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Determination of Toxic Chemicals in Effluent from Household Septic Tanks

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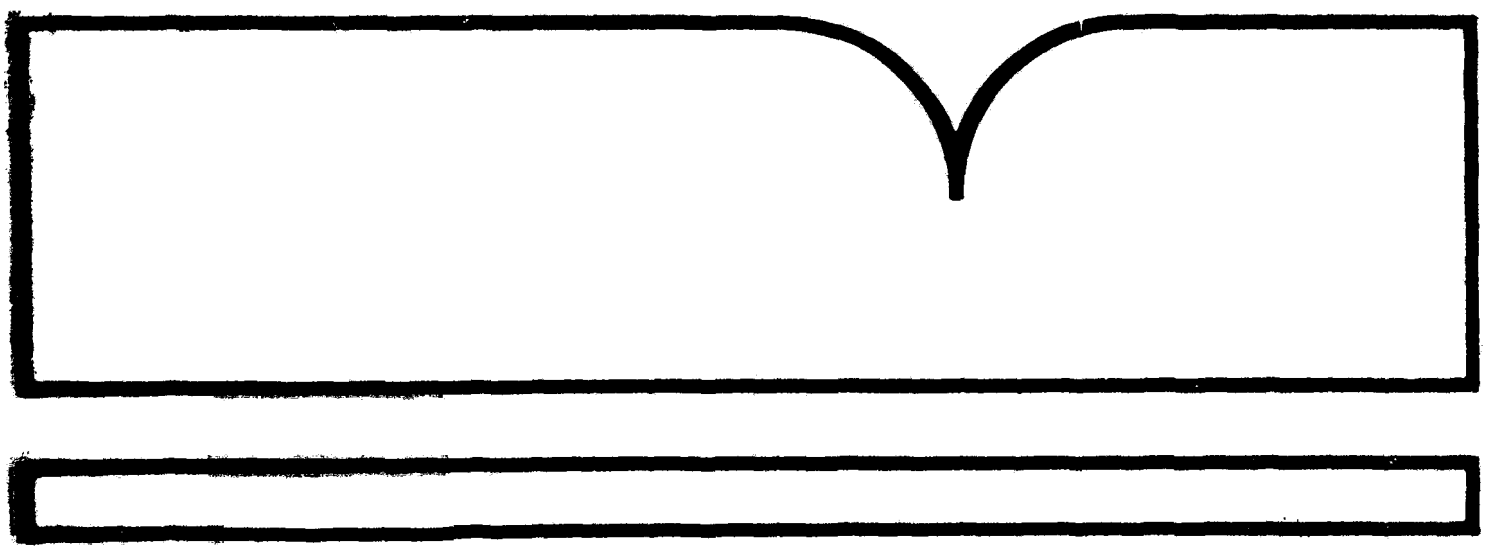

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DETERMINATION OF TOXIC CHEMICALS IN EFFLUENT FROM HOUSEHOLD SEPTIC TANKS

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WATER ENGINEERING RESEARCH LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
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16. ABSTRACT

The report study evaluated the presence of volatile organics in raw domestic sewage generated in a subdivision and treated by a large 5-year-old community septic tank that had recently been cleaned by having the solids removed by pumping just prior to this study. Analysis showed the presence of priority pollutants in the raw sewage. Essentially no removal of these compounds occurred during the 2-day detention in the septic tank. The priority pollutants generally showed higher levels during the weekend, probably reflecting leisure activities and use of related chemicals (paint thinners, grease removers, toilet bowl cleaners, etc.), than during the week days. Most of the other volatile compounds were hydrocarbons, and their removal by the septic tank generally decreased with increasing molecular weight. Several organic sulfur compounds showed substantial increase as a result of anaerobic degradation processes in the septic tank.

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Although the information described in this document has been funded wholly or in part by the United States Environmental Protection Agency through assistance agreement number R-806102 to the University of Washington, it has not been subjected to the Agency's required peer and administrative review and therefore does not necessarily reflect the views of the Agency and no official endorsement should be inferred.

FOREWORD

The U. S. Environmental Protection Agency is charged by Congress with protecting the Nation's land, air, and water systems. Under a mandate of national environmental laws, the agency strives to formulate and implement actions leading to a compatible balance between human activities and the ability of natural systems to support and nurture life. The Clean Water Act, the Safe Drinking Water Act, and the Toxics Substances Control Act are three of the major congressional laws that provide the framework for restoring and maintaining the integrity of our Nation's water, for preserving and enhancing the water we drink, and for protecting the environment from toxic substances. These laws direct the EPA to perform research to define our environmental problems, measure the impacts, and search for solutions.

The Water Engineering Research Laboratory is that component of EPA's Research and Development program concerned with preventing, treating, and managing municipal and industrial wastewater discharges; establishing practices to control and remove contaminants from drinking water and to prevent its deterioration during storage and distribution; and assessing the nature and controllability of releases of toxic substances to the air, water, and land from manufacturing processes and subsequent product uses. This publication is one of the products of that research and provides a vital communication link between the researcher and the user community.

The purpose of this project was to measure the presence of volatile priority pollutants in domestic sewage as it enters a large community septic tank system and to evaluate the removal of these compounds in the anaerobic septic tank by analyzing effluent samples collected from the distribution box as well as the sludge and scum found in the septic tank.

This report is to bring this information to the attention of design engineers and to researchers conducting work on the fate of priority pollutants.

Francis T. Mayo, Director
Water Engineering Research Laboratory

ABSTRACT

The present study evaluated the presence of volatile organics in raw domestic sewage generated in a subdivision and treated by a large 5-year-old community septic tank that had recently been cleaned by having the solids removed by pumping just prior to this study. Analysis showed the presence or priority pollutants in the raw sewage. Essentially no removal of these compounds occurred during the 2-day detention in the septic tank. The priority pollutants generally showed higher levels during the week end, probably reflecting leisure activities and use of related chemicals (paint thinners, grease removers, toilet bowl cleaners, etc.) than during the week days. Most of the other volatile compounds were hydrocarbons, and their removal by the septic tank generally decreased with increasing molecular weight. Several organosulfur compounds showed substantial increase as a result of anaerobic degradation processes in the septic tank.

This report was sbumitted in fulfillment of cooperative agreement R-806102 by the University of Washington, under sponsorship of the U.S. Environmental Protection Agency.

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On-site disposal of sewage is widely practiced in rural areas and urban fringes. However, it has received relatively little attention from regulatory agencies or research institutes. For example, little comprehensive information is currently available to document successes and failures of on-site disposal systems and the resulting health implications. The 1970 census noted 403,910 septic tanks or cesspools and 14,464 other individual systems such as aerobic or ponds in the State of Washington, representing 34.7% of all housing units (Bureau of the Census, 1972). A current survey in the State of Washington also indicates the presence of more than 500 large on-site systems serving hospitals, schools, restaurants and subdivisions (DeWalle, 1981). As the septic tank effluent is directly returned to the soil through infiltration in the subsurface drainfield, considerable public health concern exists in regard

to groundwater contamination and pollution of drinking water wells. A recent study showed such widespread contamination in major parts of central Pierce County south of Tacoma (DeWalle and Schaff, 1980).

The development of the septic tank is credited to John Louis Mouras who constructed a masonry tank in which sewage and rainwater from a dwelling in Vesoul, France, were collected before passing to a cesspool. Absence of solids after twelve years of operation led to its patent in 1881. The first household septic tank in the U.S. was constructed by Edward Philbrick of Boston, Massachusetts, in 1883, and consisted of two round chamber tanks (Metcalf, 1901). Various types, shapes and arrangements have been used since the earliest units with detention times ranging from 2 hours in so-called "freshwater clarification tanks" in Germany, to 20 days in large underground tanks in Poland, and usually 24 hours in U.S. systems. Walker and Driftmeier (1929) noted decreasing solids removals when detention times increased from 35 to 92 hours. Weibel et al. (1949) noted a leveling off of the suspended solids (SS) removal beyond a detention time of half a day, while the biochemical oxygen demand (BOD) removal still showed stabilization after one day. The low suspended solids removal observed during the summer represents a typical unloading of the sludge in which the generated gases carry the solids out of the tank. Additional factors shown to be of importance are sufficient depth to allow for sludge accumulation, compartmentalization to prevent short circuiting and use of baffles to reduce sludge carry over.

