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1980

Groundwater Contamination
and
Possible Health Effects
in
Jackson Township, New Jersey

Division of Epidemiology & Disease Control
New Jersey State Department of Health
Trenton, New Jersey 08625

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Introduction

Jackson Township Landfill is owned and operated by Jackson Township and is located on and about Homestead Road in Jackson Township, Ocean County, New Jersey.

The landfill overlies the Cohansey aquifer which is the prime source of water for the shallow wells found in residences proximate to the landfill.

The landfill has been in operation since approximately April 24, 1972, when it was registered by the Department of Environmental Protection (DEP). Under the condition of the registration, the landfill was prohibited from accepting or disposing of "liquid or soluble industrial materials" such as chemical wastes.

The landfill has not been insulated from the underlying ground waters and/or from surface waters in the area. The landfill was located in a relatively undeveloped part of the Township, but many new homes have been built and occupied in the area in recent years. The soil in the area is sandy, and the homes occupied prior to 1979 used water from shallow wells as their potable supply. Complaints about water quality in the summer of 1978 led the DEP to obtain water samples for analysis. The earlier samples were subjected to routine tests such as for bacteriological contamination and selected inorganic chemicals. By December 1978, more samples had been analyzed extensively (partly in the Department of Health laboratory), and contamination of the aquifer with a variety of organic chemicals was demonstrated.

While there is a clear gradient in contamination from the landfill, there were variations in test results from the same wells taken at different times. Despite this limitation, geologists from DEP were able to define an area around the landfill which is subject to the contamination emanating from this dump.

The contamination included compounds which are on the EPA list of priority pollutants, and the observed levels were high enough to generate concern about the risk to human health from a long-term consumption of this water. In November 1978, the Board of Health of Jackson Township, in consultation with the State

Departments of Health and Environmental Protection, had advised families neighboring the landfill not to use water from their wells for potable purposes due to chemical contamination of the aquifer. Since about January 1979, local authorities have provided water in tank trucks to area residents for potable purposes. Houses occupied since that time have had their water supplied from deep wells which DEP feels draw from a relatively clean aquifer.

The contamination has been ascribed to illegal chemical dumping in the area, and the landfill has been judicially determined to be the repository for much of this waste. Various regulatory actions were initiated in December 1978, and the landfill has been closed since February, 1980.

It was initially thought that a new water supply could be installed by the winter of 1979-80. There have been delays, but the installation has now been completed.

Since May 1978, the Department has been asked on several occasions to evaluate complaints of ill health among people who live near the landfill. These complaints have included reports of renal disease, rashes and eye irritation, and a case of respiratory arrest and death in an infant. The renal disease reports consisted of six distinctly different diagnoses, three of which were recognized before the affected persons moved to Jackson. The particulars of the renal disease will be discussed below. The dermatologic complaint was plausible, but, when first reported in January 1979, our staff was unsuccessful in its attempts to observe a typical reaction. There was a case of a sudden infant death, the cause for which is not known. However, any direct relationship between this event and the water supply is unlikely as the child had not consumed the well water for about six months.

The well water in these homes is clearly contaminated by various toxic organic chemicals at low levels. Consumption of this polluted water by any persons over a long period of time could result in an increased risk of chronic diseases such as cancer. Short-term consumption of this water would not be expected to produce acute illnesses. As this water was used for a longer period for bathing, local irritation

to skin and mucous tissue may be expected. These considerations led to the public health decision that the residents be provided with an alternative clean source of water supply.

This report will review the chemical analyses from the wells, the kidney complaints of which the Department is aware, and data extracted from a set of questionnaires which residents who are plaintiffs in a class action lawsuit completed in January 1980.

Review of Chemical Data

Water samples from private wells in the Legler Section of Jackson Township have been analyzed since 1977. The earlier analyses were conducted by private laboratories contracted by residents and builders to test the water from newly installed wells. These were subjected to routine analyses such as color, turbidity pH, hardness, solids, alkalinity, conductivity, nitrogen, chlorides, iron, manganese, calcium, copper, zinc and total coliform counts. No serious contamination was found, but several wells had high iron levels and sulfur-like odor problems. In the summer of 1978, the Jackson Township Board of Health requested assistance from the State Department of Environmental Protection to conduct an extensive sampling program to determine the extent of chemical contamination of the aquifer. Initially, DEP collected water samples from private wells as well as landfill monitoring wells and sent them to the Health Department laboratory and private laboratories for routine bacteriological and chemical analyses, where high iron and odor were again detected. Following further complaints about water quality from residents and local health department, DEP conducted a more extensive sampling program and included organic analyses. These first few samples did not show the presence of organic chemicals. The first positive results for organic chemicals were obtained in October 1978. From October 1978 through May 1979, a total of approximately 62 samples from private wells and 25 samples from monitoring wells were analyzed for organic chemicals. The private wells were sampled in October, November, and December of 1978. The monitoring wells were sampled in November and December 1978, and May 1979. The

samples were analyzed by the State Health Department laboratory or by a private laboratory. A summary of the results are presented in Tables 1 and 2. These data clearly indicate that the aquifer is contaminated with various toxic chemicals and formed the basis for the recommendation that the water should not be used for potable purposes.

Additional samples were obtained on June 17, 1980, from 21 private wells in the affected area. The volatile organic screening results from these samples are presented in Table 3. These results are not directly comparable to those in Tables 1 and 2 because of improvements in analytical methods and detection limits in the Department laboratory. However, the types and levels of contamination observed are of a similar order of magnitude as those documented 18 months ago.

