June 20, 1983

Summary of Health Studies Conducted at GEMS Landfill in Camden County by the New Jersey Department of Health

This collection of four reports summarizes the investigations that the New Jersey Department of Health, in cooperation with the Camden County Health Department, has conducted around the Gloucester Environmental Management Services, Inc. (GEMS) landfill site in Gloucester Township, Camden County.

1) The results of a health questionnaire administered to residents of Fox Chase and Erial Road, who live adjacent to GEMS, and a similar population of individuals who live away from GEMS in another part of Camden County (Winslow Township).

2) The results of a health questionnaire to Briar Lake residents who also live adjacent to GEMS.

3) The results of pulmonary function testing (breathing tests) administered to residents of Fox Chase, Erial Road and the control group in Winslow Township.

4) The results of air sampling both inside and outside homes in Fox Chase, Erial Road and Briar Lake and at the control site in Winslow Township.

These investigations were initiated in response to complaints about odors and adverse health effects. Between 1970 and 1980, chemical wastes were believed to be deposited at the site. The landfill is estimated to cover about 60 acres. It was initially opened around 1960 and was primarily used as a sanitary landfill. The landfill mass is now 80 to 100 feet above the surrounding county size. It is covered, but erosion is evident with leachate flowing into an adjacent creek. Individuals who were included in the New Jersey Department of Health investigations live north, northwest and northeast of the site. The yards of some homes abut a stream and/or a pond into which leachate flows. Other homes are up to one-half mile from the landfill. Health complaints were examined with respect to distance from the landfill.

The following are the major findings of the studies conducted:

1) Residents living near GEMS Landfill had increased complaints of odor problems as compared to individuals living in another part of Camden County.

2) Residents living near GEMS Landfill had increased respiratory complaints as compared to individuals living in another part of Camden County.

3) No increase in medical or reproductive problems other than respiratory complaints were found among individuals living near GEMS Landfill as compared to individuals living in another part of Camden County.

4) No increase in abnormal breathing tests was found among residents living near GEMS Landfill. However, there was a general trend that on the average, breathing tests were lower among individuals living near GEMS than individuals living in another part of Camden County.

5) Certain inconsistencies in the data were found: (1) the breathing tests of symptomatic individuals were not reduced, as compared to asymptomatic individuals, and (2) a statistically significant decrement in breathing tests was found in a subgroup (female nonsmokers) that did not have an increase in respiratory complaints, and male nonsmokers who had a statistically significant increase in respiratory complaints had slightly better but non-significant increase in average breathing test results.

6) All but one external air level of measured contaminants was non-detectable. Levels inside homes were low (ppb) and generally not higher in homes near the GEMS Landfill than in homes in another part of Camden County. However, certain substances like toluene found in the leachate from the landfill were only found in the air in homes near GEMS.

Our overall conclusion is that there is no evidence of increased disease among residents living adjacent to the site, nor the presence of chemicals at levels felt to cause organ damage. However, the increased respiratory and odor complaints indicate the need for corrective action. Individuals with asthma or other types of underlying lung disease are the most likely to develop symptoms from the low level of emissions that have been found. We repeat our recommendation from December 29, 1980 that no new homes be built around the landfill. After corrective action has been completed, a reassessment of respiratory and odor complaints among residents living adjacent to the landfill needs to be done. At that time, the advisability of allowing new construction can also be reassessed.

REPORT

A Health Survey of the Population Living Near
GLOUCESTER ENVIRONMENTAL MANAGEMENT SERVICES (GEMS) Landfill
Conducted by the
ENVIRONMENTAL HEALTH HAZARD EVALUATION PROGRAM
of the
NEW JERSEY STATE DEPARTMENT OF HEALTH
in Cooperation with the
CAMDEN COUNTY HEALTH DEPARTMENT
APRIL 1982

A Health Survey of the Population Living Near the Gloucester Environmental Management Services (GEMS) Landfill, Gloucester Township, Camden County April 1982

In response to complaints about odors and health problems from residents living near GEMS Landfill in Gloucester Township, Camden County, the State Department of Health, in cooperation with the Camden County Health Department, conducted an epidemiologic study of 122 homes in the affected area. The survey consisted of a questionnaire administered to each member of the household to gather information on exposure to toxic substances, the presence of symptoms and reported medical problems. In addition, this questionnaire was administered to a control group of residents living five miles away from the landfill (Winslow Township). The control households were from a similar type of housing development in the same county. The information was analyzed to determine whether health symptoms were more prevalent in residents living around the landfill.