In previously published studies only the efficiency of the septic tank with respect to BOD, SS and grease removal was evaluated while the trace organics present in domestic sewage and in septic tank effluent were not measured. The present study was conducted to collect such data. It was the purpose of the study to measure the presence of volatile priority pollutants in domestic sewage as it enters a large community septic tank system. The study also evaluated the removal of these compounds in the anaerobic septic tank by analyzing effluent samples collected from the distribution box.

Materials and Methods

A community septic tank serving 97 homes in a subdivision (Oakbrook 6) located south of Tacoma, Pierce County, Washington, was used for this study. The homes are located on four streets served by a 200 mm (8 inch) gravity sewer which discharges into a wetwell (Figure 1). A 10.1 L/s (160 gpm) submersible centrifugal pump transports the waste to the septic tank. The unit contains 84,935 litres (22,440 gallons) liquid volume in the first compartment and 42,468 litres (11,220 gallons) in the second compartment (Figure 2). The raw sewage sample was collected through the manhole from the inlet-T before the sewage mixed with the contents of the first compartment. The effluent sample was collected from the distribution box located 4.57 meters (15 feet) downstream from the effluent-T.

The sewage was collected using an all glass/teflon custom-made sampler. The sewage was drawn by suction through a 0.5 inch

teflon intake line using a 100 ml glass syringe. When the syringe was in its drawn position, a teflon solenoid valve closed the intake line and opened the discharge line. When the syringe content was subsequently displaced, it flowed through the discharge line to a collection device with a floating plunger to prevent losses of volatile organics. The septic tank effluent was collected using a similar sampler drawing from below the liquid surface in the distribution box. The samples were collected as 24 hour composites during a 7-day continuous period.

The volatile organics were removed from the aqueous sample with a purge and trap method (Kalman, et al., 1980. A modified Hewlett/Packard 7675A Purge and Trap Sampler was used to purge 10 ml of liquid with nitrogen gas at a rate of 20 ml/min. The volatile organics that were stripped from the liquid were subsequently absorbed when the nitrogen passed through a Tenax GC trap. The trap was subsequently heated and the volatile organics were back flushed and trapped in the initial 0.5 meter portion of a 30 m fused silica WCOT column with SE-54, stationary phase (J & W Scientific) chilled by liquid nitrogen. After removal of the cryotrap and flash heating of the column, the volatiles were separated in the gas chromatograph (Model (3840A Hewlett/Packard, Palo Alto, California) and detected by mass spectrometry (Finnigan 4023, Finnigan, Sunnyvale, California). A computer library system containing spectra of 30,000 compounds was used for a spectral comparison with each detected compound.

Results and Discussion

a. Flow measurements

Flow data were obtained both from the water usage records of the Lakewood Water District Company and from measurements in the wetwell. The water usage data show a baseline of 58.7 litres per minute (15.5 gallons per minute), which usage triples to 219.5 litres per minute (58 gpm) during the summer months due to extensive yard usage. The frequency distribution of the flow rates (Figure 3) shows several maxima corresponding to usage in a household with 1, 2, 3, 4, 5, 6, or 7 persons respectively. The median household, having 3.2 persons, has a usage of 897 litres per day (237 gallons/day). The usage ranges from 329.3 litres per person per day (87 gallons per person per day) for a one-person household to 242.2 litres per person per day (64 gallons per person per day) for a seven-person household.

The flow measurement at the wetwell consisted of determining the interval between sequenced pump switch-on times. By knowing the holdup volume in the wetwell the flow rate during the day can be calculated. This resulted in an average calculated flow of 44.7 litres per minute (11.8 gpm) which is 24% less than calculated from the usage data, indicating that about a quarter of the used water does not reach the septic tank and is lost through evaporation (clothes dryer, plant evapotranspiration, sewer leaks, etc.). The highest discharge rates and highest standard deviation were noted around 9 p.m. (Figure 4).

b. Presence of Trace Organics

The efficiency of the volatile organic analysis (VOA) using the purge and trap unit was evaluated using surrogate compounds spiked at 20 ppb in the liquid before purging. The results show a median recovery of 91% for bromochloromethane, 90% for 1,4-dichlorobutane, and 82% for D_6-benzene (Figure 5). The standard deviations, however, were substantial at this low concentration level.

The organics were measured in the samples during an intensive week long monitoring followed by six additional samplings, the last one occurring on January 23, 1982. The results are summarized in Table 1 and indicate that dichloromethane was found in all samples, followed by toluene in frequency of detection. These two compounds were also found in the water collected from the 125-foot deep monitoring well located adjacent to the drainfield. The analysis during the week long monitoring was initiated on Monday, September 22, and was terminated on Sunday, September 28, 1980. The volatile organic fraction typically contained 40 to 50 compounds at a concentration > 1 ppb. However, only 5 were identified as priority pollutants. Appendix A has the daily data.

Toluene was the most prevalent among the priority pollutants, at an average concentration of 34.6 µg/L in the raw sewage, and 38.8 µg/L in the effluent (Figure 6). The toluene, originating from cleaning solvents and paint thinners, reached its maximum concentration of 47.8 µg/L in the influent on Friday, while the effluent reached a maximum of 56.9 µg/L on Sunday. The

shift in the maximum toluene concentration by 2 days may be a result of the detention time which was estimated at approximately 2 days.

Dichloromethane likely originating from chlorinated tapwater was present in the next highest concentration (Figure 7) and also showed its highest level on Sunday. However, no lag was detected between effluent and influent. Chloroform (Figure 8) showed its maximum concentraion in the influent on Saturday, while the effluent showed a second maximum on Sunday, representing a one-day shift. Tetrachloroethene was generally low during the week but reached a maximum on Monday. Benzene was detected only on Wednesday.

A log-normal frequency distribution graph of the aromatic compounds (Figure 9) shows the presence of benzene only in the scum and sludge layer. Although benzene was not detected in the influent, it was detected on two occasions in th effluent, possibly due to discharge of solids from the scum or sludge layer. Toluene showed no removal in the septic tank and very little accumulation in the scum and sludge layer. Low removals were also noted for the chlorinated compounds (Figures 10, 11).

The generally low removals of the volatile organics is further reflected in Figure 12, showing the reconstructed ion current of all the compounds detected in this fraction. A tabulation of the 48 compounds (Table 2) shows that the majority are hydrocarbons including both aliphatic and cyclic structures. Several compounds reflect the presence of anaerobic degradation processes occurring in the sewerline or septic tank. High

concentrations were noted for 2-propanone, 2-ethyl-4-methyl-1-pentanol and 4-methyl-2-propyl-1-pentanol, all likely originating from anaerobic decomposition processes. Large increases were also noted for several biogenic organosulfur compounds such as carbon disulfide, methanethiol (methylmercaptan), dimethyl disulfide and dimethyl trisulfide. The largest increase was noted for methanethiol with small increases noted with larger molecular weight compounds probably reflecting the greater difficulty for bacteria to generate these larger compounds. This trend for alcohols, aldehydes, and organosulfur compounds is reflected in Figure 13 where the effluent/influent ratio of each compound generally decreases with increasing retention during the chromatographic separation. A larger retention time generally reflects an increasing molecular weight. The low molecular weight alkylated benzenes show a significant removal, probably due to biodegradation, but the results show no removal for higher molecular weight compounds. The hydrocarbons (Figure 14) showed the highest removals at intermediate molecular weight and lower removals at larger molecular weights, probably due to reduced volatilization. The increase noted for several of the low molecular weight hydrocarbons may be a result of their formation as intermediates in the breakdown of larger molecular weight hydrocarbons.