The Questionnaire

The instrument used by the Concerned Citizens Committee is essentially the same as that used by the New York State Department of Health at Love Canal. There is a checklist for 148 signs, symptoms and conditions, as well as questions relating to medications, occupation, chemical exposures, family history and maternal history. A page is available for clarification and amplification of items checked off among the 148 possible complaints. Unfortunately, the pregnancy history page is easily misread as asking for the pregnancy history of the respondent's own mother. Consequently, a number of women who have been pregnant did not complete this page properly. Finally, the cover letter (Figure 1) may have altered the threshold for respondents' identifying and reporting symptoms.

The Sample

The Concerned Citizens Committee estimates that there are 165 homes in the area which DEP geologists have identified as at risk for having a contaminated shallow aquifer. Of this group, 146 homes have a shallow water supply and 94 of these are party to a lawsuit. Questionnaires were returned from 82 of these 94 households comprising 305 persons, about 280 of whom are current residents. This represents

about 56% of all area households with shallow wells. In all, 273 questionnaires were returned, some of which were filled out by more than one person. Time and duration of residence was therefore discernible for 299 individuals. Table 4 indicates the year respondents moved into the area of concern. Nearly half the population has moved in since January 1978, and a third lived in the area for less than six months before the potable water supply was changed.

A few questionnaires dated water problems from the period 1975-1977. The landfill opened in April 1972, and considering time for migration of chemicals from the landfill, this is a plausible time for the initial groundwater contamination. However, the presence of organic chemicals in the aquifer was not actually observed until October 1978.

Maternal Histories

Interpretable maternal histories were given for 42 of the 68 ever-pregnant women who returned questionnaires (62%). Table 5 presents pregnancy outcome by maternal age and by whether the pregnancy terminated before or after the women moved to the area. The overall rate of miscarriages and stillbirths before moving in the area (14/102, 13.7%) is virtually identical to that observed after moving in (3/21, 14.3%), despite the latter representing deliveries to a somewhat older age group of women. The numbers are small, though, so the age-stratified data is difficult to interpret. If pregnancy histories are similar in the residents not answering this question or not completing this questionnaire, there have been approximately 59 deliveries and 8 to 9 miscarriages or stillbirths in this neighborhood since 1972, and 287 deliveries with 39 miscarriages or stillbirths among neighborhood residents prior to moving there. These are not unusual rates, especially in light of the small number of pregnancies.

Figure 2 plots the year of delivery for pregnancies after moving to Jackson Township. Three of the 21 deliveries antedated the probable contamination of the aquifer, and nine occurred after the water supply for drinking was changed. Five pregnancies were conceived prior to moving, at intervals ranging from one to seven

months between moving and delivery. Of possible concern is that two of the three miscarriages occurred during the period when probably contaminated shallow well water was being consumed. Fishers Exact Test does not show a significant difference in miscarriage rates between the years 1975-78 compared to the other years of observation, even when the number of observations is doubled, by including estimated numbers for women that did not complete the particular question. The miscarriage reported for 1979 occurred in December, a year after the use of well water for drinking ceased, and this case represents only 11% of 1979 deliveries.

The Review of Systems Checklist

Tables 6 and 7 summarize the symptoms indicated on the 273 questionnaires. With this self-administered questionnaire, it is difficult to interpret the importance of many of the complaints. One person checked 56 different complaints, and 30 was not an uncommon number for a single questionnaire. In contrast, 23 persons had no complaints whatsoever. The comments section was also reviewed to date the onset of the complaints and to see if patterns emerged which suggested serious morbidity.

The only really prominent pattern of complaints related to skin irritation and, to a lesser extent, to eye irritation. The skin problem was usually characterized as itching, dryness or scaliness, especially shortly after a bath or a shower. At least one of these symptoms was mentioned on 46% of the questionnaires. Few had consulted a physician, and the symptoms were usually short-lived. A few people also mentioned eye irritation in connection with washing. The onsets of the skin and eye complaints could not be precisely measured, but it is possible that there are more problems now than there were a year ago. Many people have stopped using the water for bathing as well as for drinking.

There were no other unusual patterns of morbidity, but diarrhea was occasionally attributed to drinking water from a shallow well prior to January 1979, when alternative potable water was supplied. Twenty-three percent of respondents reported a history of a surgical operation (question 141), but these represented a wide variety

of procedures, and where these were datable, 3.6 times more operations were performed before respondents moved to Jackson as were performed afterwards.

Several people attributed their headaches to carrying heavy containers of water into their homes, and one man relates the development of hemorrhoids to carrying 125 lb. water cans.

Kidney Disease

Complaints of kidney disease were reviewed from several sources. The community itself has identified seven people with renal or urologic problems. In addition, each person who mentioned a history of a kidney stone (question 58) or of kidney disease (question 146) was included for consideration. A summary of the 13 cases identified in this manner is presented in Table 8. Case 1 - 6 are the six individuals who were investigated in November 1978, and the remaining seven people are newly identified. The information presented is based on interviews with the cases or their families. Where the diagnosis was unclear after these interviews, appropriate physicians were contacted.

In two instances (cases 1 and 4), there has been progression of disease to renal failure. However, both of these people contracted their underlying disease prior to moving to their present homes, and their courses, unfortunately, are part of the clinical spectra for their diseases.

The four cases with onset or diagnosis after moving to the area (cases 2, 3, 5, and 13) have widely different conditions. Thus, the Department has been unable to substantiate the assertion that there is an association between kidney problems and the presence of pollutants in water. Leaders of the Concerned Citizens Committee have been aware of this analysis as it pertains to cases 1 - 6 for some time, and they have not presented any information to the Department which alters this conclusion.

Overall, no general indication of major morbidity possibly related to the water emerged from our review of these questionnaires. Skin irritation has been difficult to document in the past, but it could be associated with bathing in the water. While a major nuisance for many residents, it has been self-limited and should resolve

itself since a new water supply has been made available.

