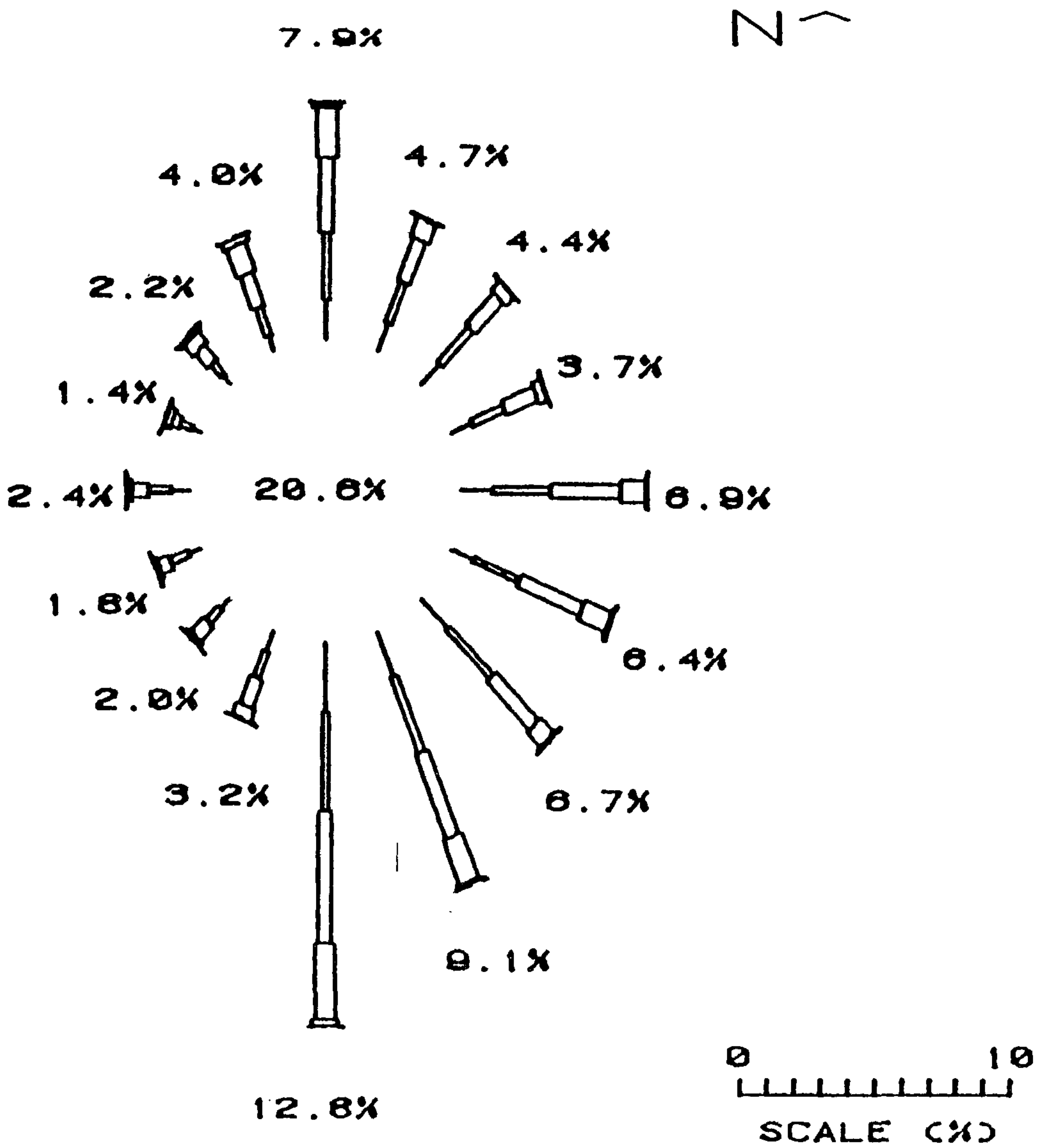


Figure C7. Wind rose for Houston (Ellington AFB), TX.

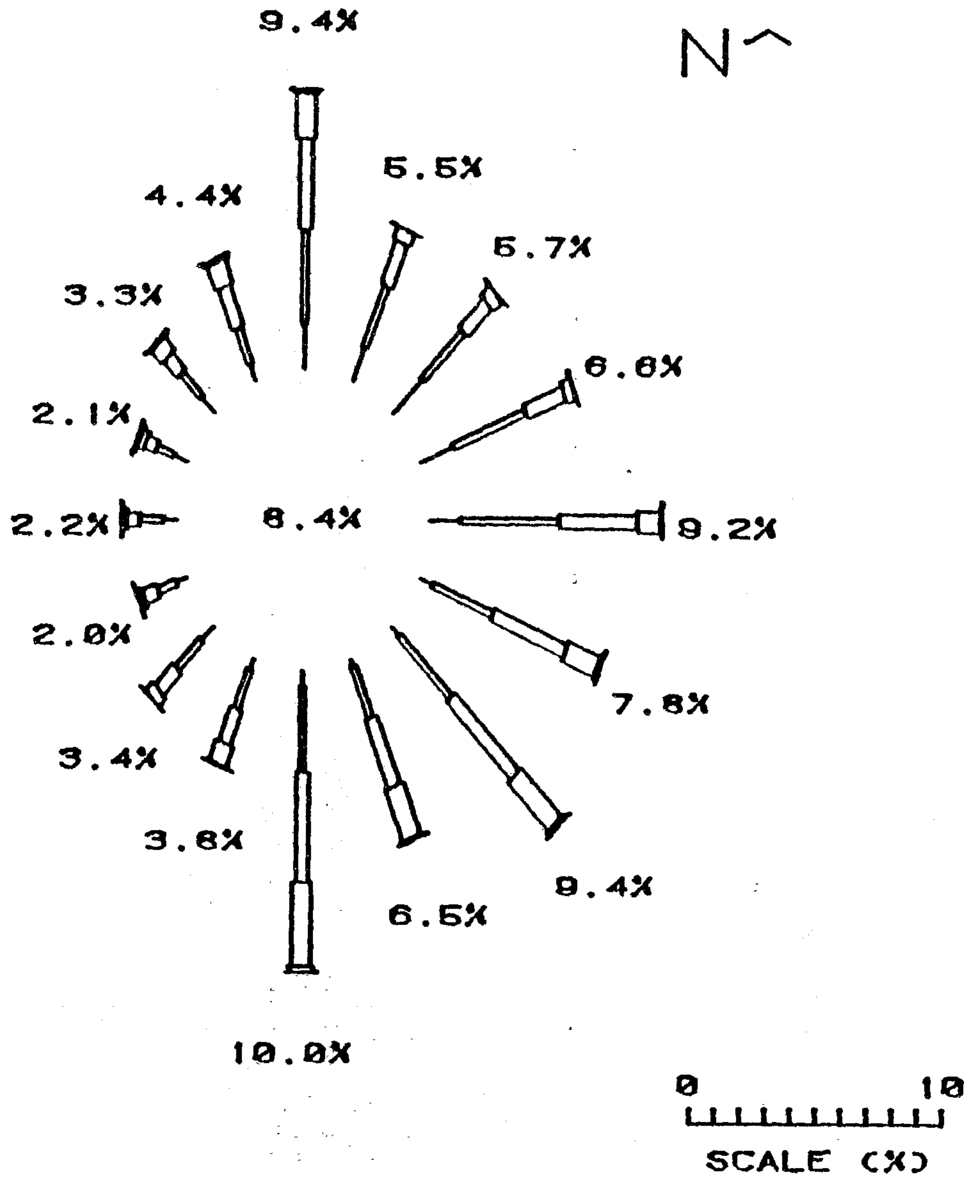


Figure C8. Wind rose for Houston Intercontinental, TX.

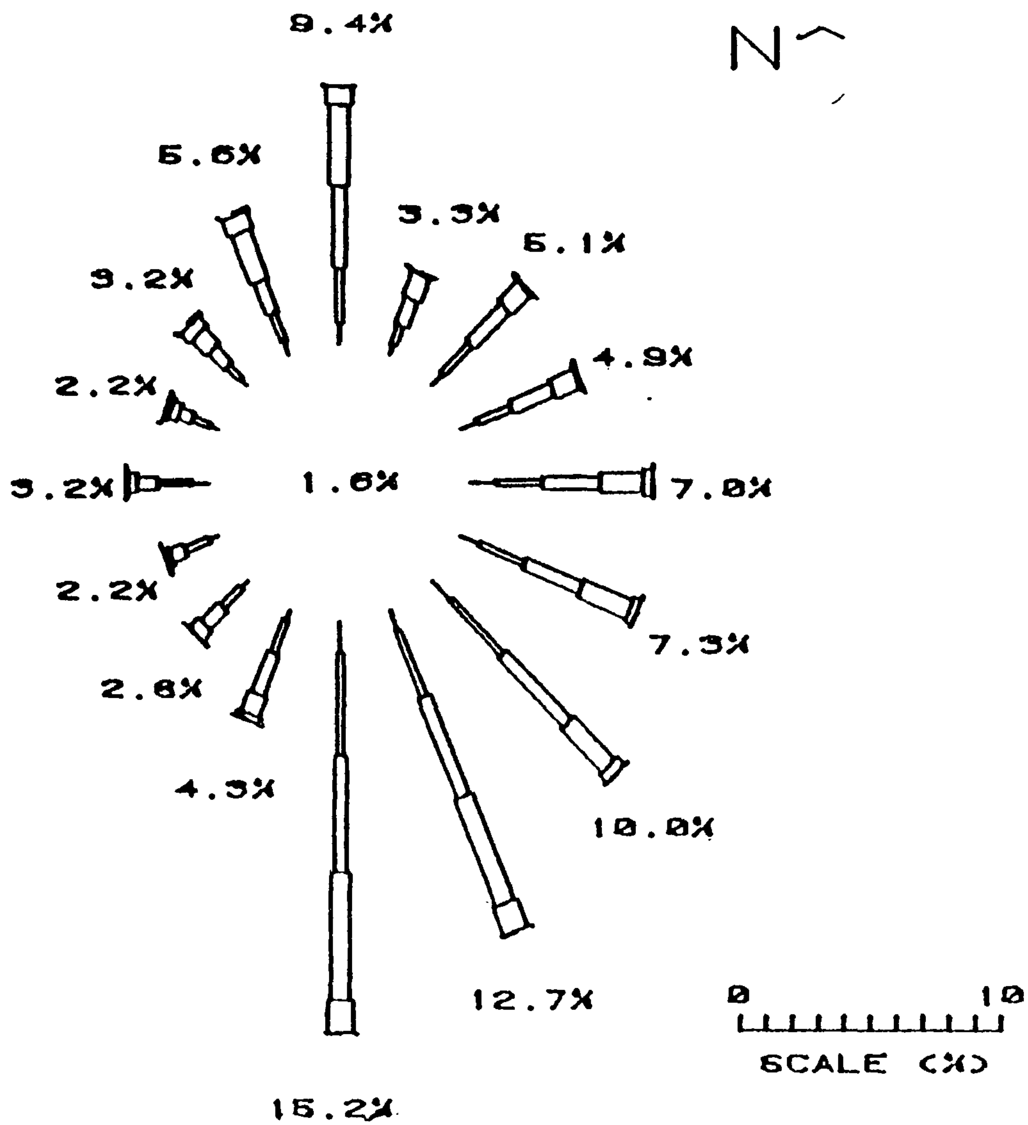


Figure C9. Wind rose for Houston (Hobby), TX.

APPENDIX D

Population Density Maps for Potential Study Sites

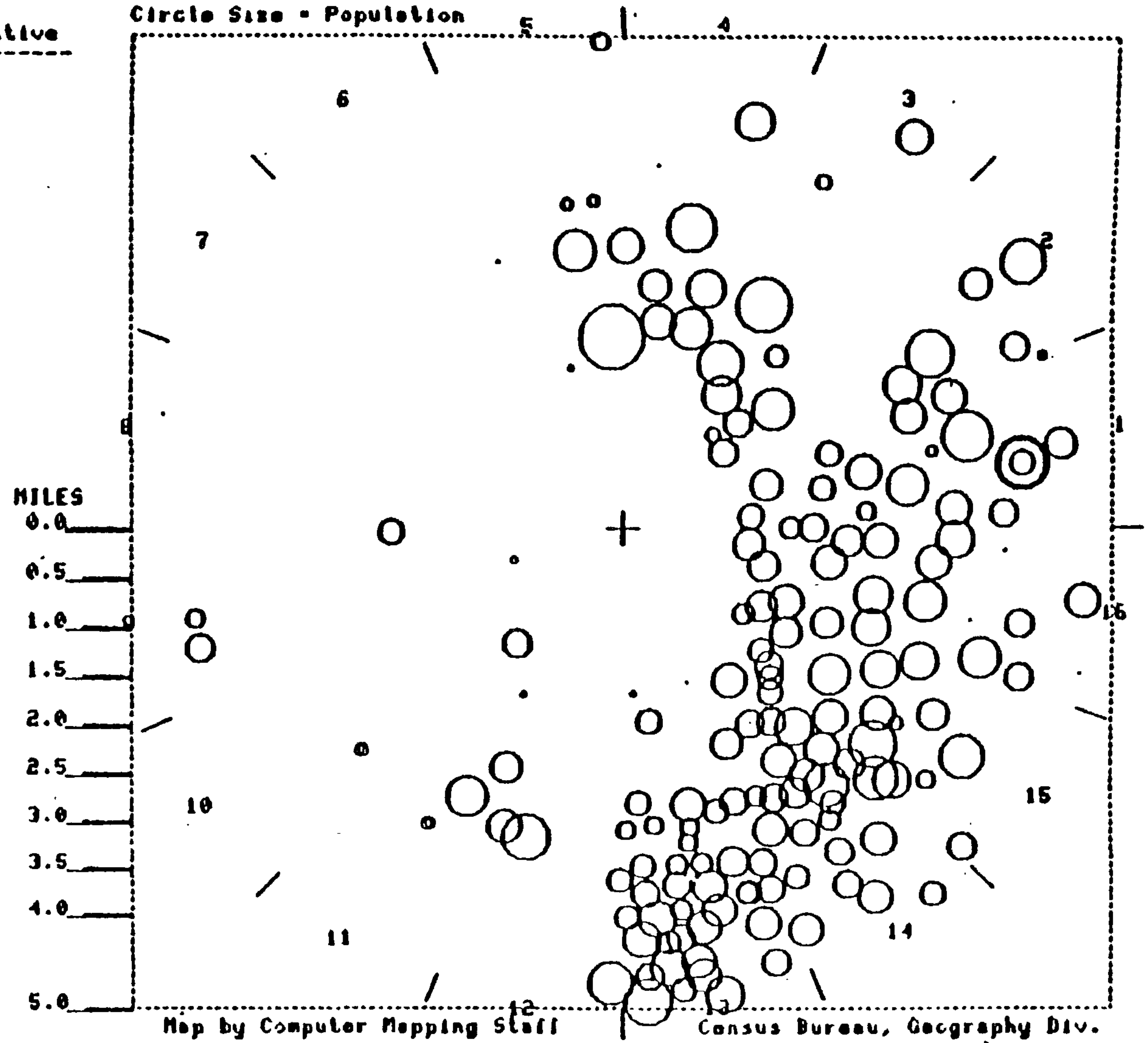
MAP CREATED ON: 11-AUG-78 AT: 11:00:18

THE PLOT CENTER IS AT:
LATITUDE 30.4954
LONGITUDE 91.1891

RADII From	To	POPULATION Within Ring	Cumulative
0.00	0.50	0.	0.
0.50	1.00	2.	2.
1.00	1.50	3757.	3759.
1.50	2.00	19087.	22846.
2.00	2.50	12995.	35841.
2.50	3.00	22185.	58026.
3.00	3.50	32940.	90966.
3.50	4.00	22109.	113075.
4.00	5.00	47182.	160257.