The present study has important implications for assessing the environmental impact of septic tanks. As little removal of the volatile priority pollutants is observed, these compounds will be discharged through the subsurface drainfield and may

enter the groundwater. Volatilization is a removal mechanism in the septic tank, but this mechanism will not be effective in the presence of a thick scum layer and during subsurface drainage and migration. Some biodegradation of several organosulfurs and hydrocarbons will likely occur during soil migration, especially since aerobic conditions generally prevail. The chlorinated organics and most of the branched or cyclic hydrocarbons, however, are less likely to be degraded by bacterial action, and are expected to migrate considerable distances in the soil. A related study by DeWalle and Chian (1981) noted substantial migration of low molecular weight chlorinated solvents away from a landfill in Delaware.

Conclusion

The present study evaluated the presence of volatile organics in raw domestic sewage generated in a subdivision and treated by a large 5-year-old community septic tank that had recently been cleaned by having the solids removed by pumping just prior to this study. Analysis showed the presence of priority pollutants in the raw sewage which compounds showed essentially no removal during the 2-day detention in the septic tank. The priority pollutants generally showed higher levels in the week end, probably reflecting leisure activities and use of related chemicals (paint thinners, grease removers, toilet bowl cleaners, etc.). Most of the other volatile compounds were hydrocarbons, and their removal by the septic tank generally decreased with increasing molecular weight. Several organosulfur compounds showed substantial increase as a result of anaerobic degradation processes in the septic tank.

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Table 1. Occurrence of Volatiles in Septic Tank

Compound	Tap n=2	Influent n=13	Effluent n=13	Scum n=2	Sludge n=2	Well n=1
Dichloromethane	100%	100%	100%	100%	100%	100%
Chloroform	0	62	62	0	0	0
Trichlorofluoromethane	0	0	0	50	0	0
Bromomethane	0	0	15	100	50	0
1,1,2-trichloroethane	0	0	8	8	0	0
Trichloroethane	0	8	8	50	0	0
1,1,1-trichloroethane	0	0	8	0	0	0
1,3-dichloropropene	0	8	0	0	0	0
Benzene	0	0	15	100	50	0
Chlorobenzene	0	0	0	0	50	0
Toluene	0	85	85	50	0	100
Ethylbenzene	0	15	23	100	100	0

Table 2. Forward Search of Volatile Compounds in Septic Tank (Sunday)

Volatile Compounds (mg/L)	Scan	Influent	Scan	Effluent
Methane, dichlorodifluoro	1380	0.64	—	< 0.7
Methanethiol	—	< 0.7	1395	128
2-Propanone	1407	18.2	1410	70.3
Methane, thiobis	1415	23.0	1418	84.4
Unknown hydrocarbon	1419	2.0	1421	4.2
Carbon disulfide + dichloromethane	1422	4.2	1424	10.0
C_7 hydrocarbon	1536	13.0	1527	13.6
Hexane, 3-methyl	1558	8.1	—	< 0.7
Heptane	1612	6.2	—	< 0.7
Disulfide, dimethyl	1754	11.6	1729	29.7
Benzene, methyl	1842	74.4	1825	16.7
Hexane, 2,5-dimethyl	1843	14.9	—	< 0.7
Heptane, 3-methyl	1875	5.3	—	< 0.7
Cyclohexane, 1,3-dimethyl, cis	1883	5.3	—	< 0.7
Cyclohexane, 1,3-dimethyl, trans	1890	1.2	—	< 0.7
Cyclohexane, 1-ethyl-2-methyl	1971	1.0	—	< 0.7
Heptane, 2.4-dimethyl	2009	15.3	—	< 0.7
C_{10} cyclic hydrocarbon	—	< 0.7	2770	3.3
Pentane, 2,2,3,4-tetramethyl	2947	9.7	—	< 0.7
Trisulfide, dimethyl	2960	11.4	2941	12.7
Heptane, 6,6-dimethyl-2-methylene	2997	6.2	—	< 0.7
Hexane, 2,2,5,5-tetramethyl	3000	8.0	—	< 0.7
Branched C_{10} hydrocarbon	3044	3.7	—	< 0.7
Nonene, 4,6,8-trimethyl	3074	3.4	—	< 0.7
Hexane, 3,3,4-trimethyl	3091	3.2	—	< 0.7
Hexane, 2,4-dimethyl	3124	8.3	—	< 0.7
Benzene, 1,4-dichloro	3149	16.7	3134	11.5
Pentane, 2,2,3-trimethyl	3157	2.5	—	< 0.7
C_{10} cyclic hydrocarbon	3179	7.2	3168	25.1
Benzene, 1-methyl-4 (1-methylethyl)	3211	15.4	3205	71.6
Heptane, 2,2,4,6,6-pentamethyl	3221	17.1	3212	7.2
Cyclohexane, 1-methyl-4-(1-methylethenyl)	3229	126	3221	107
C_{10} hydrocarbon	3238	3.6	—	< 0.7
Hexane, 2,2,5-trimethyl	3240	7.2	3231	15.5
Hexane, 3,3-dimethyl	3252	38.7	3242	21.7
Hexane, 2,2,3-trimethyl	3326	45.8	3318	24.7
1,4-cyclohexadiene, 1-methyl-4(1-methylethyl)	3346	3.9	—	< 0.7
Butane 2,2,3-trimethyl	3349	3.9	—	< 0.7
1-pentanol, 2-ethyl-4-methyl	3367	21.2	3362	13.6
Pentane, 2,3,4-trimethyl	3408	11.9	3402	7.6
Pentane, 2,2,4,4-tetramethyl	3415	4.0	3410	1.8
Cyclohexane,1-methyl-4-(1-methylethylidene	3453	9.2	3449	15.7
1 pentanol, 4-methyl-2-propyl	3500	13.5	3497	10.0
Hexane 2,2,3-trimethyl	3583	5.9	3579	3.4
Cyclonexane (1-methylethyl)	—	< 0.7	3606	1.9
Bicycloneptane 3,7,7-trimethyl	3650	5.3	3652	41.6
Heptane, 5-ethyl-2-methyl	3717	5.7	3714	37.7
Benzene, 1,2,3-trichloro	—	< 0.7	3745	2.7
Total		623		793