GEMS leased the landfill from the Township of Gloucester during the years 1970 to 1980. During the period, chemical wastes were disposed of at the site. The landfill, estimated to cover about 60 acres, was initially opened in 1960. For most of this period it was a sanitary landfill. The landfill mass, between 80 and 100 feet above the general topography, is covered but erosion is evident with leachate flowing into an adjacent creek. The problems posed by this site are contamination of surface and groundwater, odors emanating from the landfill and run off.

Subject and Methods

The data for the present analysis are from a cross-sectional study of reported respiratory symptoms and illness in the population residing in the vicinity of GEMS Landfill compared to another population residing in another part of Camden County. Maps of the surveyed area are shown on pages 13-15. Households 1-53 represent the population further away from the landfill (up to one quarter mile) and at higher elevation relative to households 54-122, which are closer to the landfill and at a lower elevation. Households 501-562 represent the control population not residing near GEMS landfill.

The analyses of relative risks were done separately by sex and smoking status. This was done because it was felt that exposure for men and women might differ because of differences in the amount of time men and women might be around their home. Smoking is an important confounding factor to be considered in evaluating respiratory symptoms.

Results

The sample sizes, the proportion of households successfully interviewed, the distribution by sex, age, tobacco use, chemical exposure and perception of odor are shown in Table I. Differences between the exposed and unexposed population are small, with the exception of odor perception that bothered over 90% of the population near the GEMS Landfill.

The data presented in Table II are tabulated relative risks of complaints in the exposed population compared to complaints in the unexposed population. A relative risk greater than one (1) indicates that the risk of the specific symptom is greater in the exposed population. An asterisk (*) by a relative risk indicates a statistically significant risk at the 5% probability level.

In some sub groups significantly high relative risks were reported for wheezing, tightness in chest, eye irritation and nasal irritation in order of decreasing relative risks. The male non-smokers had the most symptoms. Females did not report as many symptoms but, unlike males, when they do report symptoms, it was female smokers who had the most symptoms.

A comparison of the symptoms of the population living closer to the landfill with the population living further from the landfill reveals that those closer to the landfill reported a greater percentage of symptoms.

The medical problems are described in detail in Table III. No single problem was reported in excess. The exposed women did not report an excessive number of overall pregnancy problems which are described in Tables IV & V. (It should be noted that several of these reported problems, both medical and pregnancy, existed prior to moving into the area of GEMS landfill).

DISCUSSION

Although a number of respiratory problems are reported in excess by the population near the landfill, it is difficult to associate them solely with air pollution since there is a male/female difference.

The observation that males are at greater risk than females may imply however, that the males may have greater exposure to the ambient environment or to part of the house that would stimulate respiratory problems. People who live closer to the landfill reported more problems. This group presumably receives a greater or more intense exposure. A larger number of individuals complained of odors in the exposed than the control group. Individuals who live near GEMS may be more sensitive to reporting respiratory and irritant type symptoms because of their concern for odors in the neighborhood. We therefore intend to follow up this questionnaire survey with pulmonary function testing. This will enable us to assess if the symptoms are associated with a decrement in breathing functions.

TABLE I

G.E.M.S. Study

Distribution of Population Surveyed

Exposed and Unexposed

	Exposed Population to Gems Lanfill		Sub Population Upper Elevation Households 1-53		Sub Population Lower Elevation: Households 54-122		Unexposed Population Households 501-562	
	Number	(%)	Number	(%)	Number	(%)	Number	(%)
Total Sample Size of Households	122	(100%)	54	(100%)	68	(100%)	61	(100%)
Respondent Households	105	(86%)	47	(87%)	58	(85%)	42	(69%)
Non-Respondent Households	17	(14%)	7	(13%)	10	(15%)	19	(31%)
Sex								
Male	178	(50%)	72	(47%)	106	(53%)	78	(48%)
Female	176	(50%)	81	(53%)	95	(47%)	85	(52%)
Total Respondents	354	(100%)	153	(100%)	201	(100%)	163	(100%)
Age								
0-9	94	(26%)	45	(30%)	49	(24%)	56	(34%)
10-19	41	(12%)	14	(9%)	27	(13%)	18	(11%)
20-59	209	(59%)	91	(59%)	118	(59%)	88	(54%)
60+	10	(3%)	3	(2%)	7	(4%)	1	(1%)
Total Respondents	354	(100%)	153	(100%)	201	(100%)	163	(100%)
Tobacco Use and/or Chemical Exposure								
No	209	(59%)	98	(64%)	111	(55%)	108	(66%)
Yes	145	(41%)	55	(36%)	90	(45%)	55	(34%)
Total Respondents	354	(100%)	153	(100%)	201	(100%)	163	(100%)
Bothered by Odor								
No	32	(9%)	13	(9%)	19	(10%)	136	(87%)
Yes	306	(91%)	130	(91%)	176	(90%)	20	(13%)
Total Respondents	338*	(100%)	134	(100%)	195	(100%)	156	(100%)