QUADRANT TOTALS:

Sector	Population
1	20432.
2	10170.
3	8268.
4	9796.
5	5677.
6	26.
7	0.
8	0.
9	1853.
10	141.
11	3490.
12	4938.
13	31373.
14	25831.
15	21920.
16	16342.



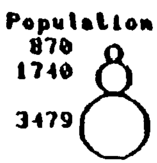


Figure D-1. Population density map for the area surrounding Allied, North, Baton Rouge, LA.

MAP CREATED ON: 11-AUG-78 AT: 11:03:31

THE PLOT CENTER IS AT:
LATITUDE 30.4742
LONGITUDE 91.1870

RADII From	To	POPULATION Within Ring	Cumulative
0.00	0.50	75.	75.
0.50	1.00	1300.	1375.
1.00	1.50	7376.	8751.
1.50	2.00	13991.	22742.
2.00	2.50	28717.	51459.
2.50	3.00	30853.	82312.
3.00	3.50	29618.	111930.
3.50	4.00	26174.	138104.
4.00	5.00	42724.	180828.

QUADRANT TOTALS:

Sector	Population
1	16261.
2	24909.
3	10481.
4	13446.
5	6588.
6	0.
7	770.
8	1865.
9	189.
10	2660.
11	3068.
12	2922.
13	34176.
14	21928.
15	23547.
16	18018.

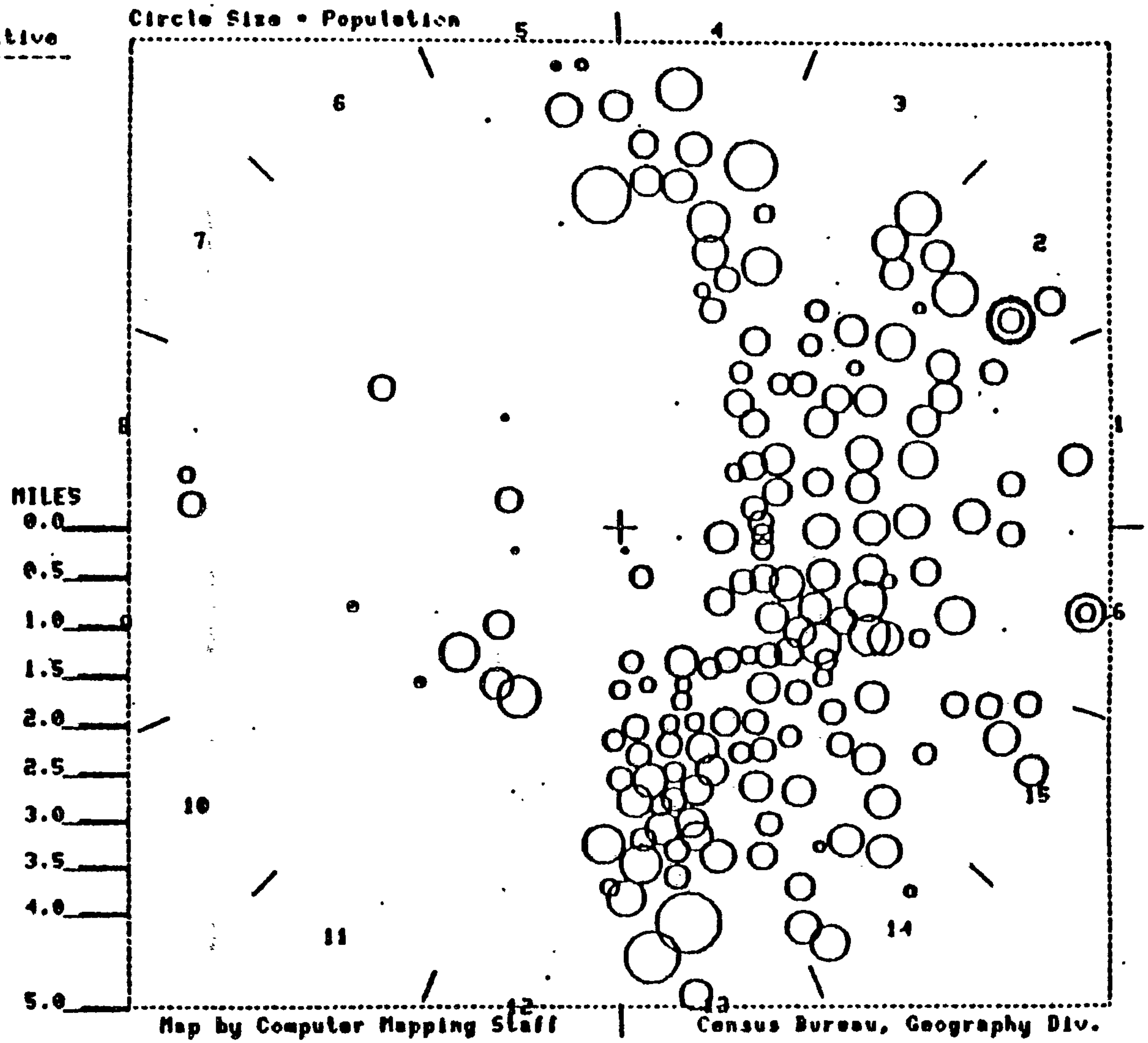


Figure D-2. Population density map for the area surrounding Allied, South, Baton Rouge, LA.

MAP CREATED ON: 11-AUG-78 AT: [illegible]

THE PLOT CENTER IS AT:
LATITUDE 30.4968
LONGITUDE 91.1814

RADII From	To	POPULATION Within Ring	Cumulative
0.00	0.50	2.	2.
0.50	1.00	2472.	2474.
1.00	1.50	6453.	8927.
1.50	2.00	19800.	28727.
2.00	2.50	17936.	46663.
2.50	3.00	25132.	71795.
3.00	3.50	25906.	97701.
3.50	4.00	27514.	125215.
4.00	5.00	34924.	160139.

QUADRANT TOTALS:

Sector	Population
1	17826.
2	9813.
3	9146.
4	8232.
5	9099.
6	68.
7	0.
8	0.
9	1853.
10	923.
11	5776.
12	9422.
13	26982.
14	29868.
15	17947.
16	13184.

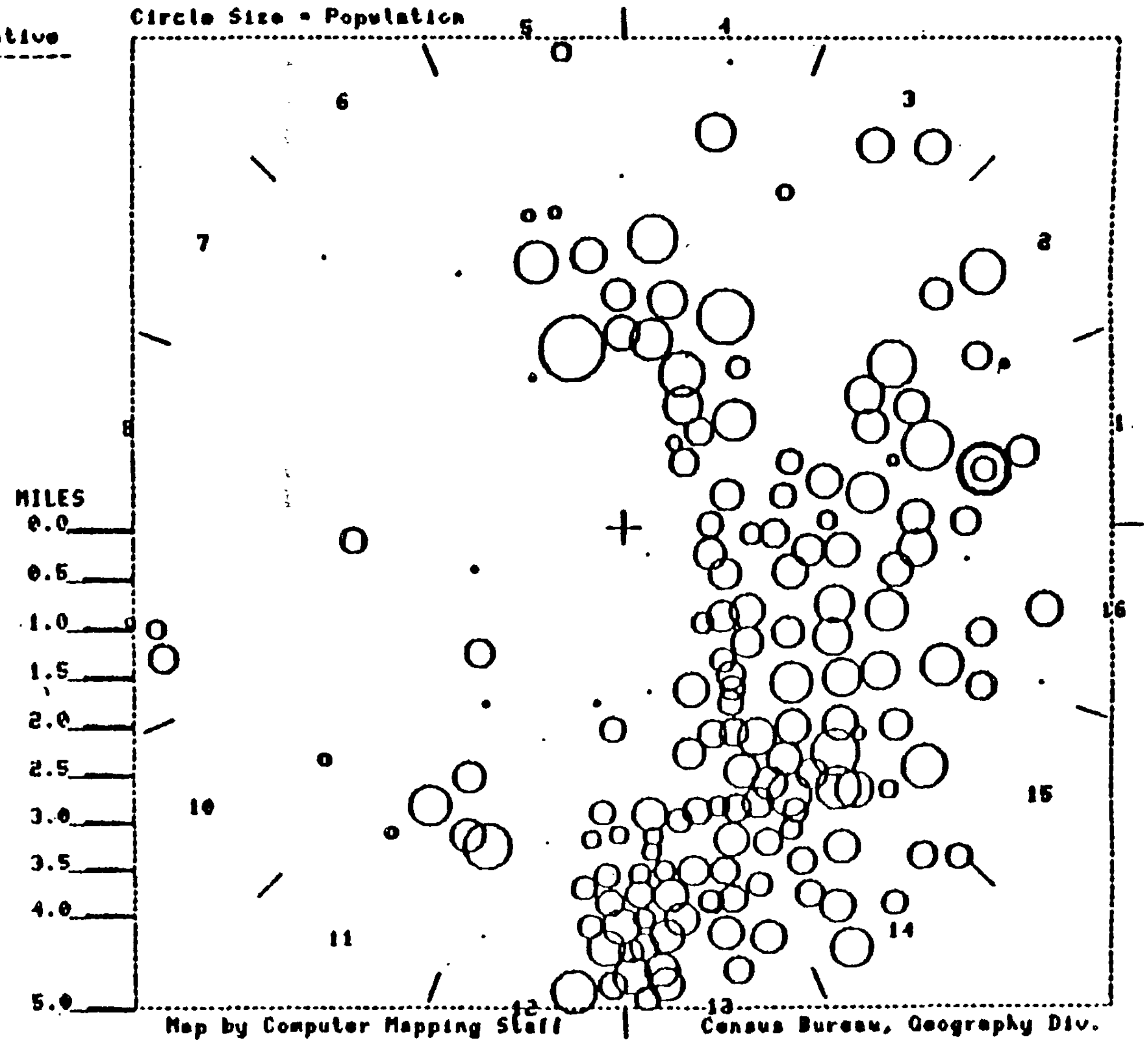


Figure D-3. Population density map for the area surrounding Ethyl Corp., Baton Rouge, LA.

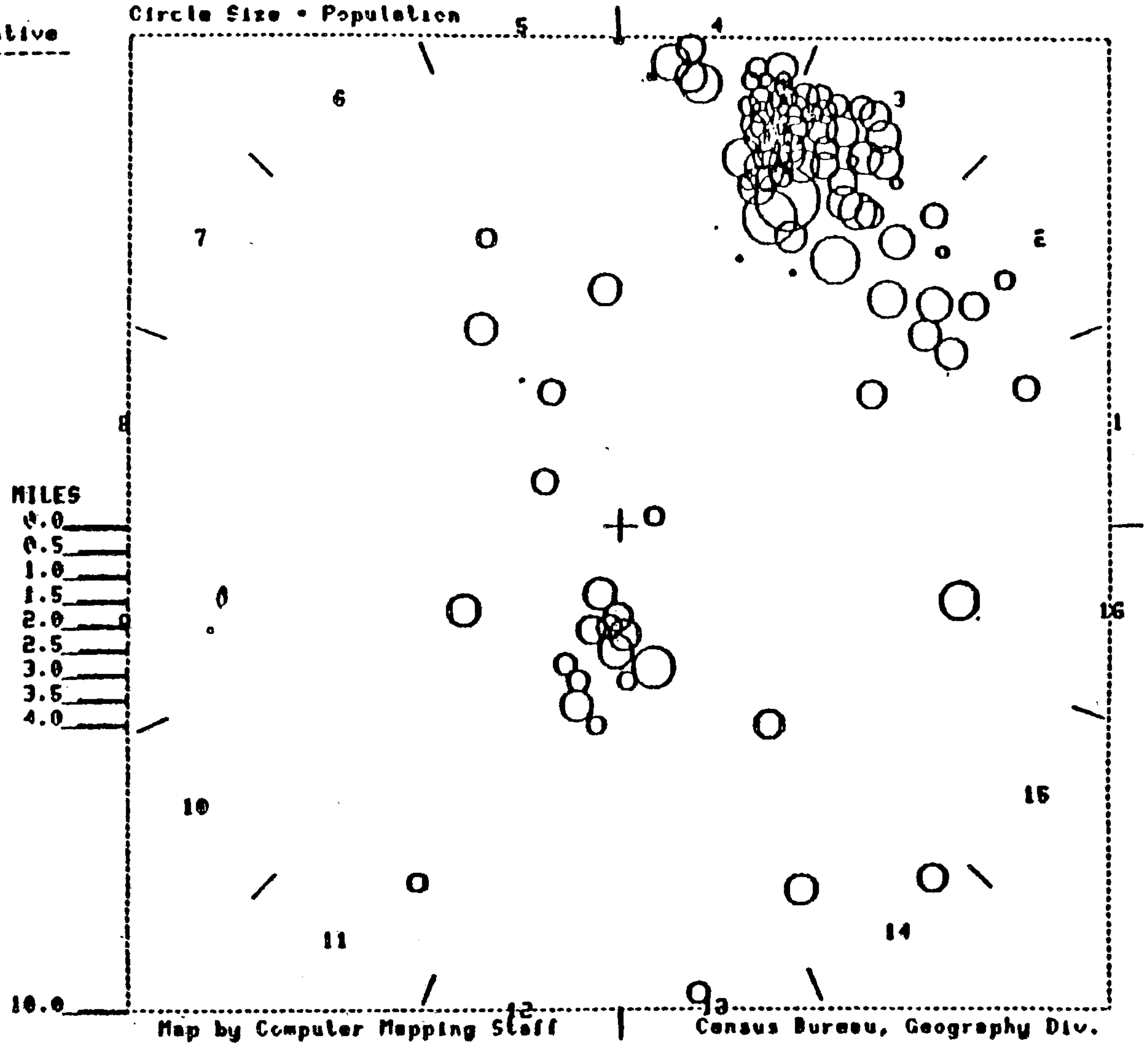
MAP CREATED ON: 11-AUG-78 AT: 11:46:15

THE PLOT CENTER IS AT:
LATITUDE 30.3179
LONGITUDE 91.2324

RADII From	To	POPULATION Within Ring	Cumulative
0.00	0.50	0.	0.
0.50	1.00	392.	392.
1.00	1.50	1226.	1618.
1.50	2.00	1742.	3360.
2.00	2.50	2988.	6348.
2.50	3.00	3422.	9770.
3.00	3.50	2390.	12160.
3.50	4.00	2443.	14603.
4.00	10.00	86513.	101116.