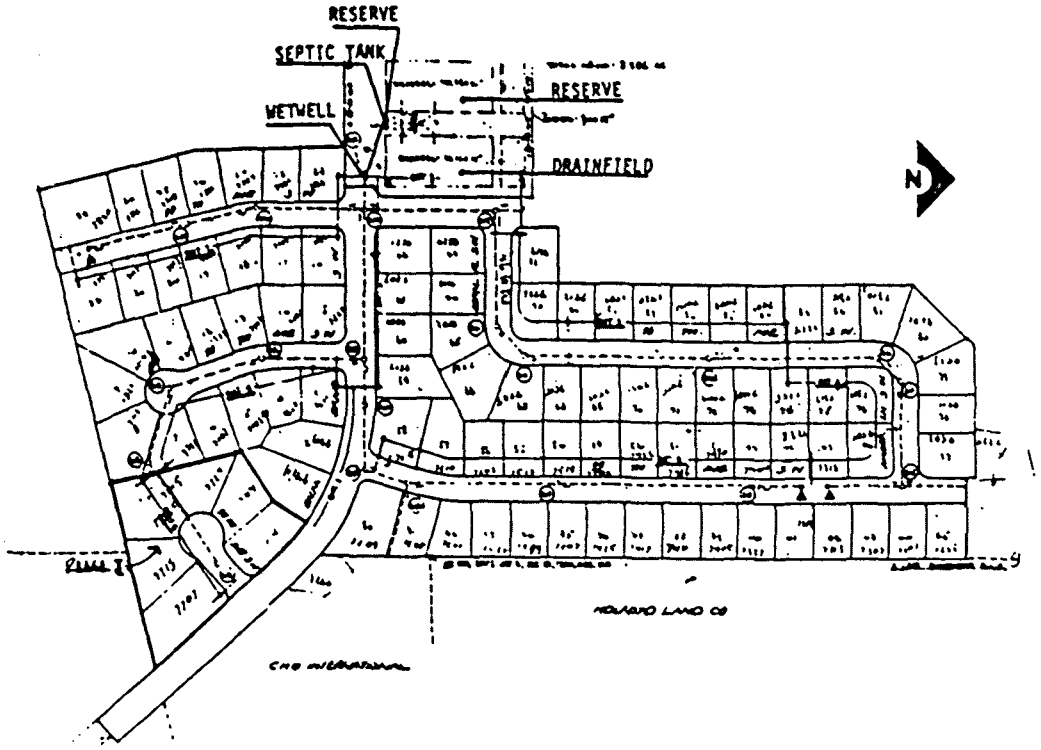

Figure 1. Subdivision with community septic tank evaluated in the present study.

(To provide the reader with complete information, these reduced engineering drawings are included. These are the best copies available; we regret that portions are undecipherable.)

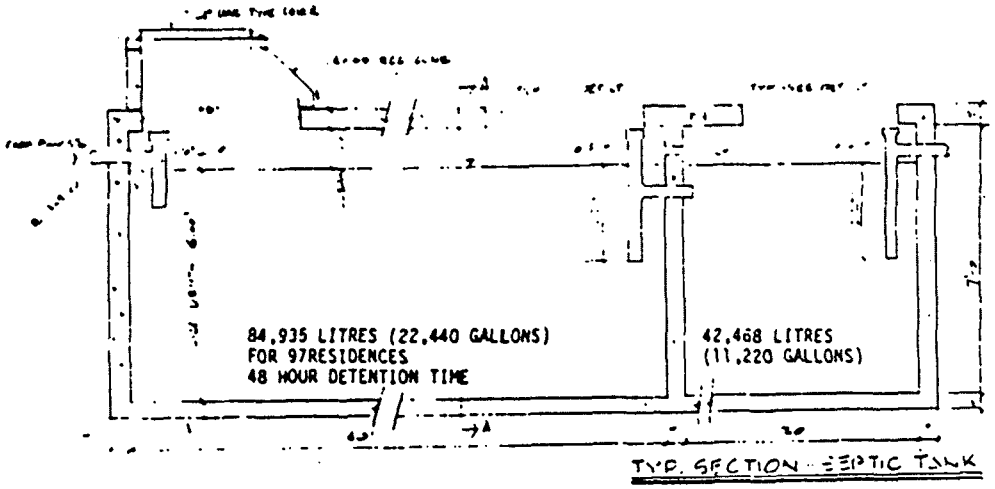

Figure 2. Community septic tank evaluated in the present study.

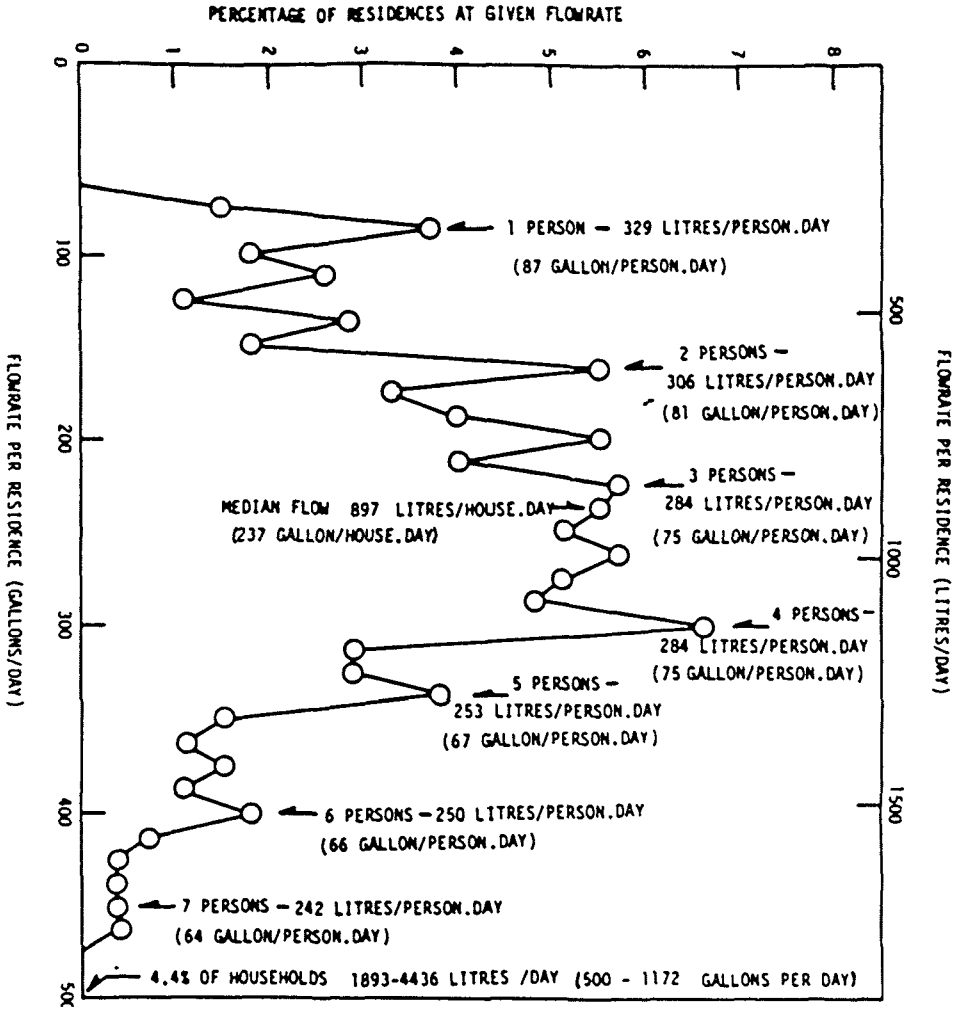

Figure 3. Frequency distribution of water usage.