*Does not include those children too young to respond.

TABLE II

G.E.M.S. Study
Relative Risks of Reported Symptomatology.
(All Comparisons are Made to the Appropriately Matched Control Group)

Complaint Level-Sex-Smoking Status-Residence Location (Upper vs. Lower) (All Relative Risks are Age Adjusted)		Eye Irritation	Nasal Irritation	Sore Throat	Cough	Wheezing	Tightness in Chest	Shortness of Breath	Medical Problems
	Upper	0.8	1.1	0.6	0.5	0.7	0.8	2.1	0.8
FNS-All Level	Lower	0.8	1.3	0.8	0.6	1.1	1.0	4.8*	1.2
	Combined	0.8	1.2	0.7	0.6	0.9	0.9	3.4	1.0
FNS-Frequent*1	Combined	1.8	2.3	1.2	0.3	0.4	2.4	2.4	
FNS-Saw M.D.	Combined	0.6	1.5	0.4	0.8	0.7	0.7	2.4	
	Upper	1.1	1.0	0.6	1.1	0.2	0.9	0.2	1.5
FS-All Level	Lower	1.4	3.3*	0.4	1.3	2.7	8.5*	0.9	2.4
	Combined	1.3	2.1	0.5	1.2	1.4	5.2	0.6	2.1
FS-Frequent	Combined	0.8	1.3	0.7	1.4		3.3	1.2	
FS-Saw M.D.	Combined	0.6	1.6	0.4	0.8	0.8	3.4	0.8	
	Upper	3.1	2.0	1.3	0.5	3.6	0.8	0.0	1.2
MNS-All Level	Lower	6.3*	2.7	1.4	1.2	14.5*	11.4*	4.9	4.5
	Combined	4.7*	2.3	1.3	0.9	9.4*	6.1	2.2	3.0
MNS-Frequent	Combined	5.1	1.4	2.0	2.0	3.5			
MNS-Saw M.D.	Combined	2.5	2.3	0.7	0.3	5.8			
	Upper	0.3	0.7	0.5	0.8	1.2	0.2	2.4	0.8
MS-All Level	Lower	0.9	0.9	0.2	0.8	1.1	1.1	5.2	1.8
	Combined	0.6	0.8	0.3	0.8	1.1	0.7	4.0	1.3
MS-Frequent	Combined	0.9	2.4	0.2	1.8	0.9			
MS-Saw M.D.	Combined	0.8	1.1	0.1	0.8	0.7	0.9		

TABLE II (Continued)

Complaint Level-Sex-Smoking Status-Residence Location (Upper vs. Lower) (All Relative Risks are Age Adjusted)		Eye Irritation	Nasal Irritation	Sore Throat	Cough	Wheezing	Tightness in Chest	Shortness of Breath	Medical Problems
Summary Relative Risks Adjusted for Age, Sex, and Smoking Status	Upper	0.9	1.2	0.7	0.7	0.8	0.6	0.6	1.0
	Lower	1.5	1.6*	0.7	0.9	2.3*	2.6*	2.5*	2.1*
	Combined	1.3	1.4	0.7	0.8	1.6	1.6	1.7	1.6

FNS = Female, Non - Smoker and/or no Chemical Exposure.
FS = Female, Smoker and/or Chemical Exposure
MNS = Male, Non-Smoker and/or no Chemical Exposure.
MS = Male, Smoker and/or Chemical Exposure
* Significant at the 5% Level.
* 1 Frequent = Daily or Weekly Complaints.
Upper = Households 1-53
Lower = Households 54-122