QUADRANT TOTALS:

Sector	Population
1	1232.
2	8803.
3	43295.
4	24196.
5	1423.
6	2369.
7	827.
8	0.
9	0.
10	1191.
11	442.
12	8347.
13	4259.
14	3135.
15	0.
16	1597.



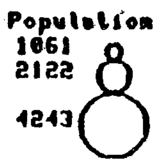


Figure D-4. Population density map for the area surrounding Dow Chemical, Plaquemine, LA.

MAP CREATED ON: 11-AUG-78 AT: 11:44:19

THE PLOT CENTER IS AT:
LATITUDE 30.2679
LONGITUDE 91.1817

RADII From	To	POPULATION Within Ring	Cumulative
0.00	0.50	0.	0.
0.50	1.00	863.	863.
1.00	1.50	0.	863.
1.50	2.00	0.	863.
2.00	2.50	2026.	2889.
2.50	3.00	480.	3369.
3.00	3.50	3439.	6808.
3.50	4.00	4247.	11055.
4.00	10.00	33801.	44856.

QUADRANT TOTALS:

Sector	Population
1	0.
2	3044.
3	6108.
4	10977.
5	1332.
6	2359.
7	4949.
8	7315.
9	1736.
10	442.
11	0.
12	625.
13	4352.
14	989.
15	0.
16	629.

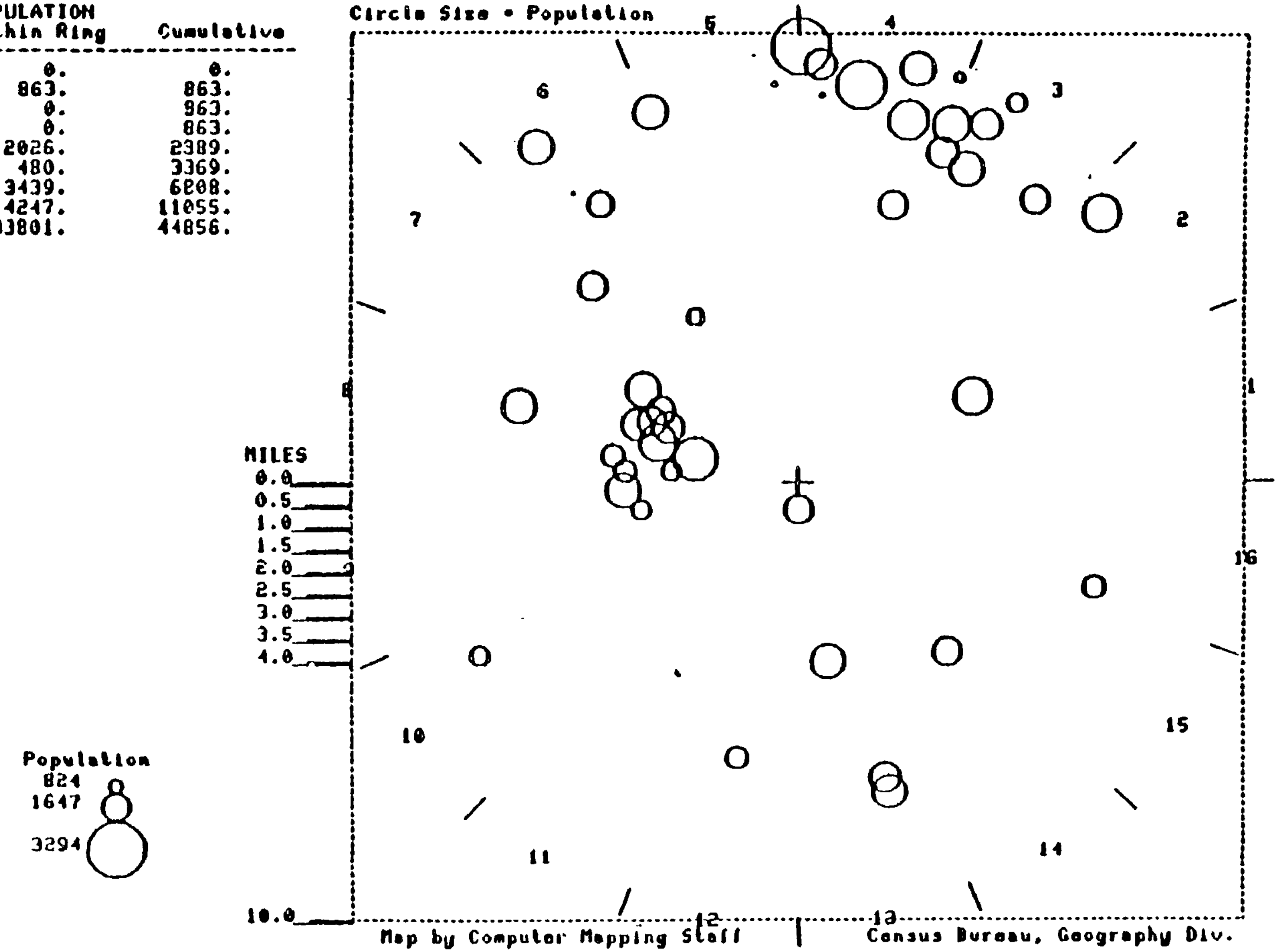


Figure D-5. Population density map for the area surrounding Hercules, Inc., Plaquemine, LA.

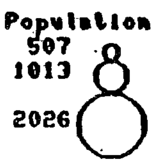
MAP CREATED ON: 11-AUG-78 AT: 11:34:23

THE PLOT CENTER IS AT:
LATITUDE 30.2440
LONGITUDE 91.0926

RADII From	To	POPULATION Within Ring	Cumulative
0.00	0.50	0.	0.
0.50	1.00	0.	0.
1.00	1.50	0.	0.
1.50	2.00	629.	629.
2.00	2.50	0.	629.
2.50	3.00	989.	1618.
3.00	3.50	0.	1618.
3.50	4.00	1597.	3215.
4.00	10.00	37266.	40481.

QUADRANT TOTALS:

Sector	Population
1	5164.
2	1477.
3	547.
4	2287.
5	7281.
6	0.
7	1618.
8	11618.
9	0.
10	1908.
11	3195.
12	1340.
13	541.
14	770.
15	985.
16	1750.



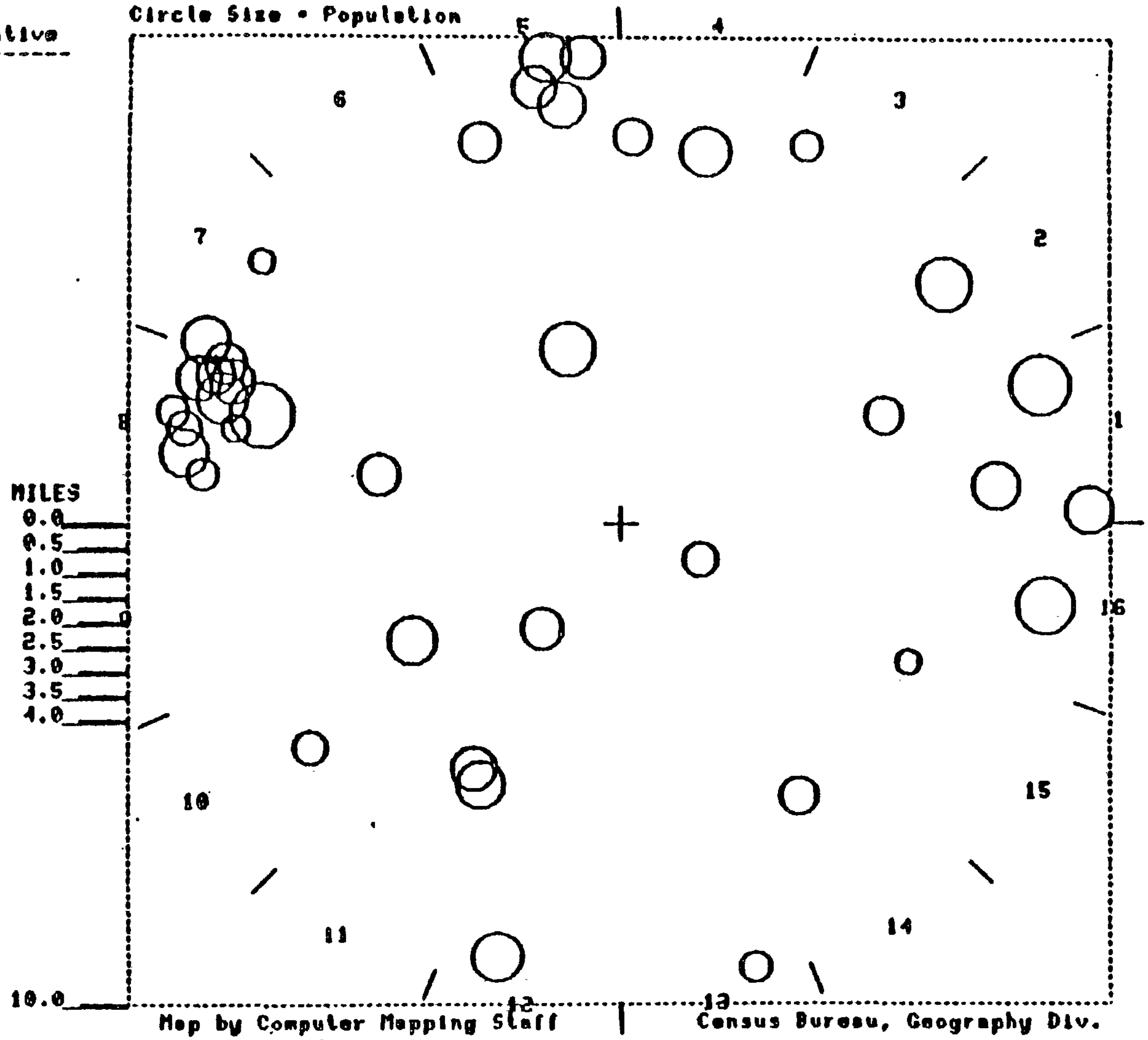


Figure D-6. Population density map for the area surrounding Ciba-Geigy, St. Gabriel, LA.

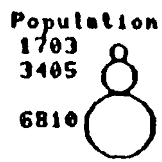
MAP CREATED ON: 11-AUG-78 AT: 10:25:11

THE PLOT CENTER IS AT:
LATITUDE 40.6520
LONGITUDE 74.1125

RADII From	To	POPULATION Within Ring	Cumulative
0.00	0.50	640.	640.
0.50	1.00	25308.	25943.
1.00	1.50	46586.	72534.
1.50	2.00	40677.	113211.
2.00	2.50	39243.	152454.
2.50	3.00	36596.	189050.
3.00	3.50	47577.	236627.
3.50	4.00	44813.	231440.
4.00	5.00	204097.	485537.

QUADRANT TOTALS:

Sector	Population
1	.463.
2	0.
3	38676.
4	82139.
5	12669.
6	13046.
7	9403.
8	30124.
9	23139.
10	16137.
11	42881.
12	31471.
13	41279.
14	40553.
15	49086.
16	54471.



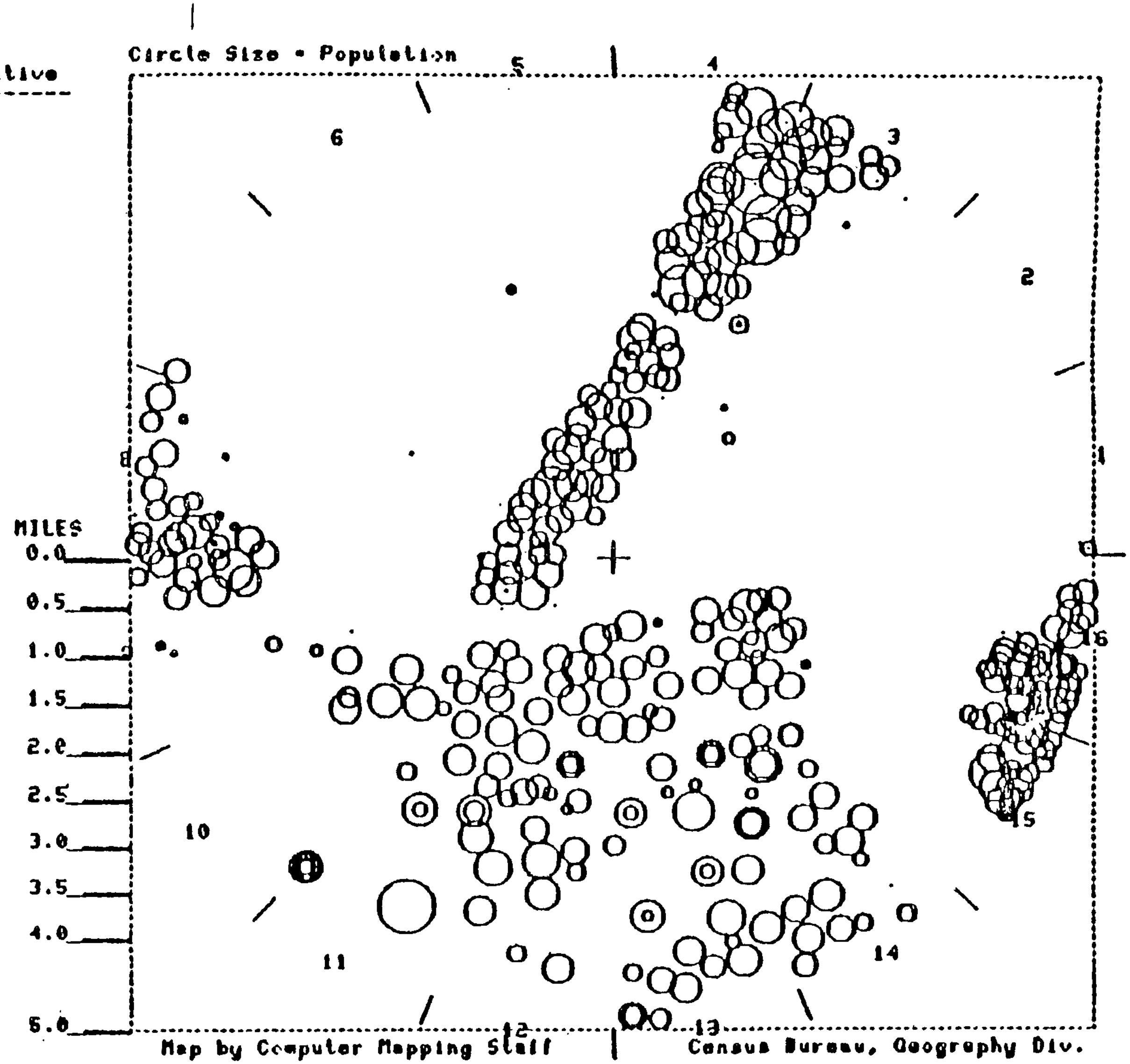


Figure D-7. Population density map for the area surrounding White Chemical Co., Bayonne, NJ.