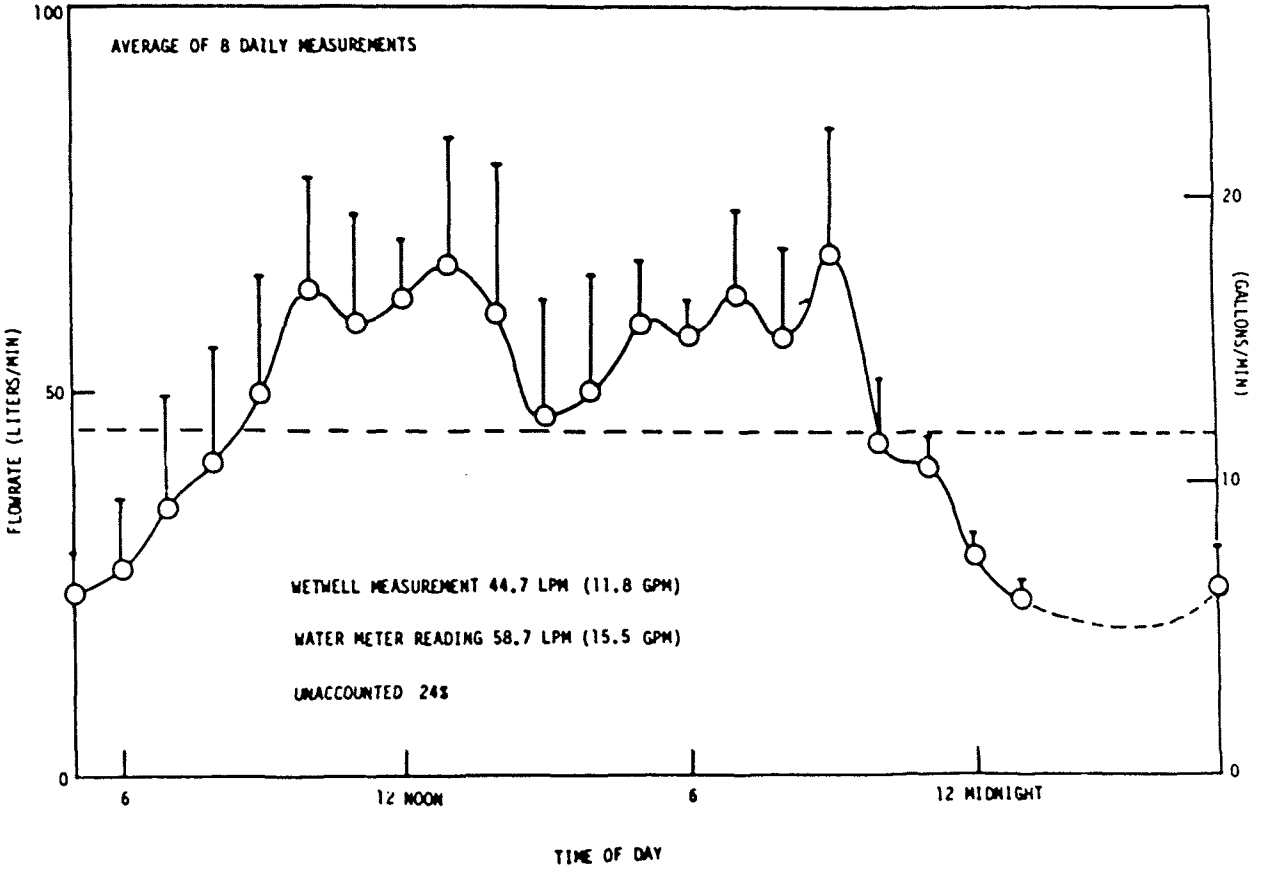

Figure 4. Flow pattern at septic tank system.

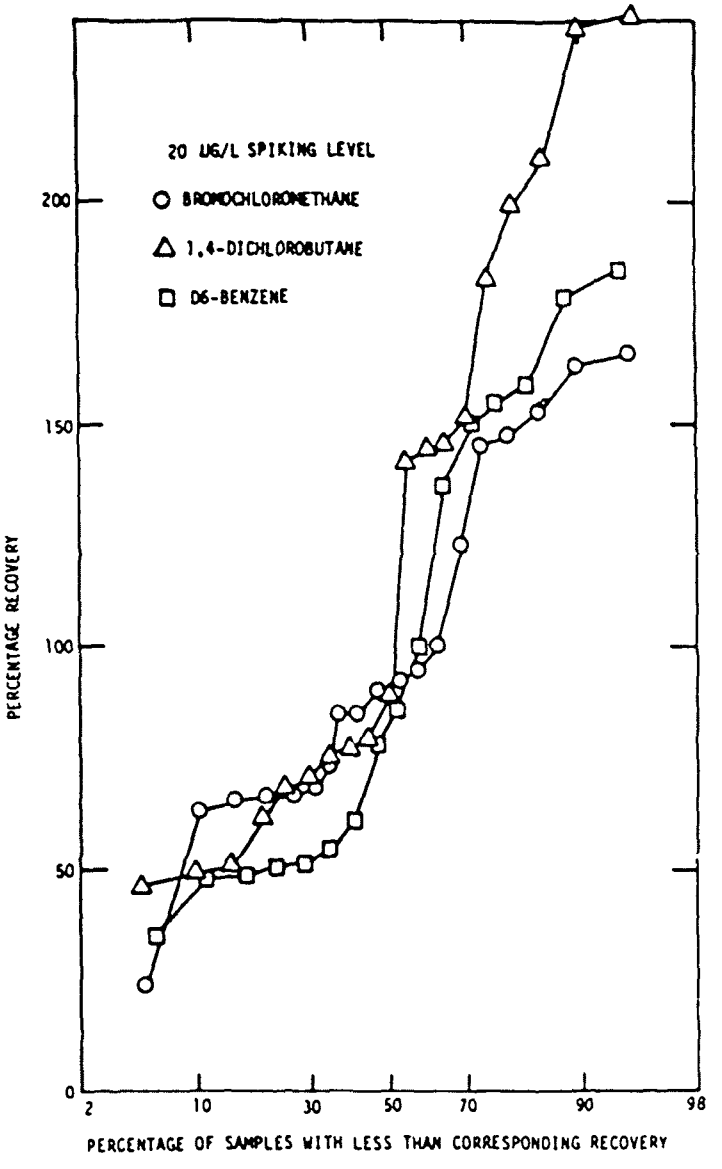

Figure 5. Normal frequency distribution of surrogate recovery.

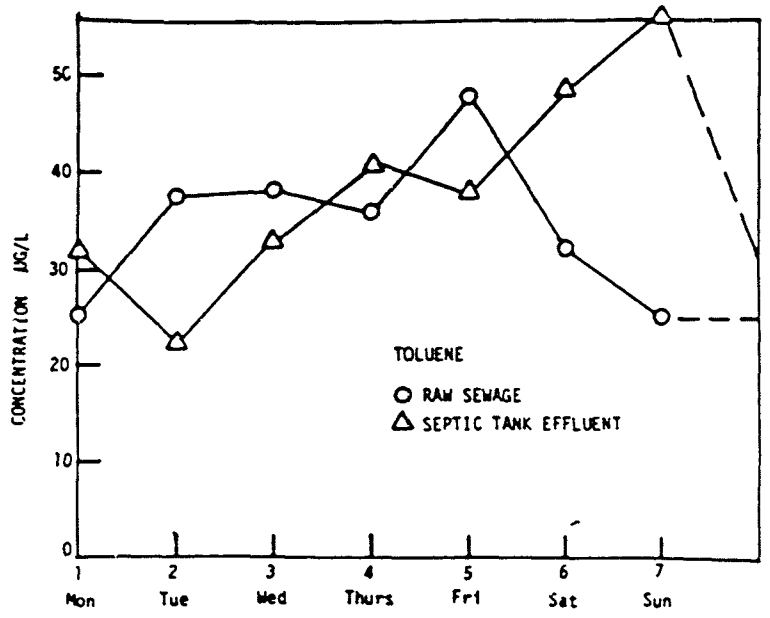

Figure 6. Daily variation of toluene.

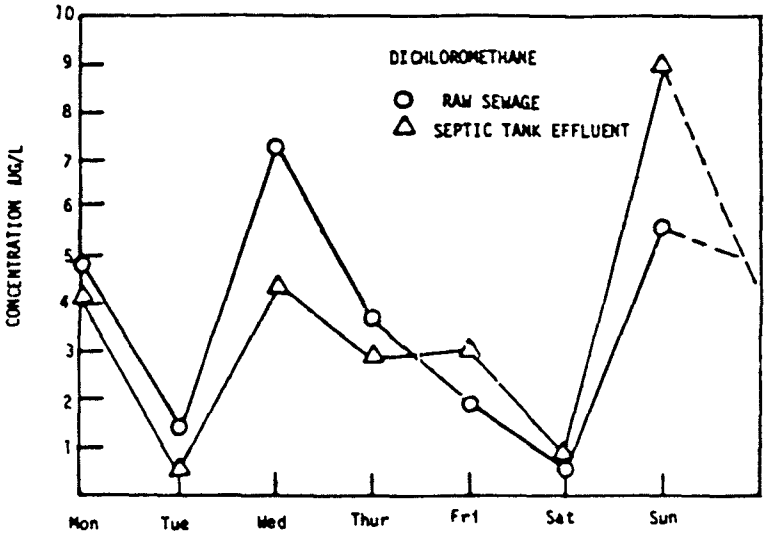

Figure 7. Daily variation of dichloromethane.