TABLE III

G.E.M.S. Study

Reported Medical Problems
for Exposed and Unexposed Populations

	Exposed		Unexposed	
Medical Problem	Total # 354	% 100.0	Total # 166	% 100.0
Hypertension	12	3.4	6	3.6
Allergies	16	4.5	5	3.0
Ectopic Ureter	1	0.3	—	—
Arthritis	3	0.8	—	—
Asthma	12	3.4	5	3.0
Birth Defect	1	0.3	—	—
Eczema	1	0.3	—	—
Ear Problem	10	2.8	3	1.8
Hyperthyroidism	1	0.3	—	—
Endometriosis	3	0.8	—	—
Bronchitis	3	0.8	1	0.6
Eye Infection	1	0.3	—	—
Backache	1	0.3	—	—
Heart Problem	6	1.7	1	0.6
Hodgkins Disease	1	0.3	—	—
Ulcers	2	0.6	1	0.6
Kidney Problem	1	0.3	—	—
GI Problem	1	0.3	—	—
Rash	4	1.1	—	—
Sinusitis	6	1.7	2	1.2
Gall Bladder Problem	1	0.3	—	—
Vasomotor Problem	1	0.3	—	—
Glaucoma	1	0.3	—	—
Skin Cancer	1	0.3	—	—
Headaches	1	0.3	—	—
Diabetes	1	0.3	1	0.6
Hypoglycemia	1	0.3	—	—
Asbestosis	1	0.3	1	0.6
Emphysema	1	0.3	—	—
"Tumors"	1	0.3	—	—
Conjunctivitis	1	0.3	—	—
"Respiratory Problem"	2	0.6	—	—
Bladder Infection	—	—	1	0.6
Sarcoidosis	—	—	1	0.6
Anemia	—	—	2	1.2
Cerebral Palsy	—	—	1	0.6
Adenoid Problem	—	—	1	0.6
Seizure Disorder	—	—	1	0.6
"Cystic"	—	—	1	0.6
Hyperactive	1	0.3	—	—
"Bankok Flu"	1	0.3	—	—
"Fibro Cystic"	1	0.3	—	—
Hernia	1	0.3	—	—
Phlebitis	1	0.3	—	—
Torn Retina	1	0.3	—	—
Adenoidectomy	1	0.3	—	—
Tonsilectomy	1	0.3	—	—
COPD	1	0.3	—	—

Revised 2/10/83

TABLE IV G.E.M.S. Study

Relative Risks of Pregnancy Problems
for Upper and Lower Residence Elevations

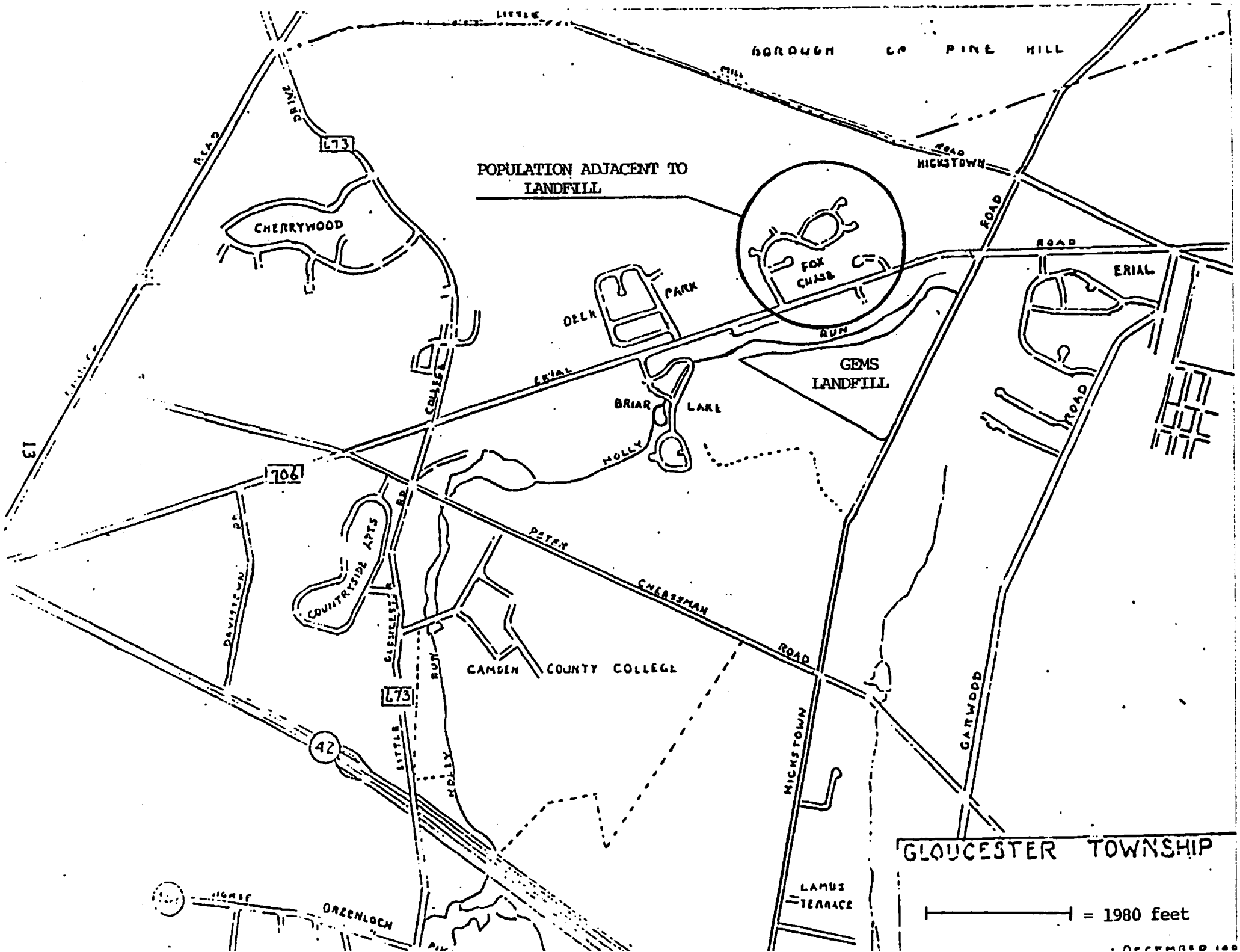
Residence Location	Relative Risk	95% Confidence Interval
Upper Elevation	1.3	0.4 - 4.1
Lower Elevation	1.3	0.4 - 4.1
Combined	1.3	