MAP CREATED ON: 11-AUG-78 AT: 10:32:18

THE PLOT CENTER IS AT:
LATITUDE 40.8312
LONGITUDE 74.1297

RADII From	RADII To	POPULATION Within Ring	Cumulative
0.00	0.50	2220.	2220.
0.50	1.00	17306.	19526.
1.00	1.50	38392.	57918.
1.50	2.00	59361.	117279.
2.00	2.50	65882.	183161.
2.50	3.00	73379.	256540.
3.00	3.50	83948.	340468.
3.50	4.00	88739.	429227.
4.00	5.00	179616.	608843.

QUADRANT TOTALS:

Sector	Population
1	22745.
2	34841.
3	50639.
4	62377.
5	65419.
6	27117.
7	24969.
8	28965.
9	46625.
10	69742.
11	79933.
12	50914.
13	15996.
14	6578.
15	17103.
16	4880.

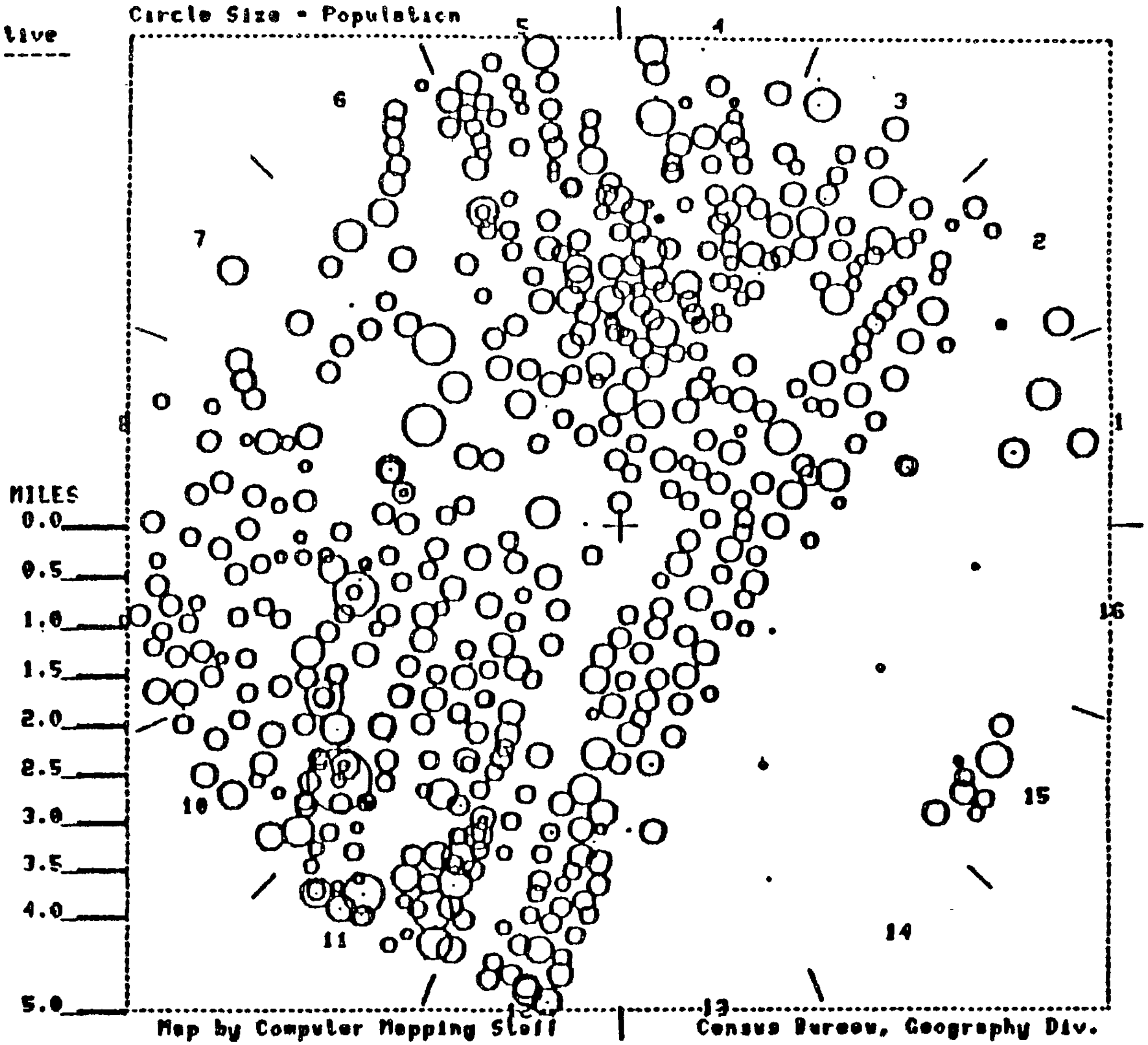


Figure D-8. Population density map for the area surrounding Givaudan Corp., Clifton, NJ.

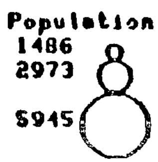
MAP CREATED ON: 11-AUG-78 AT: 09:37:21

THE PLOT CENTER IS AT:
LATITUDE 40.6137
LONGITUDE 74.2139

RADII From	To	POPULATION Within Ring	Cumulative
0.00	0.50	267.	267.
0.50	1.00	0.	267.
1.00	1.50	4284.	4551.
1.50	2.00	6018.	10569.
2.00	2.50	31775.	42344.
2.50	3.00	56586.	99930.
3.00	3.50	66734.	165664.
3.50	4.00	66109.	231773.
4.00	5.00	151673.	383446.

QUADRANT TOTALS:

Sector	Population
1	40327.
2	12680.
3	12560.
4	51975.
5	50676.
6	37664.
7	38402.
8	26371.
9	23450.
10	21307.
11	15900.
12	13267.
13	2772.
14	6037.
15	3456.
16	26602.



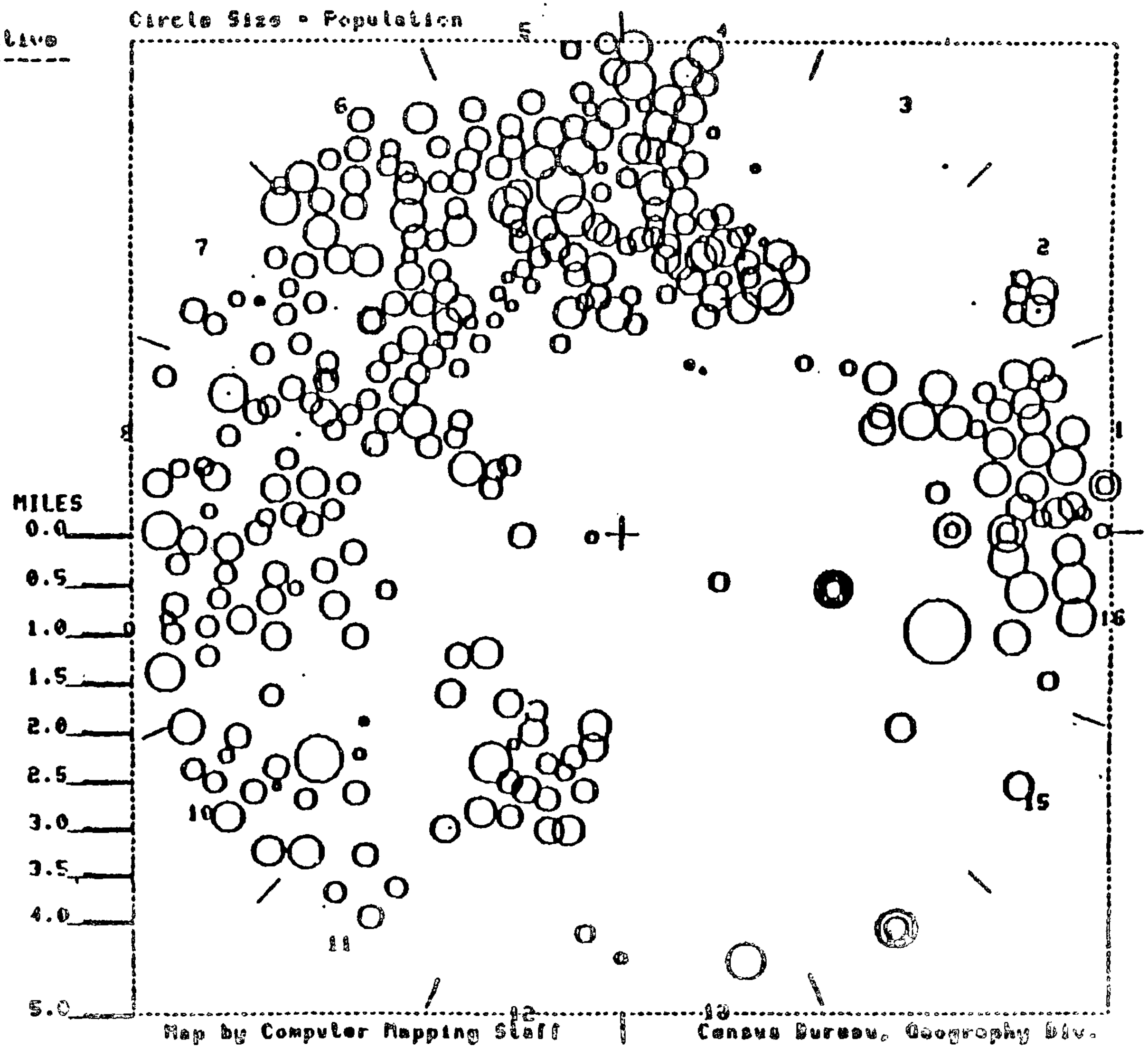


Figure D-9. Population density map for the area surrounding GAF Co., Linden, NJ..

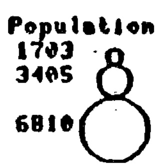
MAP CREATED ON: 11-AUG-78 AT: 09:44:04

THE PLOT CENTER IS AT:
LATITUDE 40.7196
LONGITUDE 74.1446

RADII From	RADII To	POPULATION Within Ring	Cumulative
0.00	0.50	1802.	1802.
0.50	1.00	22120.	23922.
1.00	1.50	16600.	40522.
1.50	2.00	9598.	50120.
2.00	2.50	51228.	101348.
2.50	3.00	99474.	200822.
3.00	3.50	171574.	372396.
3.50	4.00	175946.	548342.
4.00	5.00	304796.	853138.

QUADRANT TOTALS:

Sector	Population
1	85560.
2	1365.
3	3520.
4	30236.
5	74985.
6	100918.
7	121592.
8	141621.
9	73244.
10	36473.
11	12578.
12	40.
13	37545.
14	29870.
15	29141.
16	74450.



MILES
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
5.0

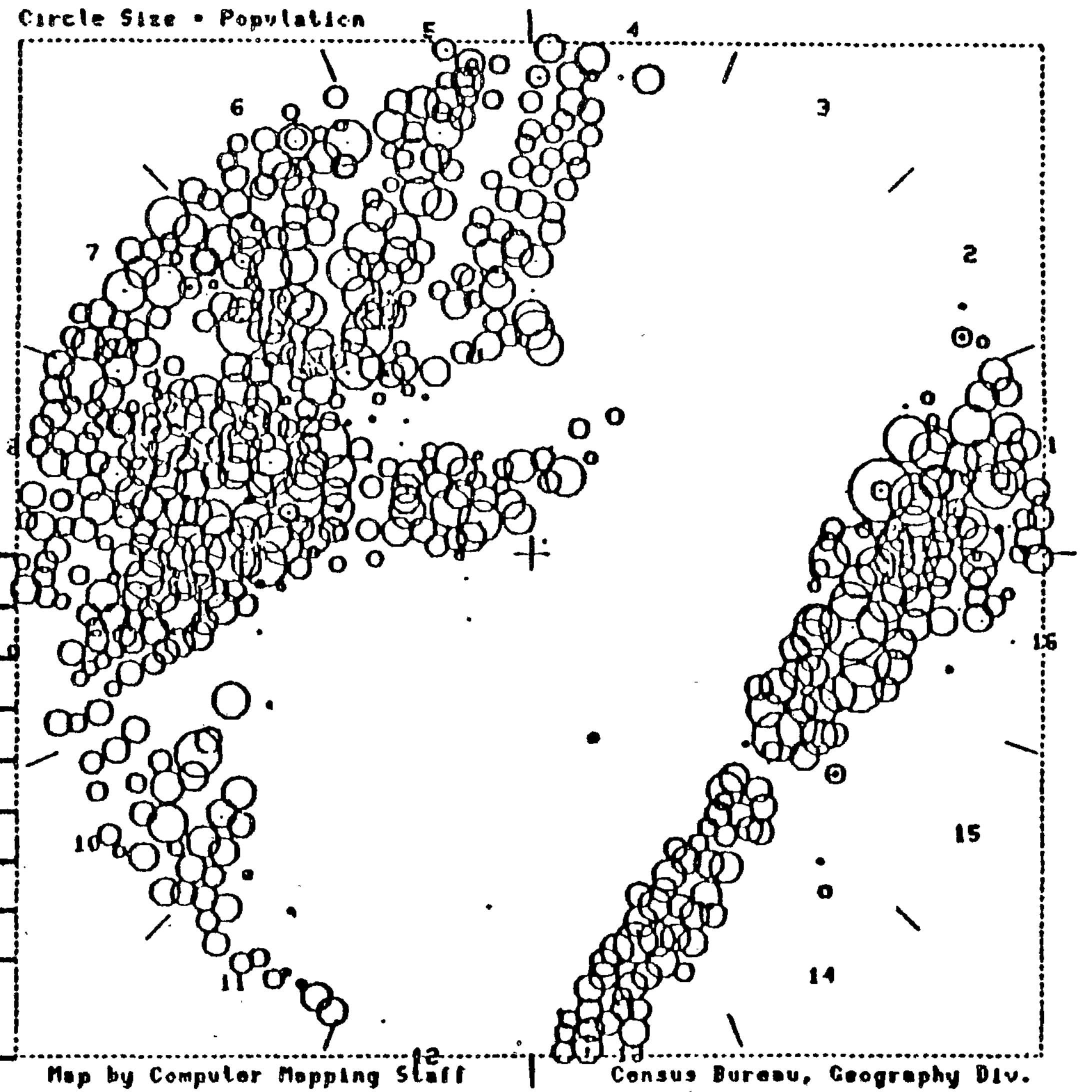


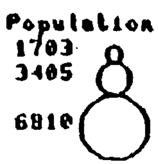
Figure D-10. Population density map for the area surrounding Prentiss Drug and Chem. Co., Newark, NJ.

THE PLOT CENTER IS AT:
LATITUDE 40.7186
LONGITUDE 74.1440

RADII From	To	POPULATION Within Ring	Cumulative
0.00	0.50	1802.	1802.
0.50	1.00	22120.	23922.
1.00	1.50	16600.	40522.
1.50	2.00	9598.	50120.
2.00	2.50	45926.	96046.
2.50	3.00	105299.	201345.
3.00	3.50	170609.	371954.
3.50	4.00	178860.	550814.
4.00	5.00	305700.	856514.

QUADRANT TOTALS:

Sector	Population
1	82854.
2	3118.
3	1055.
4	30129.
5	70244.
6	104551.
7	115852.
8	148770.
9	73244.
10	36473.
11	12578.
12	40.
13	39194.
14	28221.
15	33413.
16	70178.