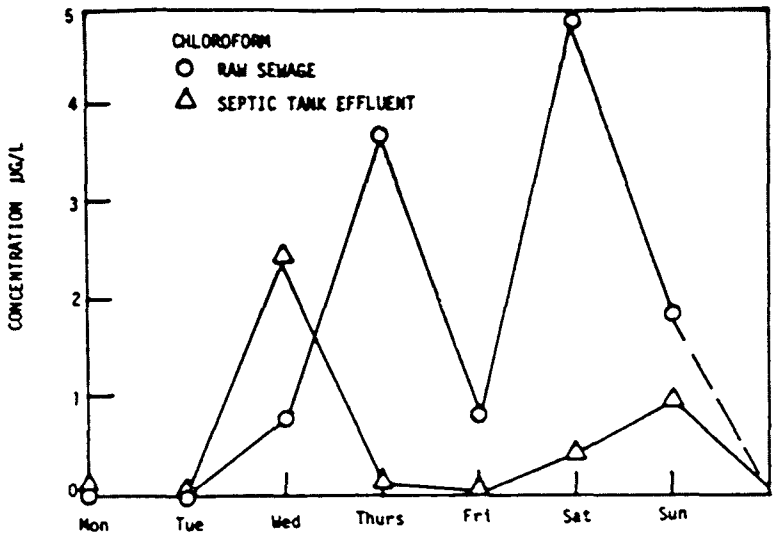

Figure 8. Daily variation of chloroform.

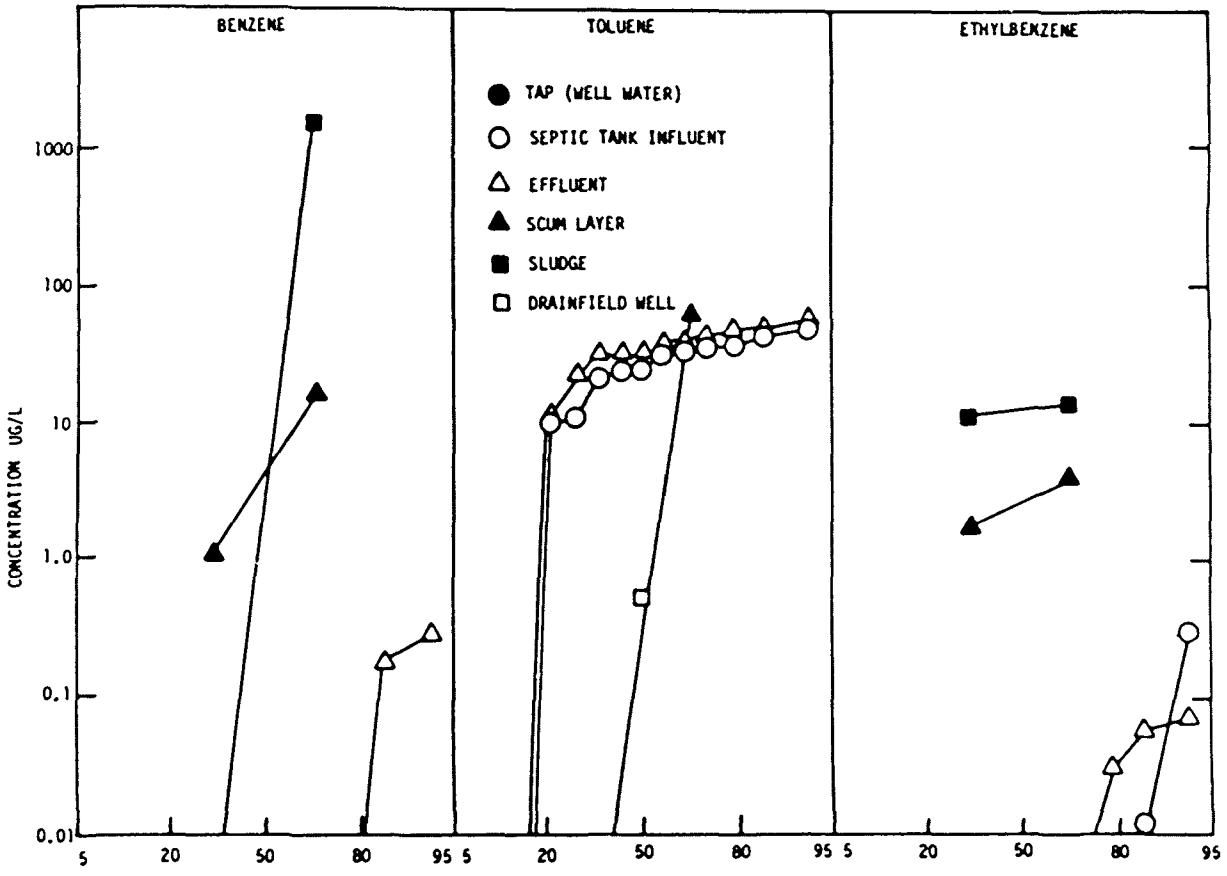

Figure 9. Percentage of samples equal to or less than indicated concentration.

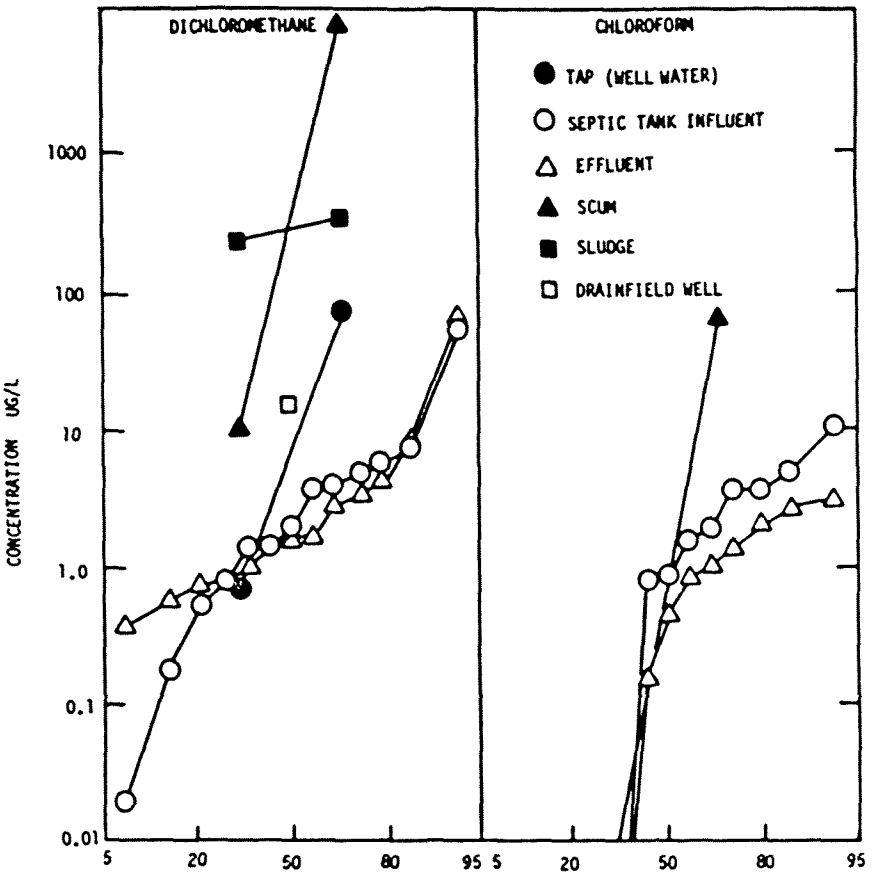

Figure 10. Percentage of samples equal to or less than indicated concentration.