Discussion

The residents of this neighborhood have suffered a great deal because of environmental contamination; they have paid for their new water supply in many ways. Besides the costs of obtaining a municipal supply, many have purchased bottled water, filtering devices and deep well hookups. Getting remedial action has been time-consuming, and there have been delays in installing the new water mains. The situation has generated an enormous amount of frustration, anxiety and anger.

The repeated questioning about health effects is partially rooted in anxiety which has its own cost in terms of emotional stress, too. While the community was drinking the water, there may have been a problem with diarrhea. Washing in the water is probably responsible for some skin irritation, but there is no indication of more serious health problems related to the water. It is unlikely that an epidemiologic study of the community at this time could detect any other problems than those already discussed, both because of the small population involved and the expected long latency for most serious medical problems which might develop in later years.

The staff of the Division of Epidemiology and Disease Control has often discussed how one would approach investigating the complaint of skin irritation. It is a difficult epidemiologic problem: a control group cannot be readily assembled because the community is so well aware of its exposure, and the reported symptoms are mostly subjective or short-lived. The questionnaires already completed by the residents go as far towards documenting the problem as may be possible short of an extensive research protocol involving the deliberate, professionally observed exposure of people to shallow and to deep well water. Such a project has always been difficult to justify since it would not lead to any new recommendation. Such a project is even more difficult to consider now since the new water supply is now available.

There are several reasons for considering a detailed epidemiologic study of health effects in general in any community. One is to assist with public health decision making. The decision to provide a new water supply has already been made. Other reasons include scientific investigation and reassurance of the affected neighborhood. To address either of these purposes, a study should only be launched if there is a chance that something significant might be found. In Jackson Township, the exposure was both recent, relatively brief, we believe, and all appropriate preventive measures have now been implemented. Thus, a study now would not add to our knowledge of toxicology, and any reassurance of the community would have to be tempered with what we have always said, that the potential health problems of concern are the long-term ones.

The contamination of the aquifer in Jackson Township was recognized relatively rapidly. It is likely that the aquifer contamination is no more than two to five years old. Corrective environmental and public health actions have been taken and prolonged exposures of the population to toxic chemicals were avoided.

Recommendations

There are several additional things which would be useful at this time. Air sampling should be done in at least a few homes. Although basement contamination is not at this time suspected, it is relatively straightforward to find out if there are volatile organic chemicals in these homes, and this would provide useful information to the residents, to DEP, and to the Department of Health.

It is conceivable that something might be learned in the future which would make a follow-up study of the residents in this area worthwhile. A census should be taken of the residents in the 146 affected homes to facilitate a possible follow-up. Complete information on maternal history, birthweights, congenital malformations and renal diseases could be collected at that time. This might be of further help in resolving the question which has been raised about miscarriages and increases in kidney ailments. The questionnaires already completed by the plaintiffs in a lawsuit suggest that the major health concern relates to skin irritation. The

extent and time course of the problem could be more precisely measured by asking about skin problems at the time of the census.

Finally, the Department should remain in contact with the neighborhood following completion of the new water system.

Summary

In May 1978, the State Department of Health was contacted by the local health office for assistance in evaluating citizens' complaints about the bad odor and taste of their drinking waters and possible health effects in Legler section of Jackson Township.

Initial water sampling results showed the presence of iron and sulfur-like odors. In October 1978, trace amounts of toxic organic chemicals were detected. The Township landfill was suspected to be a source of the chemical contamination. Further sampling confirmed the contamination of the Cohansey aquifer underlying the Legler section of the Township. The residents were advised in November 1978 not to use their well water for potable purposes.

The earlier health complaints were about skin problems and kidney diseases. Investigation by Departmental staff did not turn up any evidence for a causal relationship with water consumption. The staff continued to provide assistance to the local health office and the Department of Environmental Protection in evaluating the potential health hazards from water consumption and use in the households. A new source of potable water supply was recently made available for the Legler section of the Township.

More recently, Department staff reviewed a health effects evaluation questionnaire completed by members of 82 households in the Legler section. The only prominent pattern of complaints related to skin irritation and to a lesser extent eye irritation. There are several technical and procedural difficulties which impede the administration of a thorough epidemiologic study. The population exposed is small, and of these only a few had consumed the water for more than six months. A majority of them had moved in only a few months before the pollution had been detected, and the residents

warned not to use the water for consumption.

The only plausible health consequences of consuming this water are an increased risk of some long-term diseases such as cancer. It is therefore, recommended that a census of the residents be taken for a possible follow-up. Better information on maternal histories, birthweights, congenital malformations, skin diseases and renal disease should also be obtained at the same time. It is recommended that air in the basements of these residences should be tested to assure that the entire home environment is clean and safe from chemical pollution of the groundwater.

Table 1

Organic Chemical Contamination of Private Wells

Chemical	Range in ppb	None Detected	Frequency of Detection in ppb				
			Trace-50	51-100	101-250	251-1,000	>1,000
Acetone	0-9,300	54	1	-	-	1	6
Benzene	0-330	38	16	2	5	1	-
2,n-butoxyethanol	0-8	61	1	-	-	-	-
Carbon disulfide	0-814	58	3	-	-	1	-
Chlorobenzene	0-27.1	58	4	-	-	-	-
Chloroethane	0-4.0	59	3	-	-	-	-
Chloroform	0-75	57	4	1	-	-	-
Chlorofluoromethane	0-0.5	60	2	-	-	-	-
1,1-dichloroethane	0-17.0	57	5	-	-	-	-
1,2-dichloroethylene	0-7.0	61	1	-	-	-	-
Dichloroethylene	0-18.0	61	1	-	-	-	-
1,2-dichlorofluoro- ethylene	0-1.1	61	1	-	-	-	-
Dichlorofluoromethane	0-378	57	2	1	1	1	-
Diethylether	0-5.0	58	4	-	-	-	-
Dimethydisulfide	0-20.0	61	1	-	-	-	-
Dimethylsulfide	0-125	61	-	-	1	-	-
Ethylbenzene	0-2.0	61	1	-	-	-	-
Methylene Chloride	0-3,000	39	4	-	1	14	4
Methyl Ethyl Ketone	0-0.5	61	1	-	-	-	-
Methyl Isobutyl Ketone	0-535	59	1	-	-	2	-
Phenol	0-6	61	1	-	-	-	-
1,1,2,2-Tetrachloro- ethane	0-59	60	1	1	-	-	-
Tetrahydrofuran	0-0.4	61	1	-	-	-	-