TABLE V G.E.M.S. Study

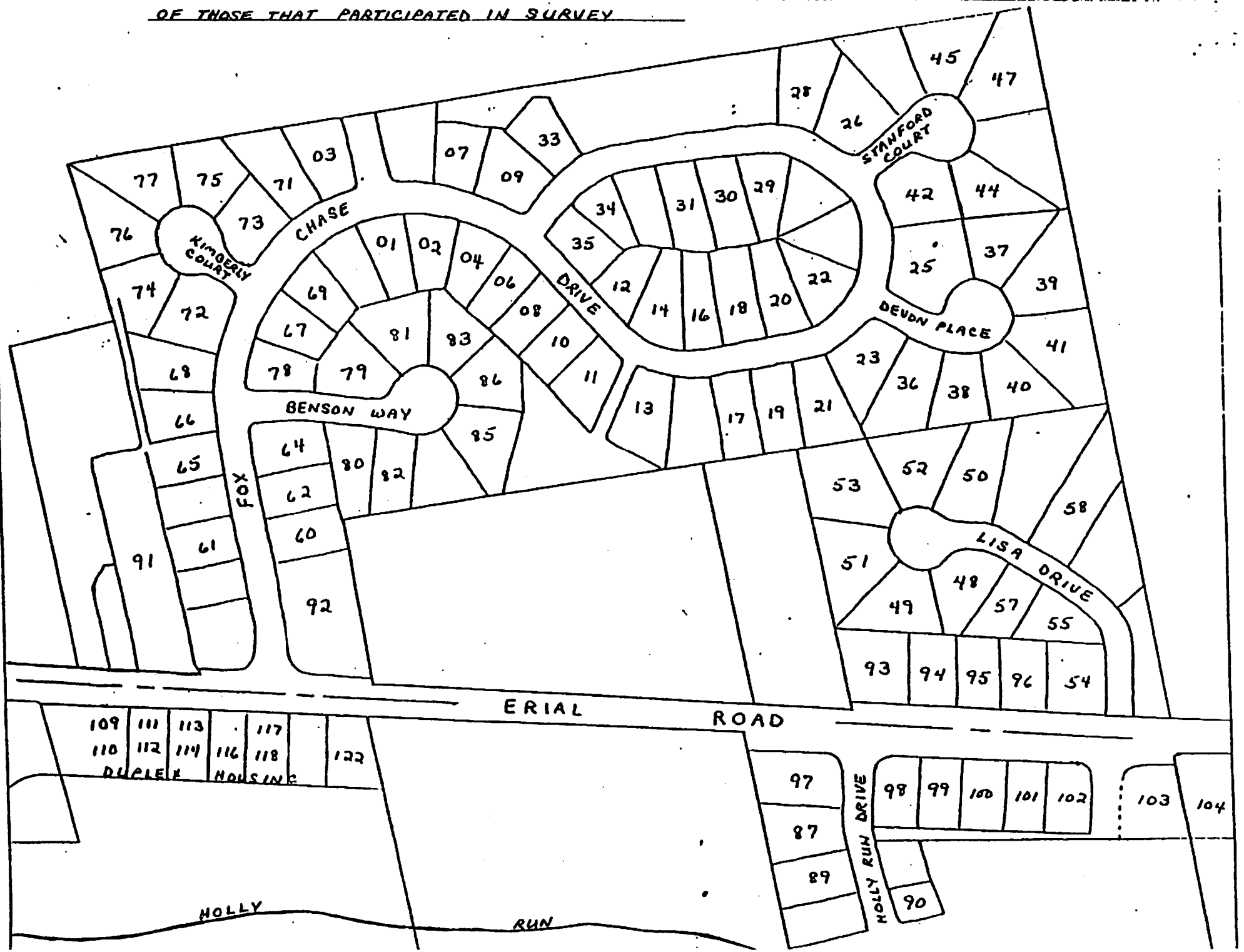
Reported Pregnancy Problems in Exposed and Unexposed Areas
by Number and Percent