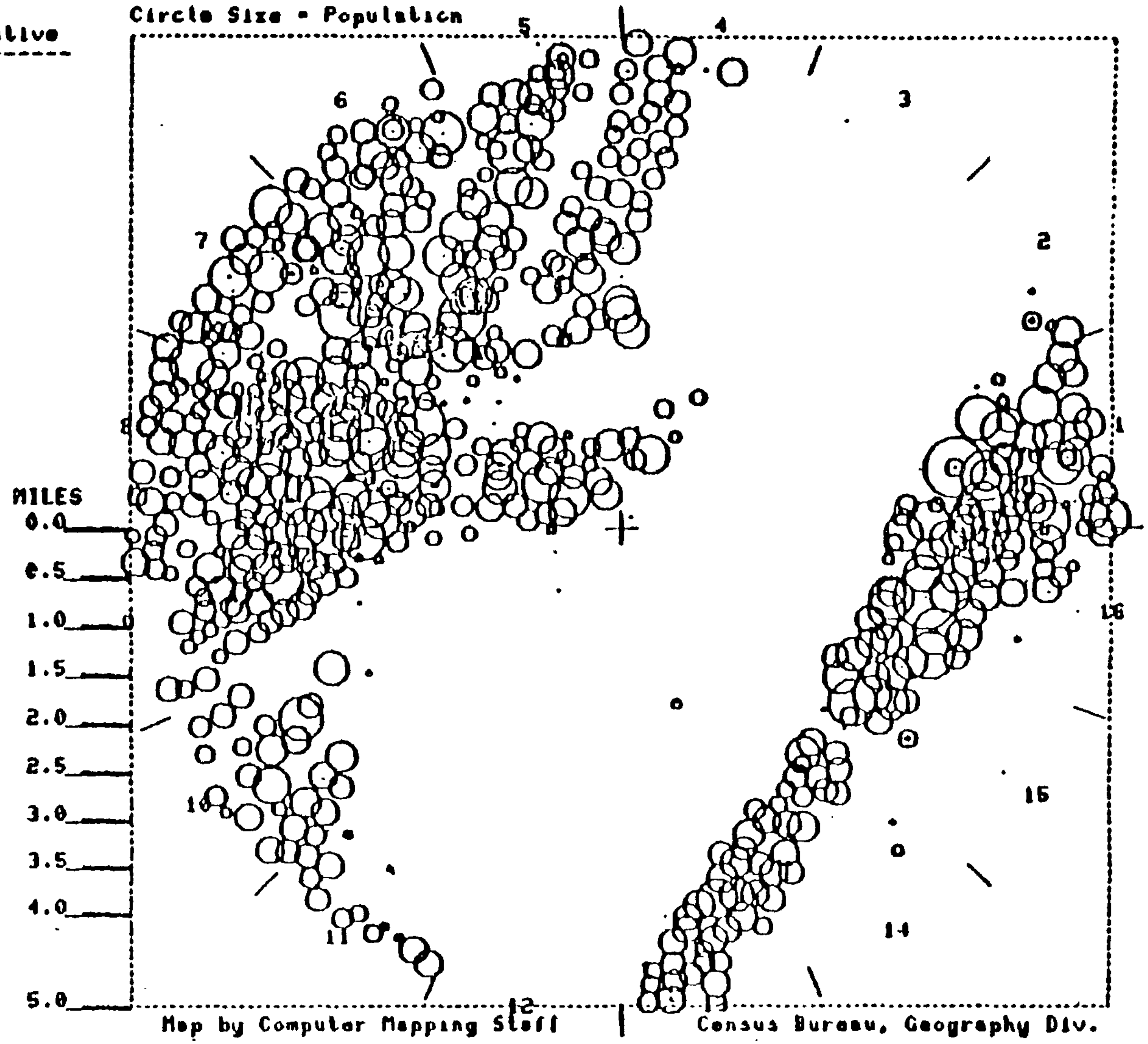


Figure D-11. Population density map for the area surrounding Troy Chem. Co., Newark, NJ.

MAP CREATED ON: 11-AUG-78 AT: 10:06:11

THE PLOT CENTER IS AT:
LATITUDE 40.7506
LONGITUDE 74.1069

RADII From	To	POPULATION Within Ring	Cumulative
0.00	0.50	11.	11.
0.50	1.00	0.	11.
1.00	1.50	608.	619.
1.50	2.00	11898.	12517.
2.00	2.50	65484.	78001.
2.50	3.00	105452.	183453.
3.00	3.50	141180.	324633.
3.50	4.00	189177.	513810.
4.00	5.00	303656.	817466.

QUADRANT TOTALS:

Sector	Population
1	96220.
2	18469.
3	9449.
4	3308.
5	29304.
6	48231.
7	62257.
8	97884.
9	95967.
10	56407.
11	42.
12	5939.
13	65815.
14	64849.
15	83631.
16	79795.

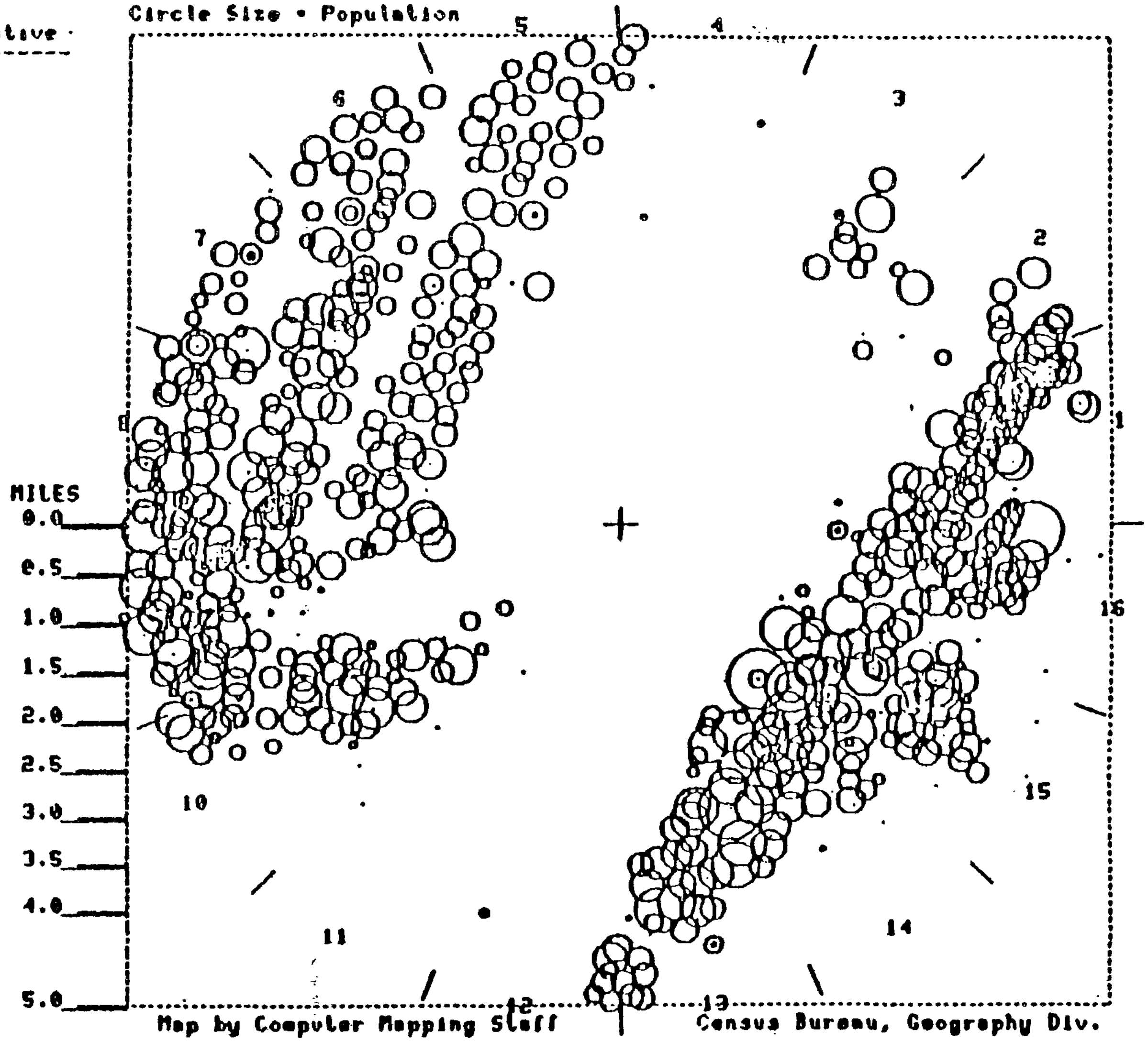


Figure D-12. Population density map for the area surrounding Standard Chlorine Chem. Co., Kearney, NJ.

MAP CREATED ON: 11-AUG-78 AT: 10:17:04

THE PLOT CENTER IS AT:
LATITUDE 40.8302
LONGITUDE 74.0887

RADII From	To	POPULATION Within Ring	Cumulative
0.00	0.50	936.	936.
0.50	1.00	15134.	16070.
1.00	1.50	20629.	36699.
1.50	2.00	23089.	59788.
2.00	2.50	32201.	91989.
2.50	3.00	67054.	159043.
3.00	3.50	61870.	220913.
3.50	4.00	83194.	304107.
4.00	5.00	265768.	569875.

QUADRANT TOTALS:

Sector	Population
1	20941.
2	37094.
3	22749.
4	46004.
5	44036.
6	68666.
7	59640.
8	33015.
9	47096.
10	62521.
11	29757.
12	128.
13	2261.
14	25171.
15	41843.
16	28953.

Population
1182
2364
4727

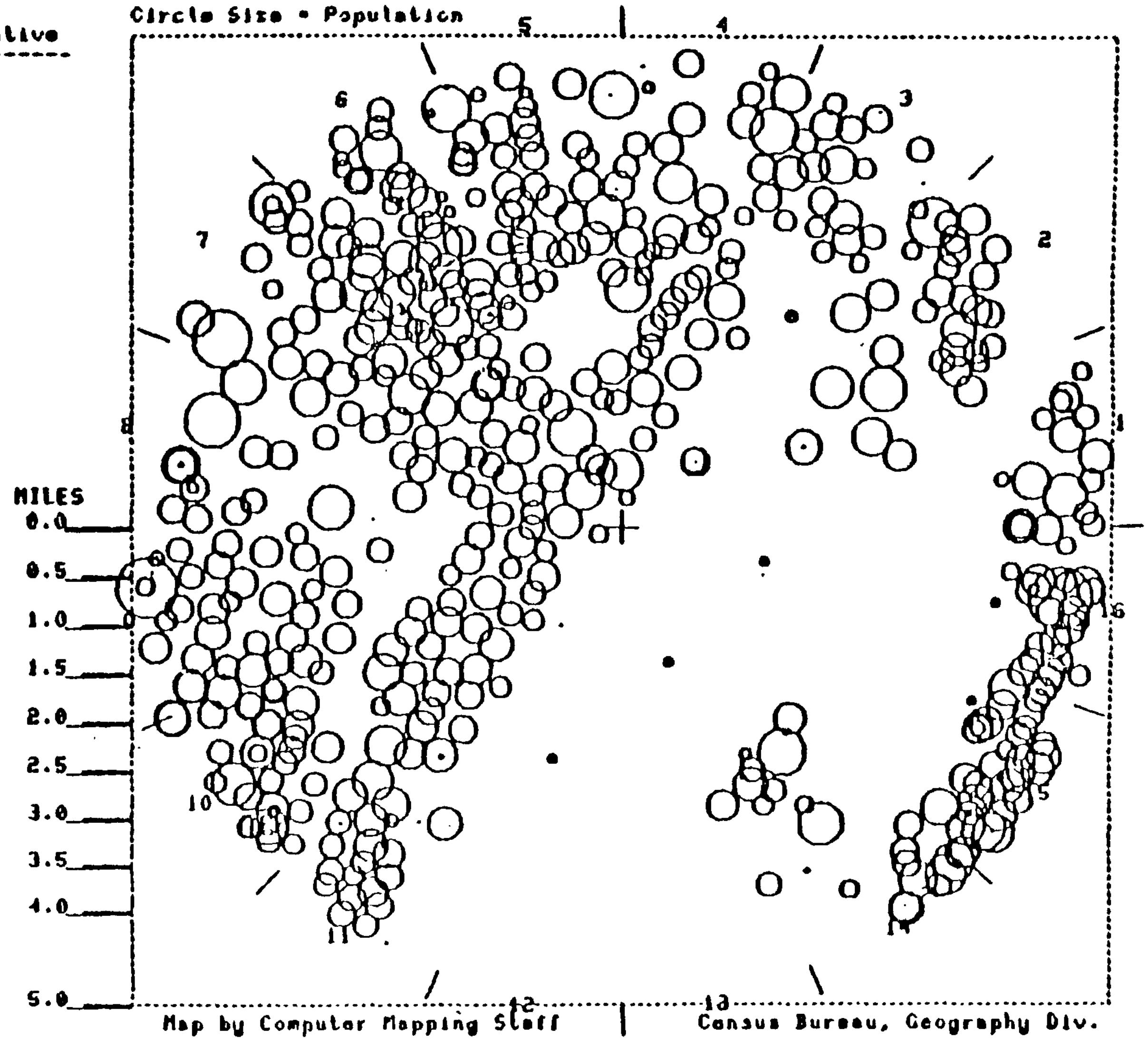


Figure D-13. Population density map for the area surrounding UOP, East Rutherford, NJ.