Table 1 (Continued)

Organic Chemical Contamination of Private Wells

Chemical	Frequency of Detection in ppb						
	Range in ppb	None Detected	Trace-50	51-100	101-250	251-1,000	>1,000
Toluene	0-3.2	60	2	-	-	-	-
Trichloroethane	0-1,360	61	-	-	-	-	1
1,1,1-Trichloroethane	0-12.6	59	3	-	-	-	-
1,1,2-Trichloro- ethane	0-59	60	1	1	-	-	-
Tetrahydrofuran	0-0.4	61	1	-	-	-	-
Toluene	0-3.2	60	2	-	-	-	-
Trichloroethane	0-1,360	61	-	-	-	-	1
1,1,1-Trichloroethane	0-12.6	59	3	-	-	-	-
1,1,2-Trichloro- ethylene	0-1,000	55	-	-	1	6	-
Trichlorofluoro- methane	0-1,457	58	2	-	-	-	2
Trichlorotrifluoro- ethane	0-2.0	60	2	-	-	-	-

Table 2

Organic Chemical Contamination of Aquifer (Monitoring Wells)

Chemical	Range in ppb	Frequency of Detection in ppb					
		None Detected	Trace-50	51-100	101-250	251-1,000	>1,000
Acetone	0-14	20	7	-	-	-	-
Benzene	0-220	19	7	-	1	-	-
Chlorobenzene	0-69	23	3	1	-	-	-
Chloroethane	0-2	25	2	-	-	-	-
Chloroflorobenzene	0-30	25	2	-	-	-	-
Chlorofloromethane	0-11.5	25	2	-	-	-	-
Chloroform	0-16	22	5	-	-	-	-
Cyclohexane	0-trace	26	1	-	-	-	-
1,1-Dichloroethane	0-4.3	25	2	-	-	-	-
1,2-Dichloro- ethylene	0-2.0	26	1	-	-	-	-
Dichloroethylene	0-27	26	1	-	-	-	-
Dichlorofluoro- methane	0-243.8	20	4	2	1	-	-
Diethyl Ether	0-trace	26	1	-	-	-	-
Dimethyldisulfide	0-3	25	2	-	-	-	-
Dimethylsulfide	0-110	23	2	1	1	-	-
Ethanol	0-0.6	26	1	-	-	-	-
Ethylbenzene	0-6.4	25	2	-	-	-	-
Ethylmercaptan	0-55	24	3	-	-	-	-
Freon-11	0-91.4	25	1	1	-	-	-
Freon-112	0-113	24	2	-	1	-	-
Hexanone	0-2.0	25	2	-	-	-	-
Methanol	0-trace	25	2	-	-	-	-
Methylene Bromide	0-5	26	1	-	-	-	-

Table 2 (Continued)

Organic Chemical Contamination of Aquifer (Monitoring Wells)

Chemical	Range in ppb	Frequency of Detection in ppb					
		None Detected	Trace-50	51-100	101-250	251-1,000	>1,000
Methylene Chloride	0-460	22	4	-	-	1	-
Methyl Ethyl Ketone	0-280	24	1	1	-	1	-
Methyl Ethyl Sulfide	0-trace	26	1	-	-	-	-
Methyl Isobutyl Ketone	0-450	22	4	-	-	1	-
2-Methoxypropene	0-trace	24	3	-	-	-	-
Tetrachloroethane	0-0.8	26	1	-	-	-	-
Tetrachloroethylene	0-2.7	26	1	-	-	-	-
Tetrahydrofuran	0-913	9	4	3	4	7	-
Toluene	0-12	24	3	-	-	-	-
1,1,1-Trichloro- ethane	0-3.9	20	7	-	-	-	-
1,1,2-Trichloro- ethylene	0-67	24	2	1	-	-	-
Trichlorofluoro- methane	0-86	23	3	1	-	-	-
Trans-1,2-Dichloro- ethylene	0-27	23	4	-	-	-	-
Xylene	0-20	25	2	-	-	-	-

Table 3

Organic Chemical Contamination of Private Wells - June 17, 1980

Chemical	Range in ppb	Frequency of Detection in ppb				
		None Detected	Trace-50	51-100	101-250	>250
Benzene	0-10.0	11	10	-	-	-
Butylbenzene	0-2.4	20	1	-	-	-
Chlorobenzene	0-16.1	12	9	-	-	-
Chloroform	0-10.4	2	19	*	-	-
2-Chloroethylvinyl Ether	0-17.0	20	1	-	-	-
Cumene	0-6.5	20	1	-	-	-
p-Cymene	0-<1.0	20	1	-	-	-
1,2-Dichlorobenzene	0-16.0	15	6	-	-	-
1,3-Dichlorobenzene	0-17.5	15	6	-	-	-
1,1-Dichlorethane	0-6.8	14	7	-	-	-
1,1-Dichloromethane	0-3.2	20	1	-	-	-
Heptane	0-3.8	20	1	-	-	-
Methylene Chloride	0-6.4	14	7	-	-	-
Nonane	0-2.5	19	2	-	-	-
Propylbenzene	0-1.0	20	1	-	-	-
Tetrachloroethylene	0-1.8	16	5	-	-	-
Trichlorofluoromethane	0-101.7	17	3	-	1	-
m,p-Xylene	0-2.5	17	4	-	-	-

Table 4

Year of First Residence in Area Among Respondents

Year	N*	%
1972 and before	49	16.4
1973	3	1.0
1974	16	5.4
1975	15	5.0
1976	48	16.1
1977	21	7.0
1978	130	43.5
1979	17	5.7
Total	299	100.1%

* Excludes six people whose residence time was indeterminate.