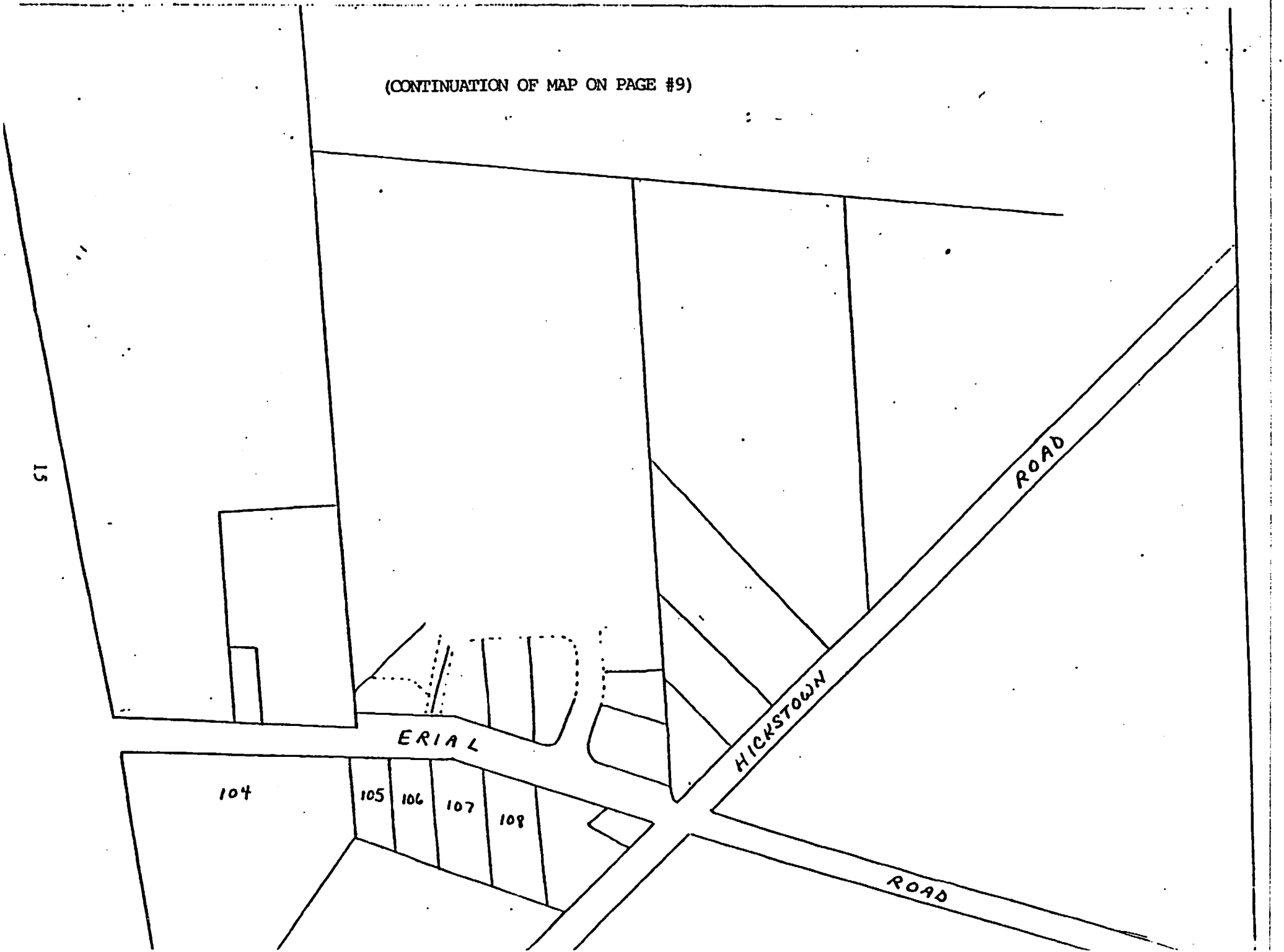
Pregnancy Problems	Exposed Area Responding - 113		Unexposed Area Responding - 38	
	#	%	#	%
Miscarriage	2	1.8	4	10.5
Difficulty Conceiving	8*	7.2	1	2.6
Placenta Previa	1	0.9	—	—
Endometriosis	2	1.8	—	—
Tubal Pregnancy	1	0.9	—	—
Early C-Section	1	0.9	—	—
Premature Delivery			1	2.6
Kidney Problem	1	0.9	—	—
Severe Vomiting	1	0.9	—	—
No Description	3	2.7	—	—
Total	20	17.7	6	15.8