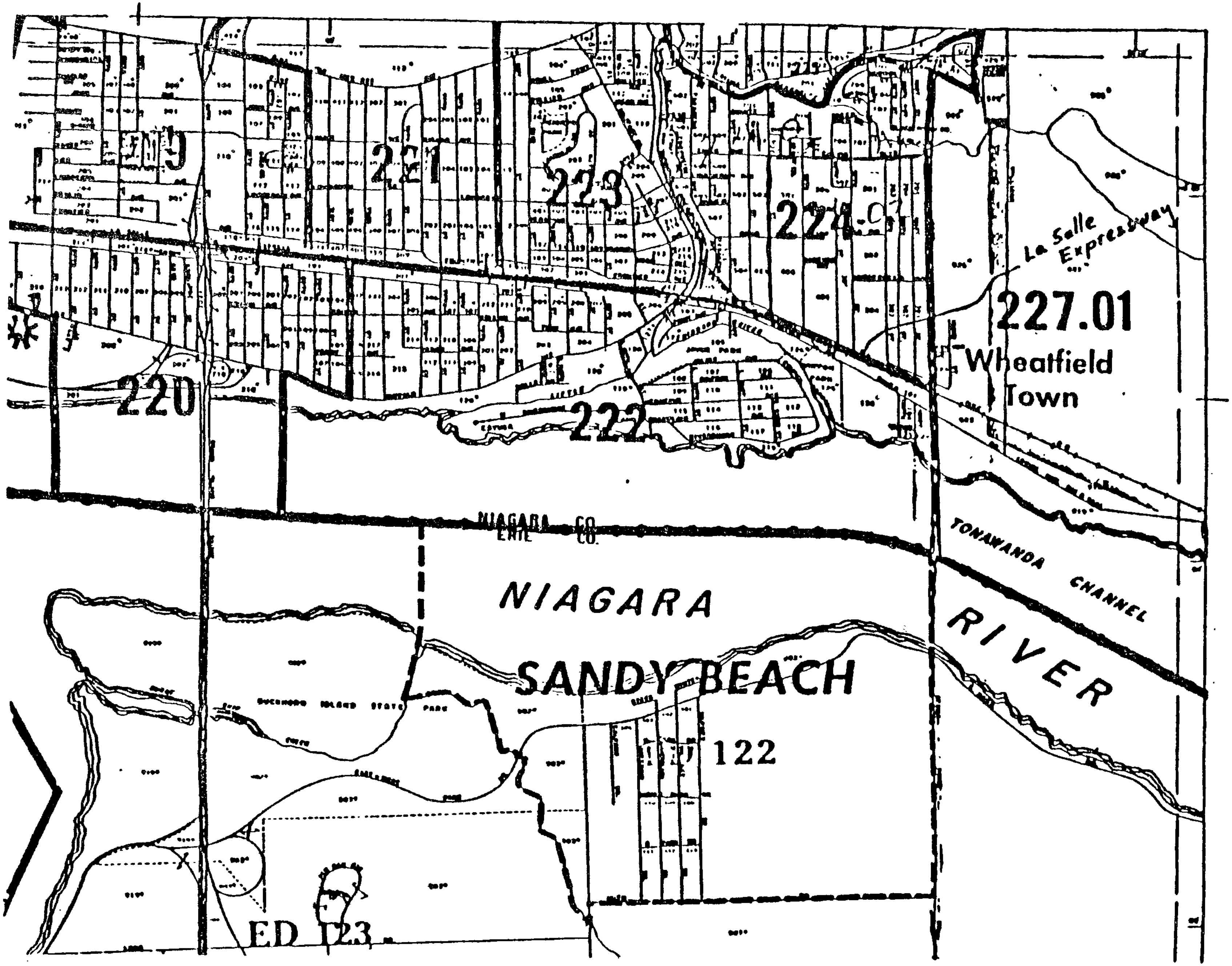


Figure D-14. Census tract map for the portion of Niagara Falls, NY, surrounding "Old Love" Canal.

Table D-1. CENSUS DATA FOR TRACTS SHOWN IN FIGURE D-14

Table 2. Characteristics of Housing Units and Population, by Blocks: 1970—Con. Niagara County, N.Y.

Blocks Within Census Tracts	
[illegible]	[illegible]

BLOCK STATISTICS

BUFFALO URBANIZED AREA N.Y.—87

MAP CREATED ON: 11-AUG-78 AT: 11:28:07

THE PLOT CENTER IS AT:
LATITUDE 29.7010
LONGITUDE 95.2564

RADII From	To	POPULATION Within Ring	Cumulative
0.00	0.50	0.	0.
0.50	1.00	5689.	5689.
1.00	1.50	15055.	20744.
1.50	2.00	18102.	38846.
2.00	2.50	22030.	60876.
2.50	3.00	43830.	104706.
3.00	3.50	29264.	133970.
3.50	4.00	39805.	173775.
4.00	5.00	103895.	277670.

QUADRANT TOTALS:

Sector	Population
1	17599.
2	94.
3	6263.
4	18104.
5	13485.
6	16143.
7	23512.
8	20734.
9	19669.
10	25414.
11	10191.
12	11392.
13	15888.
14	20198.
15	25283.
16	28701.

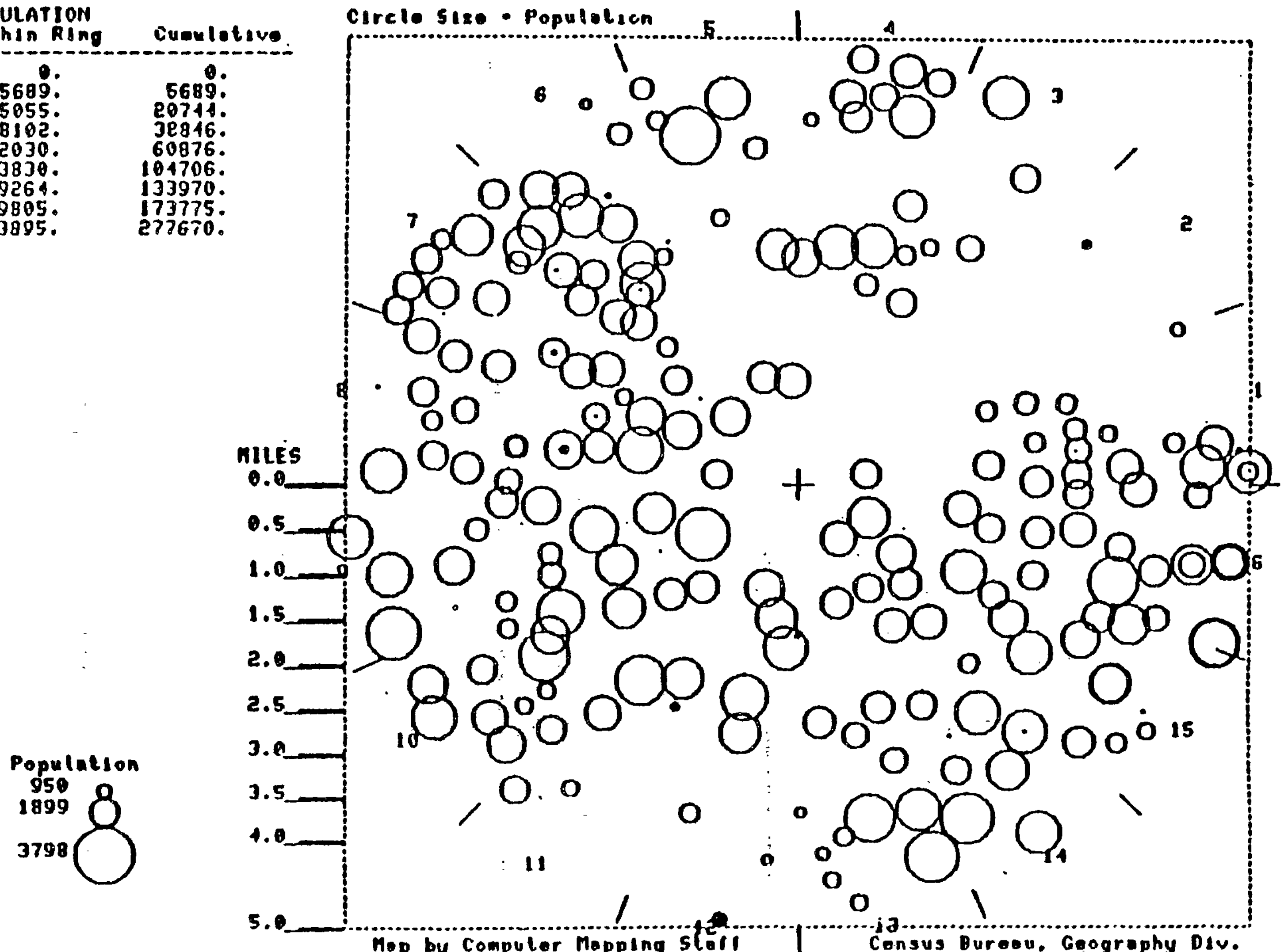


Figure D-15. Population density map for the area surrounding Petrotex, Houston, TX.

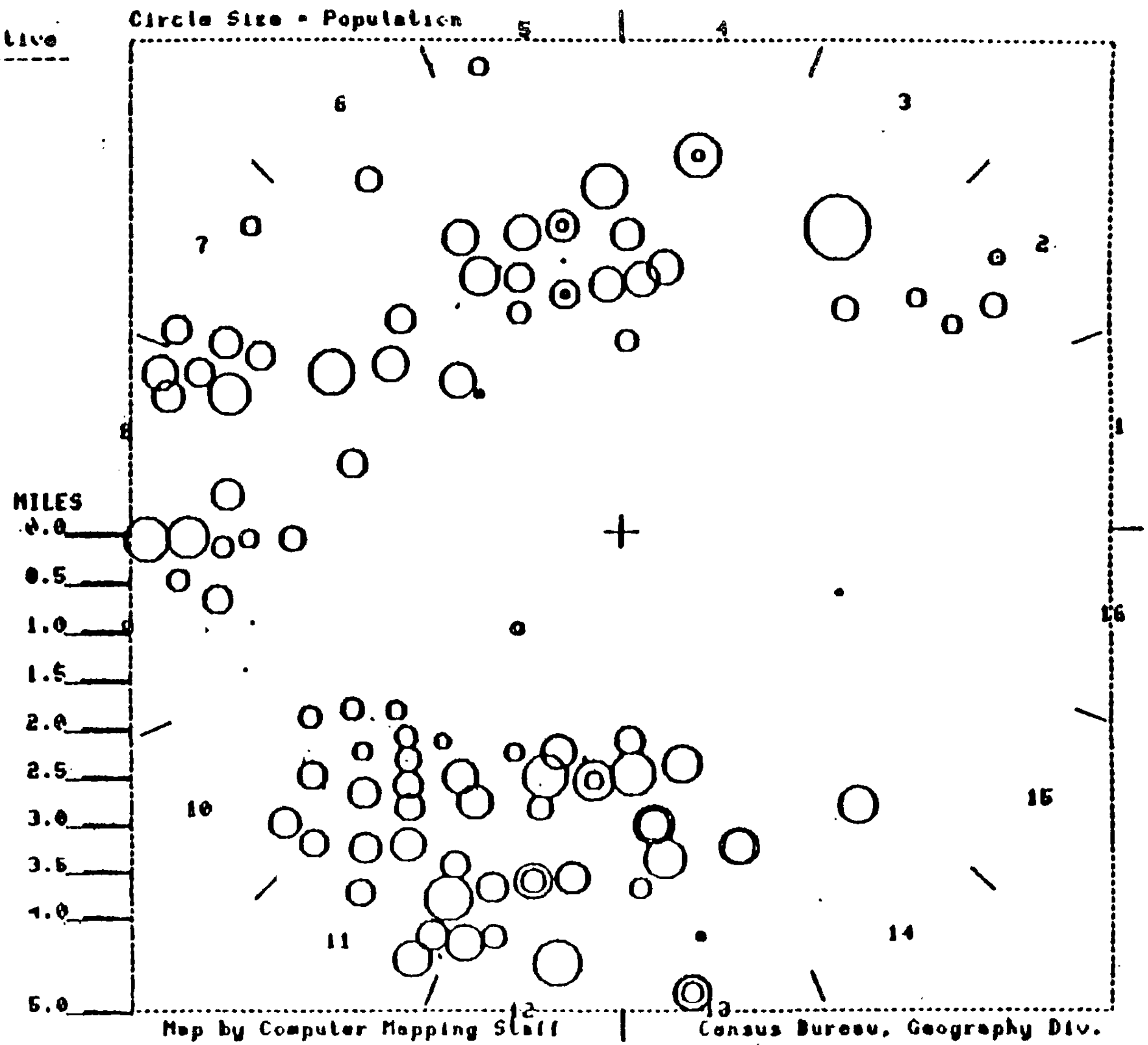
IAP CREATED ON: 11-AUG-78 AT: 11:08:30

THE PLOT CENTER IS AT:
LATITUDE 29.7405
LONGITUDE 95.1694

RADII From	To	POPULATION Within Ring	Cumulative
0.00	0.50	0.	0.
0.50	1.00	0.	0.
1.00	1.50	281.	281.
1.50	2.00	703.	984.
2.00	2.50	8462.	9446.
2.50	3.00	21691.	31137.
3.00	3.50	25243.	56380.
3.50	4.00	27918.	84298.
4.00	5.00	45496.	129794.

QUADRANT TOTALS:

Sector	Population
1	74.
2	3096.
3	4716.
4	7716.
5	9924.
6	5145.
7	10699.
8	8380.
9	8279.
10	5705.
11	20351.
12	24316.
13	19327.
14	1944.
15	0.
16	122.



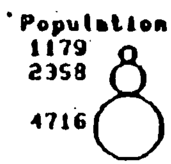


Figure D-16. Population density map for the area surrounding Ethyl Corp., Pasadena, TX.

IAP CREATED ON: 11-AUG-78 AT: 09:17:07

'HE PLOT CENTER IS AT:
.ATITUDE 29.3569
.ONGITUDE 94.9417

RADII From	To	POPULATION Within Ring	Cumulative
0.00	1.00	1105.	1105.
1.00	1.50	2053.	3159.
1.50	2.00	5570.	8728.
2.00	2.50	13350.	22078.
2.50	3.00	5635.	27713.
3.00	3.50	16327.	44040.
3.50	4.00	8689.	52729.
4.00	4.50	4742.	57471.
4.50	5.00	2539.	60010.

JUADRANT TOTALS:

Sector	Population
1	5920.
2	21387.
3	4876.
4	22325.
5	4047.
6	862.
7	422.
8	171.

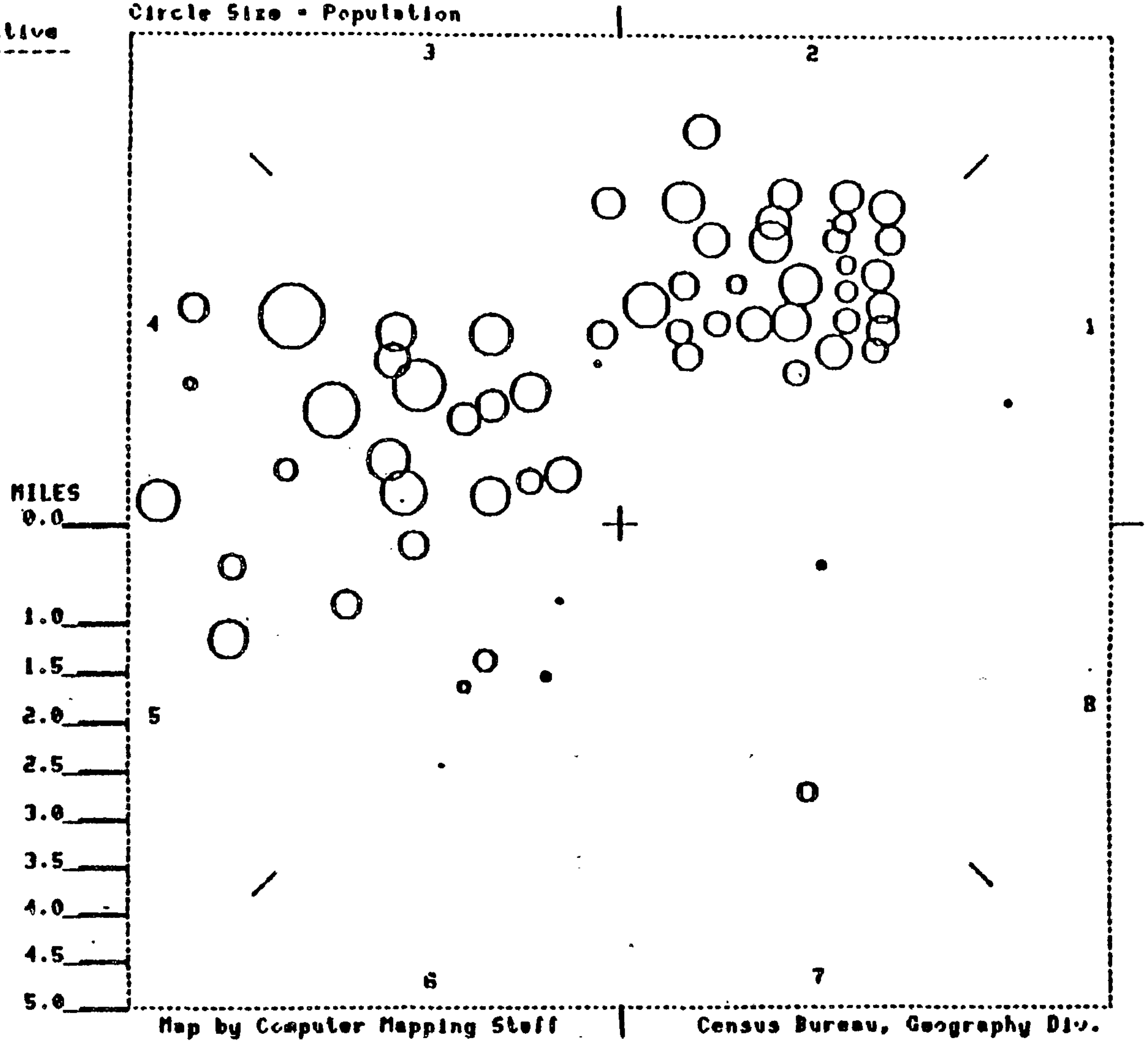


Figure D-17. Population density map for the area surrounding Gulf Chemical, Texas City, TX.