Table 5

Reported Deliveries to Women in the Area,
Before and After Moving to Neighborhood

Maternal Age	Liveborn	Before		Liveborn	After	
		Miscarriage, Stillbirth	Total		Miscarriage	Total
Under 20	13	3	16			
20-24	32	3	35	7		7
25-29	32	3	35	6	3	9
30-34	4	3	7	4		4
35-39	2	1	3	1		1
Unknown	5	1	6			
Total	88	14	102	18	3	21

Table 6

Frequency of Specific Complaints Among 273 Respondents by Onset
in Relationship to Move to Jackson Township

	Prior to Move	After Move	Onset Date Indetermi- nable	Total
1. Excessive Weight Loss	1	1	4	6
2. Excessive Weakness	1	3	13	17
3. Fever	0	0	8	8
4. Chills	0	0	12	12
5. Sweats	1	1	9	11
6. Night Sweats	1	4	15	20
7. Itching of the Skin	5	42	60	107
8. Changes in Coloration of the Skin	0	10	21	31
9. A Tendency to Bruise Easily	0	6	32	38
10. Excessive Dryness of the Skin	4	32	59	95
11. Scaling of the Skin	4	18	37	59
12. Loss of Hair on Your Arms	0	0	9	9
13. Headaches	6	10	42	58
14. Dizziness	1	5	20	26
15. Pain in the Eyes	3	7	26	36
16. Recent Changes in Vision	0	7	22	29
17. Seeing Double	0	0	8	8
18. Infections of the Eye	3	2	4	9
19. Earaches	6	5	14	25
20. Hearing Defect	3	0	9	12
21. Ringing in the Ears	2	2	15	19
22. Frequent Ear Infections	9	4	6	19
23. Sinus Pain	11	10	25	46
24. Infections of the Nose	3	3	3	9

Table 6 (Continued)

	Prior to Move	After Move	Onset Date Indetermi- nable	Total
25. Bleeding from the Nose	5	4	20	29
26. Post Nasal Drip	10	6	32	48
27. Frequent Colds	4	8	17	29
28. Soreness of the Gums or Lips	2	1	17	20
29. Bleeding from the Gums	1	2	8	11
30. Frequent Sore Throats	4	9	19	32
31. Sore Tongue	0	0	5	5
32. Changes in Taste	0	2	4	6
33. Hoarseness	2	4	9	15
34. Limitations in Movement of the Neck	0	3	12	15
35. Frequent Pains in the Neck	0	5	11	16
36. Enlargement of the Thyroid Gland	0	0	3	3
37. Swollen Glands in the Neck or Under Arms	2	0	5	7
38. Breast Lumps	1	1	1	3
39. Pain in the Breast	0	4	4	8
40. Discharge from the Breast	0	3	0	3
41. Chest Pain	1	0	13	14
42. Pain Upon Taking a Deep Breath	0	0	12	12
43. Frequent Coughing	3	3	14	20
44. Spitting Up Blood	0	0	1	1
45. Wheezing	4	4	15	23
46. Coughing Up Discolored Sputum	0	0	6	6
47. Asthma	4	1	3	8
48. Bronchitis	8	4	18	30
49. Pneumonia	4	5	13	22

Table 6 (Continued)

	Prior to Move	After Move	Onset Date Indetermi- nable	Total
50. Tuberculosis	0	0	0	0
51. Recent Contact With an Individual Who Has Tuberculosis	0	0	4	4
52. Shortness of Breath	1	2	25	28
53. Urination More Than Once After Going to Bed	0	3	28	31
54. Hesitancy in Urinating	0	1	6	7
55. Pain on Urination	0	1	5	6
56. Any Abnormalities in Color of Urine	0	1	4	5
57. History of Urinary Tract Infections	5	3	12	20
58. History of Kidney Stones	0	1	4	5
59. Passing Blood in the Urine	2	0	1	3
60. History of Gout	0	0	0	0
61. Pain in the Testicles (Males Only)	0	0	4	4
62. Abnormalities in Menstrual Cycle (Females Only)	3	1	12	16
63. Excessive Bleeding During Menstruation (Females Only)	2	1	9	12
64. Vaginal Discharge (Females Only)	5	8	18	31
65. Pain in the Legs Upon Walking or Exercising	0	3	26	29
66. Varicose Veins	2	3	12	17
67. Clots in the Leg	1	1	3	5
68. Joint Stiffness	2	1	25	28
69. Joint Swelling	2	1	13	16
70. History of Rheumatoid Arthritis	2	1	12	15
71. Osteo-arthritis	0	0	3	3
72. Bursitis	0	1	12	13
73. Osteomyelitis (Infection of the Bone)	0	0	1	1
74. History of Fractures	4	2	13	19
75. Frequent Muscle Cramps	0	0	22	22

Table 6 (Continued)