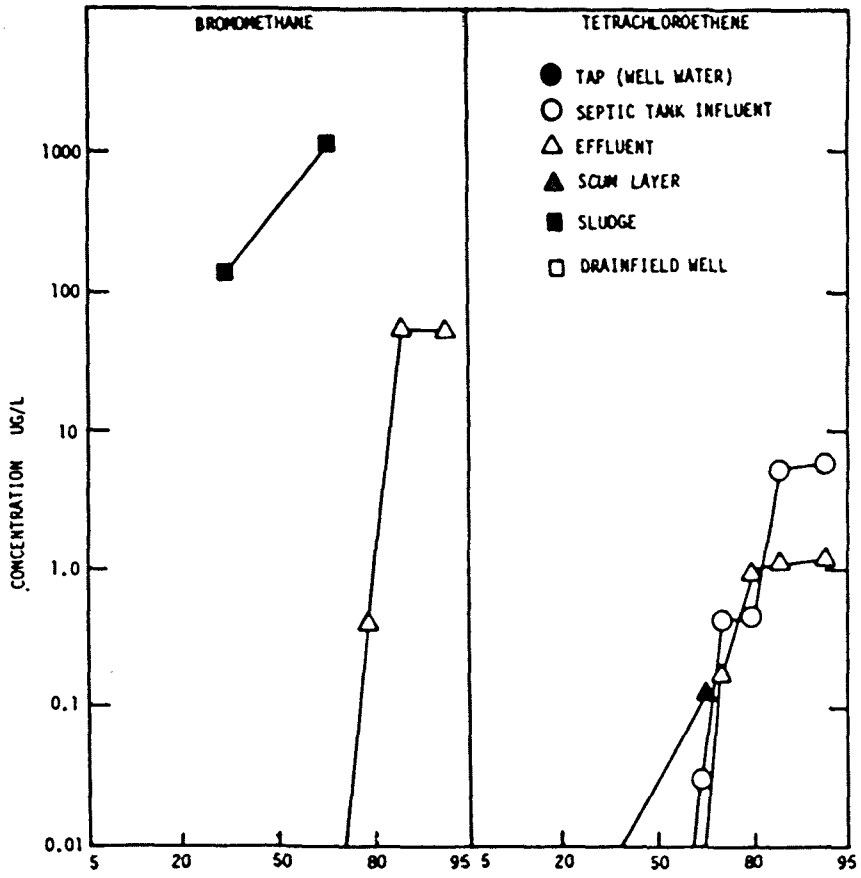

Figure 11. Percentage of samples equal to or less than indicated concentration.

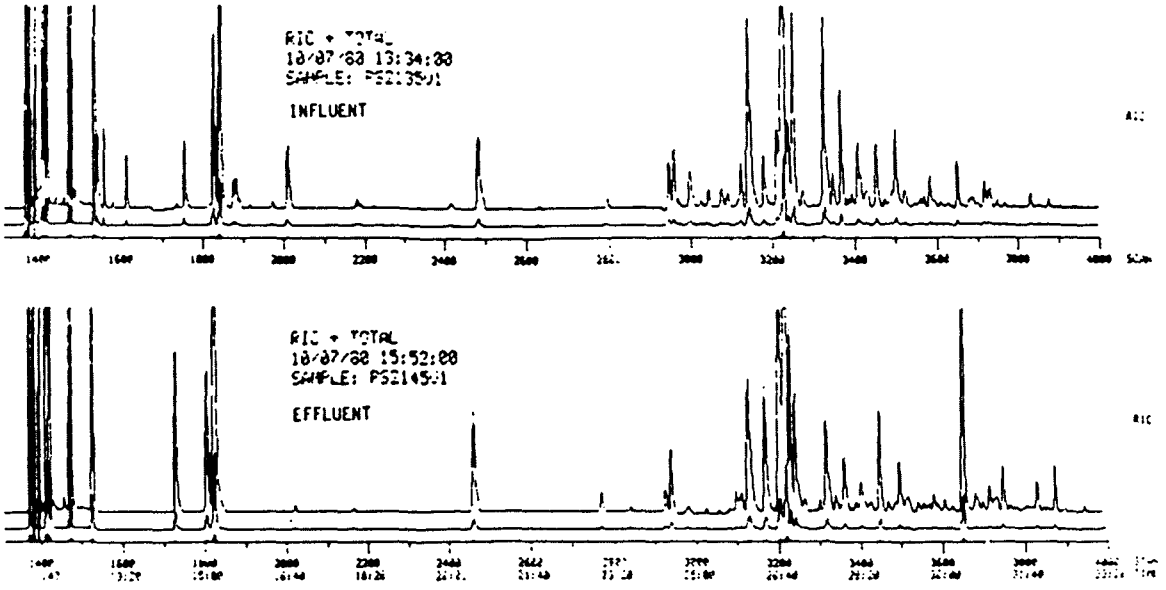

Figure 12. Reconstructed total ion current of the volatile organics in the influent and effluent of the septic tank.

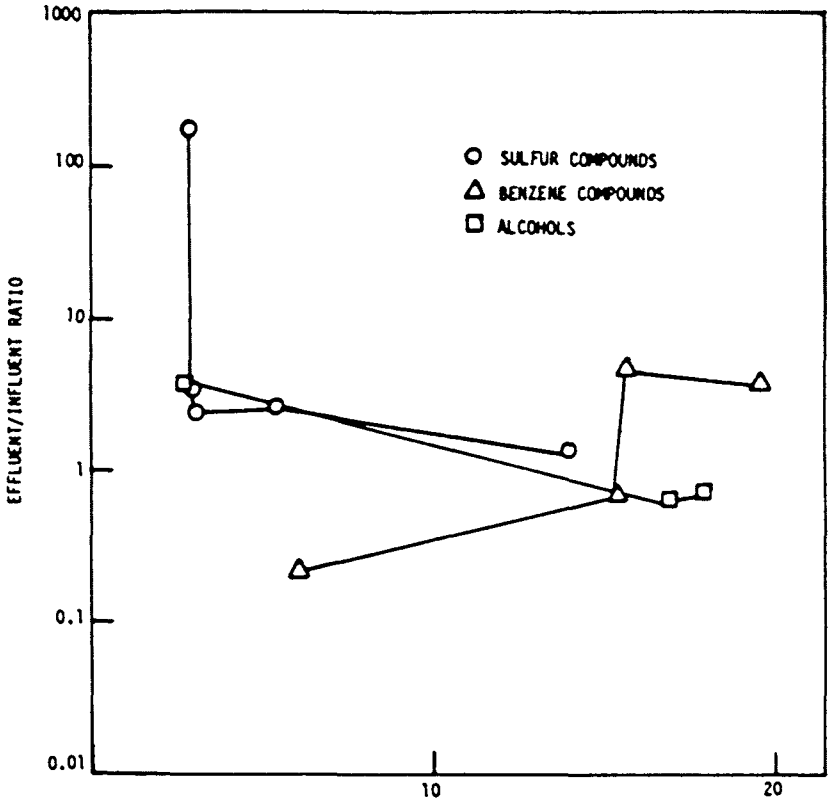

Figure 13. Attenuation of volatile compounds during septic tank treatment.