MAP CREATED ON: 11-AUG-78 AT: 11:25:29

THE PLOT CENTER IS AT:
LATITUDE 29.3722
LONGITUDE 94.9444

RADII From	RADII To	POPULATION Within Ring	Cumulative
0.00	0.50	0.	0.
0.50	1.00	3916.	3916.
1.00	1.50	8231.	12147.
1.50	2.00	5275.	17422.
2.00	2.50	16831.	34253.
2.50	3.00	8427.	42680.
3.00	3.50	10628.	53308.
3.50	4.00	1203.	54511.
4.00	5.00	5762.	60273.

QUADRANT TOTALS:

Sector	Population
1	4393.
2	11842.
3	6449.
4	5639.
5	852.
6	261.
7	3046.
8	13790.
9	6541.
10	4900.
11	1817.
12	150.
13	0.
14	422.
15	171.
16	0.

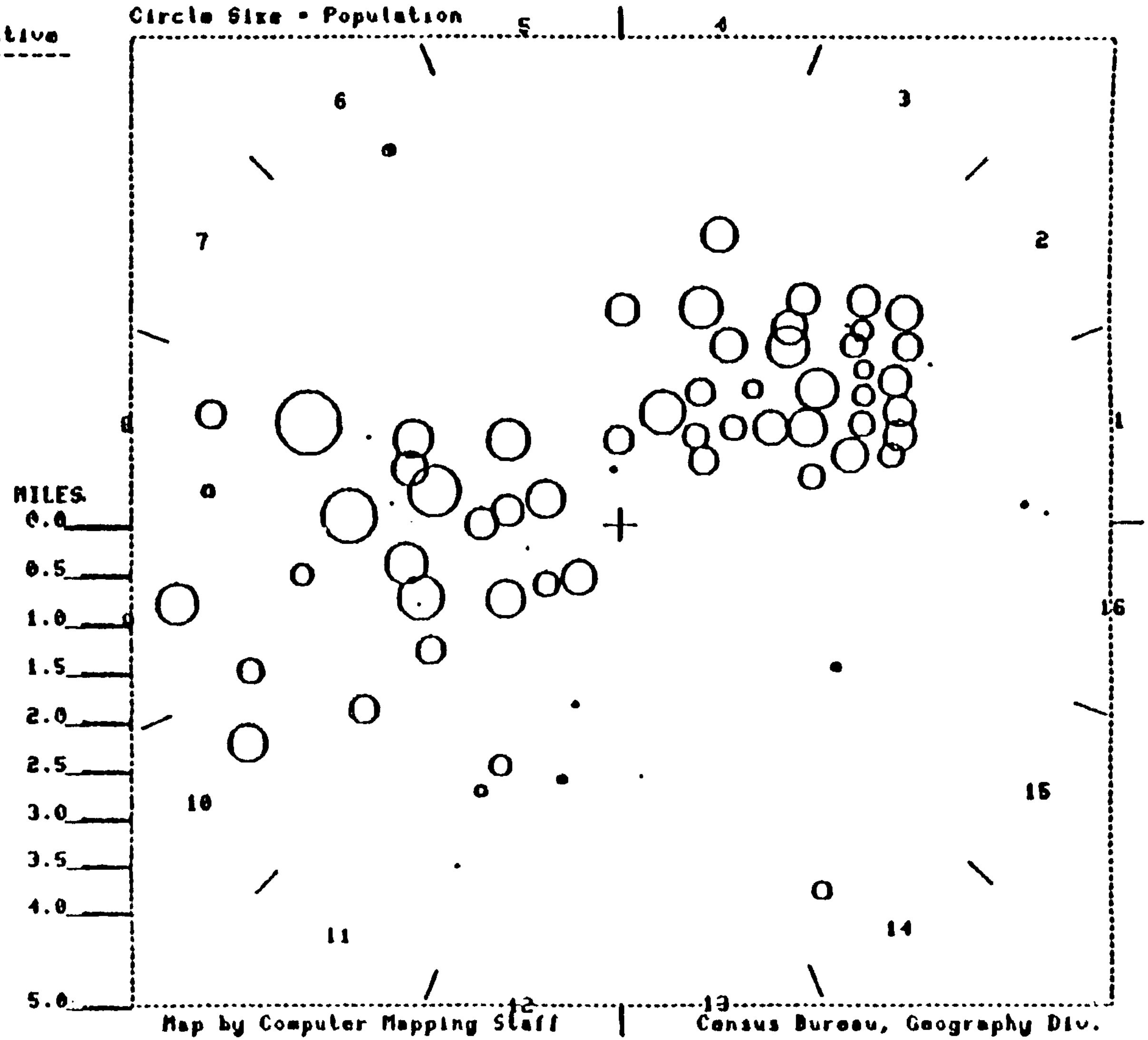


Figure D-18. Population density map for the area surrounding Union Carbide, Texas City, TX.

MAP CREATED ON: 11-AUG-78 AT: 11:23:10

THE PLOT CENTER IS AT:
LATITUDE 29.7001
LONGITUDE 95.0366

RADII From	To	POPULATION Within Ring	Cumulative
0.00	0.50	0.	0.
0.50	1.00	13.	13.
1.00	1.50	0.	13.
1.50	2.00	2516.	2529.
2.00	2.50	1866.	4395.
2.50	3.00	5167.	9562.
3.00	3.50	2999.	12561.
3.50	4.00	7312.	19873.
4.00	5.00	20382.	40255.

QUADRANT TOTALS:

Sector	Population
1	1852.
2	12281.
3	1753.
4	1834.
5	4080.
6	33.
7	106.
8	0.
9	6942.
10	1955.
11	869.
12	1305.
13	5095.
14	1549.
15	593.
16	8.

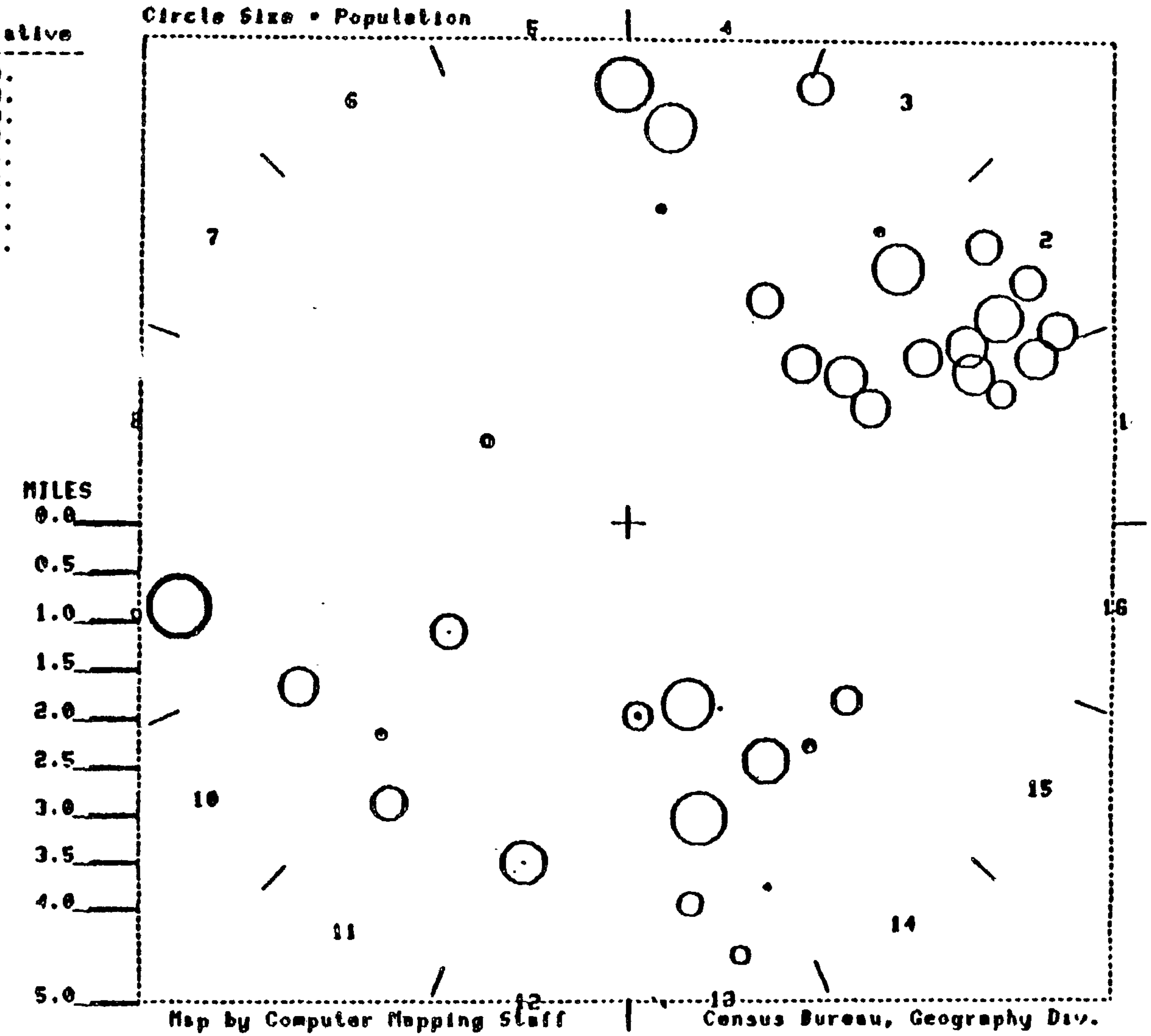


Figure D-19. Population density map for the area surrounding DuPont, LaPorte, TX.

MAP CREATED ON: 11-AUG-78 AT: 11:17:15

THE PLOT CENTER IS AT:
LATITUDE 29.7196
LONGITUDE 95.0870

RADII From	To	POPULATION Within Ring	Cumulative
0.00	0.50	0.	0.
0.50	1.00	0.	0.
1.00	1.50	0.	0.
1.50	2.00	167.	167.
2.00	2.50	59.	226.
2.50	3.00	9849.	10075.
3.00	3.50	1008.	11083.
3.50	4.00	1481.	12564.
4.00	5.00	31380.	43944.

QUADRANT TOTALS:

Sector	Population
1	1816.
2	1834.
3	4080.
4	911.
5	1364.
6	1935.
7	0.
8	57.
9	8833.
10	7639.
11	10083.
12	988.
13	942.
14	1552.
15	1808.
16	102.

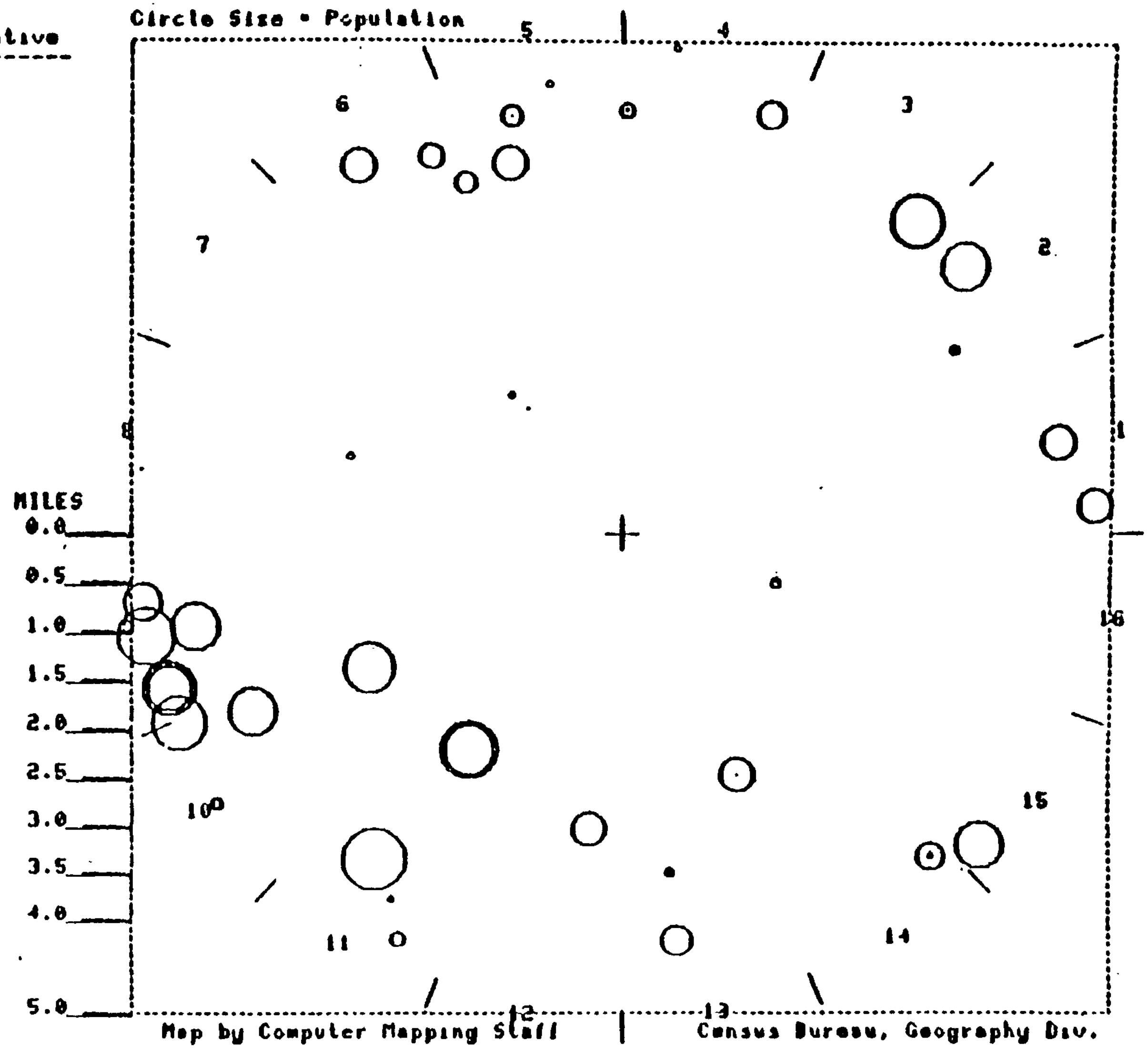


Figure D-20. Population density map for the area surrounding Upjohn, LaPorte, TX.