	Prior to Move	After Move	Onset Date Indetermi- nable	Total
76. Morning Stiffness	1	2	22	25
77. Limitation of Motion in Any Joint	2	1	16	19
78. Disc Disease (Low Back Pain)	6	5	19	30
79. Sciatica	0	0	5	5
80. Fainting Spells	1	0	2	3
81. Heart Palpitations	1	2	11	14
82. Shortness of Breath But Only On Exertion	2	1	34	37
83. Shortness of Breath While in Bed	0	0	5	5
84. Swelling of the Ankles	2	2	13	17
85. History of a Heart Murmur	6	3	10	19
86. Rheumatic Fever	1	0	2	3
87. High Blood Pressure	0	5	12	17
88. Coronary Artery Disease	1	0	3	4
89. Poor Appetite	0	3	5	8
90. Difficulty in Swallowing Solids	0	0	1	1
91. Difficulty in Swallowing Liquids	0	0	1	1
92. Heart Burn	1	2	23	26
93. Pain in the Stomach	3	9	24	36
94. Belching Excessively	0	3	12	15
95. Nausea - Vomiting	2	3	13	18
96. Passing Blood in Stool	1	2	4	7
97. Constipation	1	3	15	19
98. Diarrhea	2	16	15	33
99. Hemorrhoids	7	2	22	31
100. Fissures	1	0	0	1

Table 6 (Continued)

	Prior to Move	After Move	Onset Date Indetermi- nable	Total
101. <u>Fistulas</u>	0	0	0	0
102. <u>A History of Ulcers</u>	3	1	0	4
103. <u>History of Gall Bladder Disease</u>	0	0	6	6
104. <u>History of Cirrhosis</u>	0	0	0	0
105. <u>History of Hepatitis</u>	2	0	2	4
106. <u>Appendicitis</u>	5	0	9	14
107. <u>History of Colitis</u>	1	0	6	7
108. <u>Frequent Urination</u>	Illegible on Original Form			
109. <u>Loss of Consciousness</u>	1	0	3	4
110. <u>Convulsions</u>	2	1	0	3
111. <u>Stroke</u>	0	0	2	2
112. <u>Encephalitis</u>	0	0	0	0
113. <u>Speech Disorders</u>	1	0	4	5
114. <u>Memory Disorders</u>	1	0	4	5
115. <u>Changes in Sleeping Patterns</u>	0	5	21	26
116. <u>Nervous Breakdown</u>	0	1	0	1
117. <u>Muscle Weakness</u>	0	5	10	15
118. <u>Muscle Paralysis</u>	0	0	1	1
119. <u>Clumsiness of Movement</u>	1	0	9	10
120. <u>Loss of Sensation in the Extremities</u>	4	1	7	12
121. <u>Bleeding Tendencies of the Skin Mucous Membrane</u>	0	0	0	0
123. <u>History of Transfusions</u>	3	0	3	6
124. <u>History of Thyroid Disease</u>	0	1	1	2
125. <u>Poor Tolerance to Heat</u>	0	1	7	8

Table 6 (Continued)

	Prior to Move	After Move	Onset Date Indetermi- nable	Total
126. Poor Tolerance to Cold	3	0	15	18
127. Nervousness	4	6	22	32
128. Tremors	0	0	1	1
129. Diabetes	3	0	3	6
130. Excessive Urination	1	2	12	15
131. Excessive Growth of Hair	0	0	1	1
132. Allergies	20	8	30	58
133. Drug Reactions	5	1	19	25
134. Reactions to Certain Foods	5	2	14	21
135. Acne	3	3	13	19
136. Psoriasis	1	0	8	9
137. Eczema	4	5	2	11
138. Inflammation of Sweat Glands (Dermatitis)	0	0	0	0
139. Hay Fever	13	2	15	30
140. Hives	2	5	9	16
141. Frequent Infections	3	1	4	8
142. Surgical Operations	26	7	30	63
143. Injuries	10	1	19	30
144. Cancer of Any Type	1	2	1	4
145. Migraine Headaches	1	1	13	15
146. Hypertension	1	4	16	21
147. Kidney Disease	0	0	6	6
148. Anemia	5	3	11	19
149. Other Illnesses Requiring Hospitalization	0	1	1	2

Table 7

Percentage of 273 Respondents with Specific Complaints
By Onset in Relationship to Move to Jackson Township

	Prior to Move	After Move	Onset Date Indeterminable	Total
1. Excessive Weight Loss	0.4	0.4	1.5	2.2
2. Excessive Weakness	0.4	1.1	4.8	6.2
3. Fever	0	0	2.9	2.9
4. Chills	0	0	4.4	4.4
5. Sweats	0.4	0.4	3.3	4.0
6. Night Sweats	0.4	1.5	5.5	7.3
7. Itching of the Skin	1.8	15.4	22.0	39.2
8. Changes in Coloration of the Skin	0	3.7	7.7	11.4
9. A Tendency to Bruise Easily	0	2.2	11.7	13.9
10. Excessive Dryness of the Skin	1.5	11.7	21.6	34.8
11. Scaling of the Skin	1.5	6.6	13.6	21.6
12. Loss of Hair on Your Arms	0	0	3.3	3.3
13. Headaches	2.2	3.7	15.4	21.2
14. Dizziness	0.4	1.8	7.3	9.5
15. Pain in the Eyes	1.1	2.6	9.5	13.2
16. Recent Changes in Vision	0	2.6	8.1	10.6
17. Seeing Double	0	0	2.9	2.9
18. Infections of the Eye	1.1	0.7	1.5	3.3
19. Earaches	2.2	1.8	5.1	9.2
20. Hearing Defect	1.1	0	3.3	4.4
21. Ringing in the Ears	0.7	0.7	5.5	7.0
22. Frequent Ear Infections	3.3	1.5	2.2	7.0
23. Sinus Pain	4.0	3.7	9.2	16.8
24. Infections of the Nose	1.1	1.1	1.1	3.3

Table 7 (Continued)