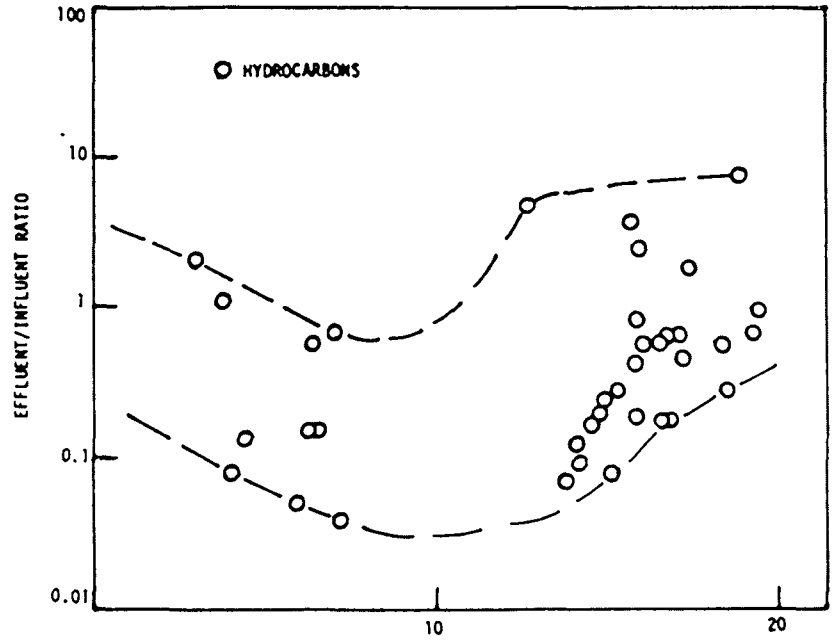

Figure 14. Attenuation of volatile hydrocarbons during septic tank treatment.

APPENDIX A

DAILY ANALYSES (µg/L)

PURGEABLES	Mo, Sept. 22 Influent (UW)	Mo, Sept. 22 Effluent (UW)	Mo, Sept. 22 Scum (UW)	Tu, Sept. 23 Influent (UW)	Tu, Sept. 23 Effluent (UW)	We, Sept. 24 Influent (UW)	We, Sept. 24 Effluent (UW)	Th, Sept. 25 Influent (UW)	Th, Sept. 25 Effluent (UW)	Fr, Sept. 25 Influent (UW)	Fr, Sept. 26 Effluent (UW)	Sa, Sept. 27 Influent (UW)	Sa, Sept. 27 Effluent (UW)	Su, Sept. 28 Influent (UW)	Su, Sept. 28 Effluent (UW)	Sa, Sept. 27 Influent (GIT)	Sa, Sept. 27 Effluent (GIT)	Su, Sept. 28 Influent (GIT)	Su, Sept. 28 (dupl) Influent (GIT)	Su, Sept. 28 Effluent (GIT)	Su, Sept. 28 Scum Layer (GIT)
				T*/72*					T*/72*												
1. Methane, bromo-																					
2. Methane, trichlorofluoro-	14.8																				0.01
3. Methane, dichloro (methylenechloride)	4.8	44.4	1.0	0.9/ 1.8	0.6	7.3	4.4	3.7	3.7/ 4.6	1.9	3.0	0.5	0.8	5.6	9.0	0.18	0.37				10.3
4. Ethene,1,2-dichloro-																					
5. Ethane,1,1-dichloro-																					
6. Chloroform	5.3	0.9				0.82			-/0.3	0.5			0.4	1.9	1.0						
7. Toluene	24.9	31.9	0.7	18.2/ 36.9	22.2	38.1	32.9		26.5/ 53.2	47.8	38.4	32.1	48.9	25.3	56.9	44.5	44.9	21.4	26.9	49.1	63.2
8. Ethene, tetrachloro-																0.47	0.17	0.44	0.31		0.13
9. Benzene, chloro-																					
10. Benzene, ethyl-																0.01	0.03	0.30	0.34	0.06	1.7
11. Methane, tribromo-									3.5/-												
12. Ethane,1,1,1-Trichloro-																					
13. Benzene							0.18														1.1
14. Propane,1,2-Dichloro-																				0.12	
15. Ethene,trichloro-																0.03				0.04	0.15
16. 1-Propene,1,3-dichloro(Z)-																					
17. Ethane,1,1,2-trichloro-																0.13				0.31	
18. 1,4-dichlorobenzene				0.79/ 2.12		2.57			1.0/ 2.2	2.9		2.7	2.9	4.7	0.7						

APPENDIX A (continued)

DAILY ANALYSES (µg/L)

PURGEABLES	~~Su, Dec. 7 1980~~ Su, Dec. 7 Influent (GIT)	Su, Dec. 7 Effluent (GIT)	Su, Dec. 7 Sludge (GIT)	~~Su, Dec. 7 Water Blank (GIT) 1981~~	Su, Jan. 11 Tapwater (GIT)	Su, Jan. 11 Influent (GIT)	Su, Jan. 11 Effluent (GIT)	Su, March 21 Influent (GIT)	~~Su, March 21 Effluent (GIT) 1982~~	Su, Jan. 24 Tapwater (GIT)	Su, Jan. 24 Influent (GIT)	Su, Jan. 24 Effluent (GIT)	Su, Jan. 24 Scum (GIT)	Su, Jan. 24 Sludge (GIT)	Su, Jan. 24 Well Water (GIT)
1. Methane, bromo-		52.3	1158				54.4		0.40					134	
2. Methene, trichlorofluoro-															
3. Methane, dichloro (methylenechloride)	0.02	1.7	356.3	0.61	0.72	0.79	0.74	4.1	1.4	69.9	50.7	66.2	7997	231	153
4. Ethene,1,2-dichloro-								0.60	1.2						
5. Ethane,1,1-dichloro-		0.36						4.2							
6. Chloroform	1.5	3.0						3.7	0.84		10.5	2.6			
7. Toluene		10.4		0.21		5.8	34.2				10.7				0.52
8. Ethene, tetrachloro-		1.2									0.034				
9. Benzene, chloro-														232.1	
10. Benzene, ethyl-			13.8									0.07	4.0	11.5	.015
11. Methane, tribromo-															
12. Ethane,1,1,1-Trichloro-		0.56							0.29						
13. Benzene									0.28				16.6	1588	
14. Propane,1,2-Dichloro-															
15. Ethene,trichloro-															
16. 1-Propene,1,3-dichloro(Z)-								0.34							
17. Ethane,1,1,2-trichloro-															
18. 1,4-dichlorobenzene															

APPENDIX A (continued)

DAILY ANALYSES (µg/L)

BASE-NEUTRAL EXTRACTABLES	1981 Su, Sept. 28 Influent	Su, Sept. 28 Effluent	Su, Sept. 28 Sludge	Su, Dec. 7 Influent	Su, Dec. 7 Effluent	Su, Dec. 7 Sludge	Su, Jan. 11 Influent	Su, Jan. 11 Effluent	Sa, March 21 Influent	Sa, March 21 Effluent	1982 Su, Jan. 24 Tapwater	Su, Jan. 24 Influent	Su, Jan. 24 Effluent	Su, Jan. 24 Scum	Su, Jan. 24 Sludge	Su, Jan. 24 Well Water
1. 1,4-Dichlorobenzene			165							3.26				607.4		
2. Nitrobenzene														52.8	9.6	
3. Acenaphthylene										0.1						
4. Di-N-Buthylphthalate	10.2	23.5		12.4		82.0			11				32.0			7.9
5. Bis(2-ethylhexyl)phthalate	136	128	3004	168		325.5	123	444				5.8	74.2	37.2		11.0
6. 1,3 Dichlorobenzene													1.9		50.6	
7. 1,2 Dichlorobenzene			1859											1590.2	18.2	
8. Naphthalene										1.43			21.8	67.1	3.6	0.6
9. Acenaphthene									0.33							
10. Diethylphthalate	1.1	8.3	297	20.6	141.7	28.29	21.55	33.1	4.57	41.96		8.3	30.9		12.9	1.26
11. 1,2,4 Trichlorobenzene			6823											2057	26.6	
12. Azobenzene(Diphenylhydrazine)		0.22		0.59					0.37	1.48						
13. Phenanthrene														107.1		2.2
14. Buthylbenzylphthalate	3.4	14.4		17			14.6	24.6		9.3		0.6	6.6			