MAP CREATED ON: 11-AUG-78 AT: 11:14:31

THE PLOT CENTER IS AT:
LATITUDE 29.7296
LONGITUDE 95.1109

RADII From	To	POPULATION Within Ring	Cumulative
0.00	0.50	0.	0.
0.50	1.00	65.	65.
1.00	1.50	95.	160.
1.50	2.00	17.	177.
2.00	2.50	1963.	2140.
2.50	3.00	7404.	9544.
3.00	3.50	7426.	16970.
3.50	4.00	8812.	25782.
4.00	5.00	37885.	63667.

QUADRANT TOTALS:

Sector	Population
1	74.
2	12.
3	729.
4	2666.
5	7708.
6	2553.
7	3745.
8	64.
9	5912.
10	18469.
11	9590.
12	10083.
13	988.
14	967.
15	0.
16	102.

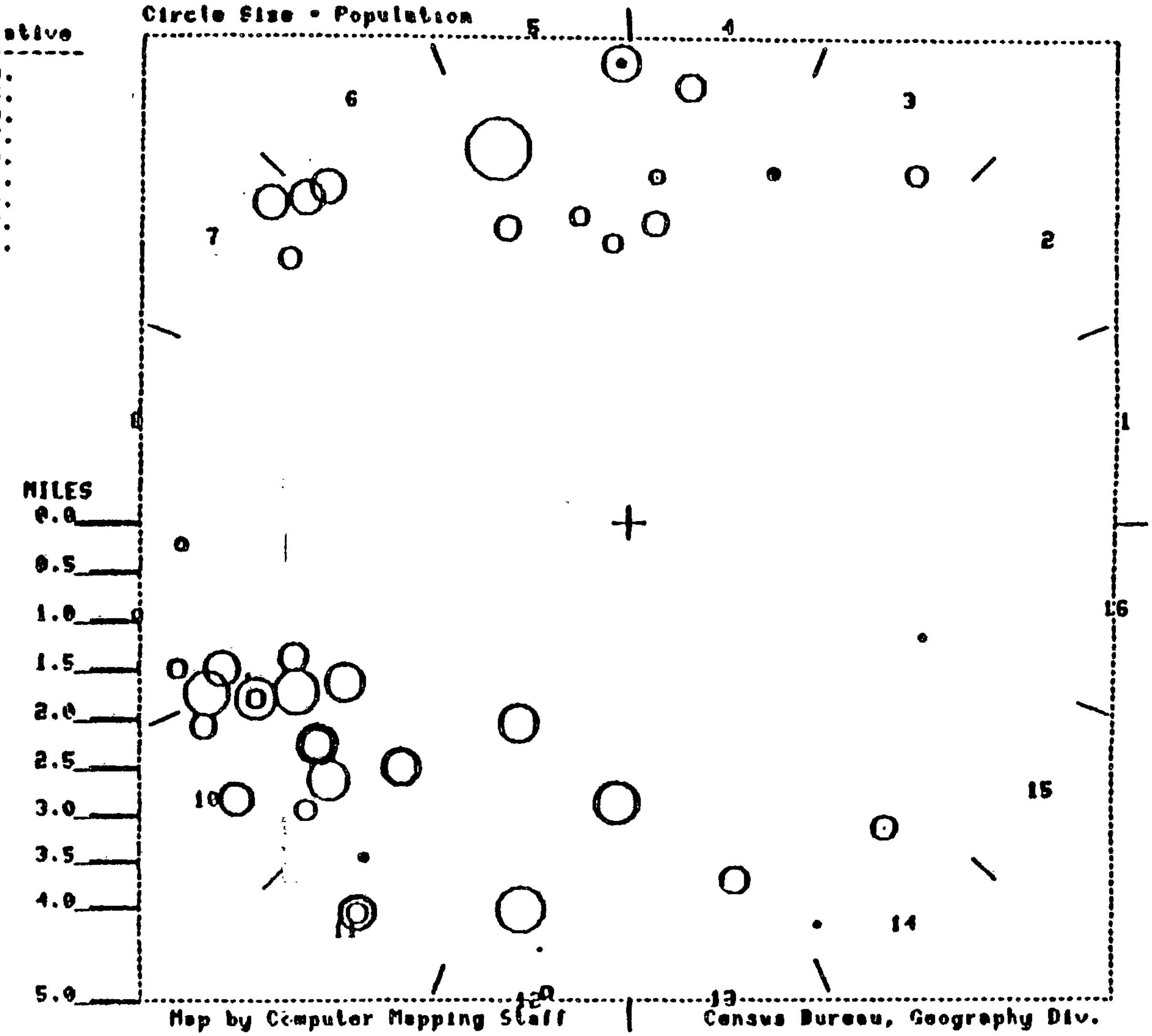


Figure D-21. Population density map for the area surrounding Diamond Shamrock, Deer Park, TX.

MAP CREATED ON: 11-AUG-78 AT: 11:19:50

THE PLOT CENTER IS AT:
LATITUDE 29.7305
LONGITUDE 95.0952

RADII From	To	POPULATION Within Ring	Cumulative
0.00	0.50	0.	0.
0.50	1.00	65.	65.
1.00	1.50	55.	120.
1.50	2.00	4.	124.
2.00	2.50	171.	295.
2.50	3.00	1964.	2259.
3.00	3.50	8765.	11024.
3.50	4.00	3475.	14499.
4.00	5.00	32674.	47173.

QUADRANT TOTALS:

Sector	Population
1	956.
2	5837.
3	603.
4	329.
5	4898.
6	6186.
7	15.
8	57.
9	3571.
10	10832.
11	4843.
12	6989.
13	1061.
14	894.
15	102.
16	0.

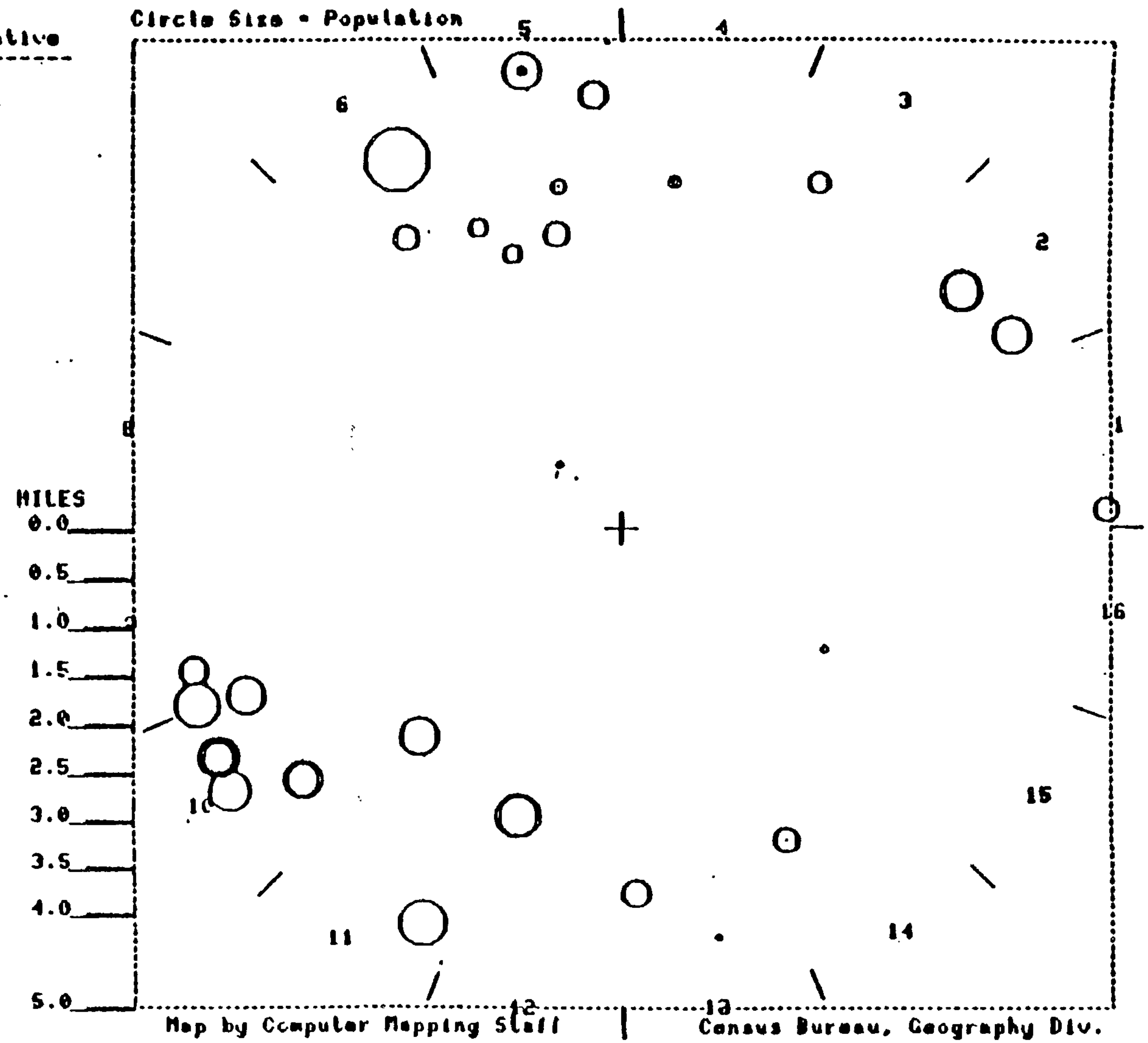


Figure D-22. Population density map for the area surrounding Rollins Environmental, Deer Park, TX.

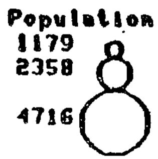
MAP CREATED ON: 11-AUG-78 AT: 11:11:59

THE PLOT CENTER IS AT:
LATITUDE 29.7149
LONGITUDE 95.1235

RADII From	To	POPULATION Within Ring	Cumulative
0.00	0.50	0.	0.
0.50	1.00	0.	0.
1.00	1.50	2001.	2001.
1.50	2.00	6942.	8943.
2.00	2.50	5133.	14076.
2.50	3.00	9388.	23464.
3.00	3.50	9024.	32488.
3.50	4.00	13302.	45790.
4.00	5.00	31694.	77484.

QUADRANT TOTALS:

Sector	Population
1	0.
2	12.
3	129.
4	2216.
5	5609.
6	760.
7	7.
8	274.
9	19311.
10	27492.
11	6719.
12	5085.
13	6942.
14	1930.
15	894.
16	102.



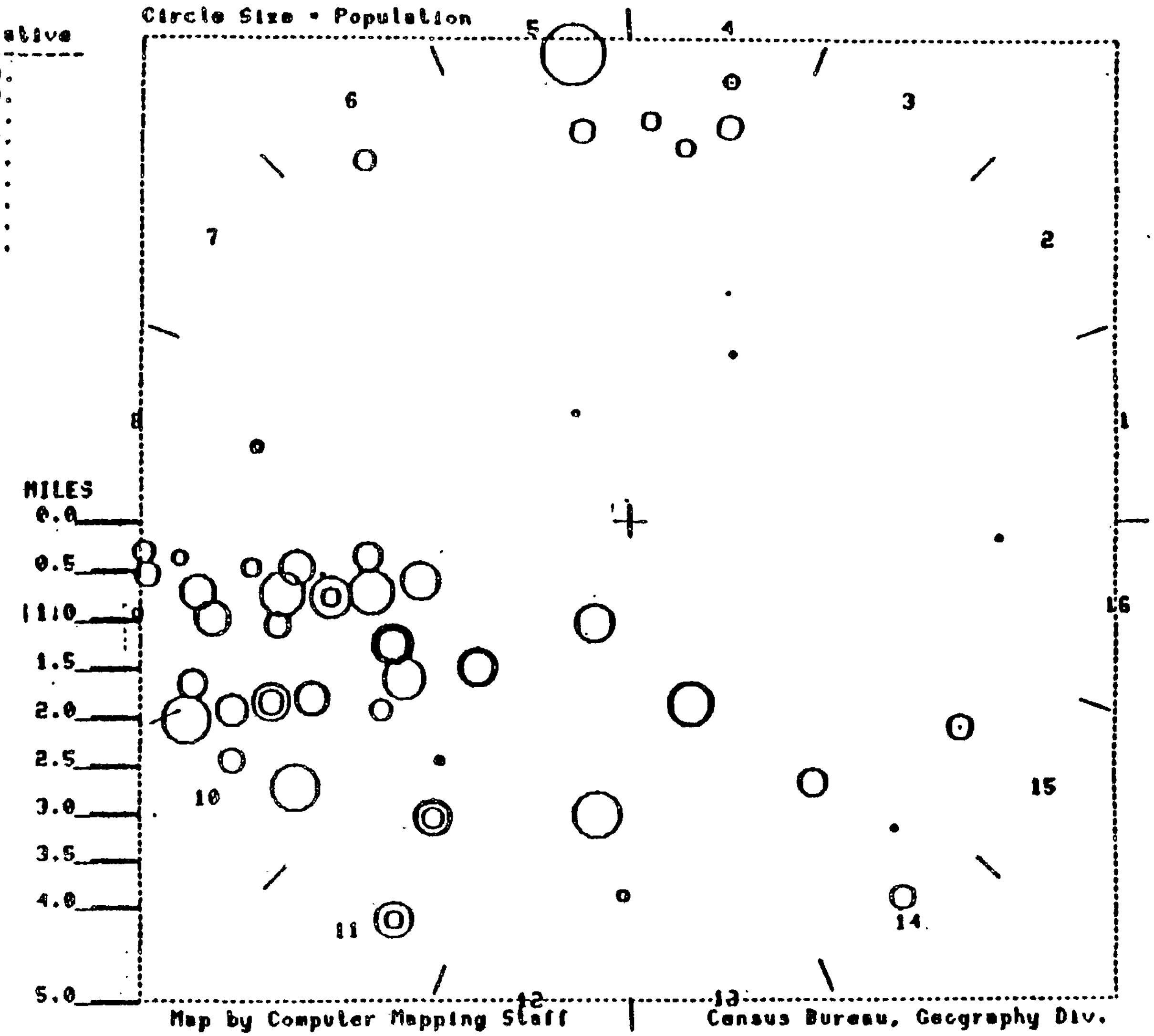


Figure D-23. Population density map for the area surrounding Shell Co., Deer Park, Tx.