		Prior to Move	After Move	Onset Date Indeterminable	Total
25.	Bleeding from the Nose	1.8	1.5	7.3	10.6
26.	Post Nasal Drip	3.7	2.2	11.7	17.6
27.	Frequent Colds	1.5	2.9	6.2	10.6
28.	Soreness of the Gums or Lips	0.7	0.4	6.2	7.3
29.	Bleeding from the Gums	0.4	0.7	2.9	4.0
30.	Frequent Sore Throats	1.5	3.3	7.0	11.7
31.	Sore Tongue	0	0	1.8	1.8
32.	Changes in Taste	0	0.7	1.5	2.2
33.	Hoarseness	0.7	1.5	3.3	5.5
34.	Limitations in Movement of the Neck	0	1.1	4.4	5.5
35.	Frequent Pains in the Neck	0	1.8	4.0	5.9
36.	Enlargement of the Thyroid Gland	0	0	1.1	1.1
37.	Swollen Glands in the Neck or Under Arms	0.7	0	1.8	2.6
38.	Breast Lumps	0.4	0.4	0.4	1.1
39.	Pain in the Breast	0	1.5	1.5	2.9
40.	Discharge from the Breast	0	1.1	0	1.1
41.	Chest Pain	0.4	0	4.8	5.1
42.	Pain Upon Taking a Deep Breath	0	0	4.4	4.4
43.	Frequent Coughing	1.1	1.1	5.1	7.3
44.	Spitting up Blood	0	0	0.4	0.4
45.	Wheezing	1.5	1.5	5.5	8.4
46.	Coughing up Discolored Sputum	0	0	2.2	2.2
47.	Asthma	1.5	0.4	1.1	2.9
48.	Bronchitis	2.9	1.5	6.6	11.0
49.	Pneumonia	1.5	1.8	4.8	8.1

Table 7 (Continued)

	Prior to Move	After Move	Onset Date Indeterminable	Total
50. Tuberculosis	0	0	0	0
51. Recent Contact with an Individual who has Tuberculosis	0	0	1.5	1.5
52. Shortness of Breath	0.4	0.7	9.2	10.3
53. Urination more than once after going to Bed	0	1.1	10.3	11.4
54. Hesitancy in Urinating	0	0.4	2.2	2.6
55. Pain on Urination	0	0.4	1.8	2.2
56. Any Abnormalities in Color of Urine	0	0.4	1.5	1.8
57. History of Urinary Tract Infections	1.8	1.1	4.4	7.3
58. History of Kidney Stones	0	0.4	1.5	1.8
59. Passing Blood in the Urine	0.7	0	0.4	1.1
60. History of Gout	0	0	0	0
61. Pain in the Testicles (Males Only)	0	0	1.5	1.5
(Females Only)				
62. Abnormalities in Menstrual Cycle	1.1	0.4	4.4	5.9
(Females Only)				
63. Excessive Bleeding During Menstruation	0.7	0.4	3.3	4.4
64. Vaginal Discharge (Females Only)	1.8	2.9	6.6	11.4
65. Pain in the Legs Upon Walking or Exercising	0	1.1	9.5	10.6
66. Varicose Veins	0.7	1.1	4.4	6.2
67. Clots in the Leg	0.4	0.4	1.1	1.8
68. Joint Stiffness	0.7	0.4	9.2	10.3
69. Joint Swelling	0.7	0.4	4.8	5.9
70. History of Rheumatoid Arthritis	0.7	0.4	4.4	5.5
71. Osteo-Arthritis	0	0	1.1	1.1
72. Bursitis	0	0.4	4.4	4.8
73. Osteomyelitis (Infection of the Bone)	0	0	0.4	0.4
74. History of Fractures	1.5	0.7	4.8	7.0
75. Frequent Muscle Cramps	0	0	8.1	8.1

Table 7 (Continued)

	Prior to Move	After Move	Onset Date Indeterminable	Total
76. Morning Stiffness	0.4	0.7	8.1	9.2
77. Limitation of Motion in any Joint	0.7	0.4	5.9	7.0
78. Disc Disease (low back pain)	2.2	1.8	7.0	11.0
79. Sciatica	0	0	1.8	1.8
80. Fainting Spells	0.4	0	0.7	1.1
81. Heart Palpitations	0.4	0.7	4.0	5.1
82. Shortness of Breath but only on Exertion	0.7	0.4	12.5	13.6
83. Shortness of Breath while in Bed	0	0	1.8	1.8
84. Swelling of the Ankles	0.7	0.7	4.8	6.2
85. History of a Heart Murmur	2.2	1.1	3.7	7.0
86. Rheumatic Fever	0.4	0	0.7	1.1
87. High Blood Pressure	0	1.8	4.4	6.2
88. Coronary Artery Disease	0.4	0	1.1	1.5
89. Poor Appetite	0	1.1	1.8	2.9
90. Difficulty in Swallowing Solids	0	0	0.4	0.4
91. Difficulty in Swallowing Liquids	0	0	0.4	0.4
92. Heartburn	0.4	0.7	8.4	9.5
93. Pain in the Stomach	1.1	3.3	8.8	13.2
94. Belching Excessively	0	1.1	4.4	5.5
95. Nausea - Vomiting	0.7	1.1	4.8	6.6
96. Passing Blood in Stool	0.4	0.7	1.5	2.6
97. Constipation	0.4	1.1	5.5	7.0
98. Diarrhea	0.7	5.9	5.5	12.1
99. Hemorrhoids	2.6	0.7	8.1	11.4
100. Fissures	0.4	0	0	0.4
101. Fistulas	0	0	0	0

Table 7 (Continued)

	Prior to Move	After Move	Onset Date Indeterminable	Total
102. A History of Ulcers	1.1	0.4	0	1.5
103. History of Gall Bladder Disease	0	0	0	0
104. History of Cirrhosis	0	0	0	0
105. History of Hepatitis	0.7	0	0.7	1.5
106. Appendicitis	1.8	0	3.3	5.1
107. History of Colitis	0.4	0	2.2	2.6
109. Frequent Urination	Illegible on Original Forms			
110. Convulsions	0.7	0.4	0	1.1
111. Stroke	0	0	0.7	0.7
112. Encephalitis	0	0	0	0
113. Speech Disorders	0.4	0	1.5	1.8
114. Memory Disorders	0.4	0	1.5	1.8
115. Changes in Sleeping Patterns	0	1.8	7.7	9.5
116. Nervous Breakdown	0	0.4	0	0.4
117. Muscle Weakness	0	1.8	3.7	5.5
118. Muscle Paralysis	0	0	0.4	0.4
119. Clumsiness of Movement	0.4	0	3.3	3.7
120. Loss of Sensation in the Extremities	1.5	0.4	2.6	4.4
121. Bleeding Tendencies of the Skin Mucous Membrane	0	0	0	0
123. History of Transfusions	1.1	0	1.1	2.2
124. History of Thyroid Disease	0	0.4	0.4	0.7
125. Poor Tolerance to Heat	0	0.4	2.6	2.9
126. Poor Tolerance to Cold	1.1	0	5.5	6.6
127. Nervousness	1.5	2.2	8.1	11.7
128. Tremors	0	0	0.4	0.4
129. Diabetes	1.1	0	1.1	2.2

Table 7 (Continued)

	Prior to Move	After Move	Onset Date Indeterminable	Total
130. Excessive Urination	0.4	0.7	4.4	5.5
131. Excessive Growth of Hair	0	0	0.4	0.4
132. Allergies	7.3	2.9	11.0	21.2
133. Drug Reactions	1.8	0.4	7.0	9.2
134. Reactions to Certain Foods	1.8	0.7	5.1	7.7
135. Acne	1.1	1.1	4.8	7.0
136. Psoriasis	0.4	0	2	2.9
137. Eczema	1.5	1.8	0.7	4.0
138. Inflammation of Sweat Glands (Dermatitis)	0	0	0	0
139. Hay Fever	4.8	0.7	5.5	11.0
140. Hives	0.7	1.8	3.3	5.9
141. Frequent Infections	1.1	0.4	1.5	2.9
142. Surgical Operations	9.5	2.6	11.0	23.1
143. Injuries	3.7	0.4	7.0	11.0
144. Cancer of Any Type	0.4	0.7	0.4	1.5
145. Migraine Headaches	0.4	0.4	4.8	5.5
146. Hypertension	0.4	1.5	5.9	7.7
147. Kidney Disease	0	0	2.2	2.2
148. Anemia	1.8	1.1	4.0	7.0
149. Other Illnesses Requiring Hospitalization	0	0.4	0.4	0.7

Table 8

RENAL DISEASE IN COMMUNITY NEAR LANDFILL

Case #	Source of Case +	Age	Sex	Moved to Area	Onset or Diagnosis Established	Diagnosis	Comment
1	Community	44	M	7/69	1948	Diabetes	Juvenile onset. Multiple complications including retinopathy and renal failure.
2	Community	33	M	1969	1974*	Hypertension	Unilaterally diseased kidney recognized in 1975. Nephrectomy 1977
3	Community		F	1/75	10/75*	Wilms Tumor	Presented as brain tumor at age 9 mos. Deceased.
4	Community	35	F	9/70	1968	Nephritis	Renal biopsy in 1968. Disease has progressed to renal failure.
5	Community	28	F	3/75	5/77*	Kidney Stone	
6	Community	16	F	10/68	1964	Congenital Urologic Defect	Corrective surgery 11/64; nephrectomy for hydronephrosis 7/75.
7	Q 58	79	F	11/73	1923	Kidney Stone	Several episodes prior to moving to present home; none since.
8	Q 58	30	M	10/78	1970	Kidney Stone	
9	Q 58	41	F	11/76	ca. 1965	Kidney Stone	
10	Q 58	44	F	9/70	ca. 1958	Kidney Stone	Also reports several episodes of urinary tract infection, including pyelonephritis over last 10 yrs.; none in last 2 years.
11	Q 146	12	F	11/76	ca. 1970	Pyelonephritis	No recurrence since age 2.
12	Q 146	9	F	10/78	5/78	Reflux	Recurrent UTI's began in 5/78. Diagnosis established in 3/79.
13	Community	5	F	ca. 4/77 thru 10/78	ca. 6/79*	Meatal Stenosis	No problems since meatotomy, 9/79. Reflux at high pressure also found.

* Onset or diagnosis subsequent to living in neighborhood

+ Source of Case: Community - case brought to attention by community

Q 58 - case brought to attention by relating history of kidney stones in 1/80 questionnaire

Q 146 - case brought to attention by relating history of kidney disease in 1/80 questionnaire

Figure 1

January, 1980

Dear Member:

Please fill out the enclosed Health Survey - one copy for each member of your family. (If there are four members in your family, you must fill out four forms.)

This form is being requested by our attorney for the following reasons:

1. to assist us in obtaining federal funds for health purposes;
2. to assist our attorney in preparing our case for trial in determining the current extent and nature of health problems due to the contaminated water supply.

These health surveys will be computerized and turned over to a major New York Medical Center for evaluation and documentation.

This form must be filled out immediately and please enclose them in the envelope provided. To keep all your information confidential, SEAL THE ENVELOPE. Please have these forms completed within seven days and they will be picked up by volunteers.

Thank you for your prompt attention and cooperation in this matter.

CONCERNED CITIZENS COMMITTEE

Figure 2

Year and Outcome of Pregnancies
Completed Following Move to Jackson Township