*5 of 8 respondents indicated that this condition existed prior to moving into their residence.


POPULATION ADJACENT TO LANDFILL
GEMS LANDFILL
BOROUGH OF PINE HILL
CHERRYWOOD
FOX CHASE
BRIAR LAKE
HOLLY
COUNTRYSIDE APTS
CAMDEN COUNTY COLLEGE
GLOUCESTER TOWNSHIP
LAMBS TERRACE
GARWOOD
= 1980 feet

GEMS SURVEY - RESIDENCES BY HOUSEHOLD NUMBER (01 - 122)
OF THOSE THAT PARTICIPATED IN SURVEY




(CONTINUATION OF MAP ON PAGE #9)
15
ERIAL
HICKSTOWN
ROAD
ROAD
104
105
106
107
108

G.E.M.S. Study
Eye Irritation-
Number and % Of Cases

Complaint Level-Sex-Smoking Status-Residence Location (Upper vs. Lower)		EXPOSED		UNEXPOSED		RELATIVE RISKS
		#	%	#	%	
FNS-All Level	Upper	12	20.7	14	22.2	0.8
	Lower	11	21.2	14	22.2	0.8
	Combined	23	20.9	14	22.2	0.8
FNS-Frequent	Combined	10	9.1	3	4.8	1.8
FNS-Saw M.D.	Combined	14	12.7	8	12.7	0.6
FS-All Level	Upper	7	30.4	6	27.3	1.1
	Lower	14	32.6	6	27.3	1.4
	Combined	21	31.8	6	27.3	1.3
FS-Frequent	Combined	12	18.2	5	22.7	0.8
FS-Saw M.D.	Combined	7	10.6	4	18.2	0.6
MNS-All Level	Upper	10	25.0	4	8.9	3.1
	Lower	23	39.0	4	8.9	6.3*
	Combined	33	33.3	4	8.9	4.7*
MNS-Frequent	Combined	10	10.1	1	2.2	5.1
MNS-Saw M.D.	Combined	20	20.2	4	8.9	2.5
MS-All Level	Upper	4	12.5	10	30.3	0.3
	Lower	12	25.5	10	30.3	0.9
	Combined	16	20.3	10	30.3	0.6
MS-Frequent	Combined	8	10.1	4	12.1	0.9
MS-Saw M.D.	Combined	7	8.9	4	12.1	0.8

G.E.M.S. Study
Tightness in Chest
Number and % of Cases

Complaint Level-Sex-Smoking Status-Residence Location (Upper vs. Lower)		EXPOSED		UNEXPOSED		RELATIVE RISKS
		#	%	#	%	
FNS-All Level	Upper	4	6.9	5	7.9	0.8
	Lower	6	11.5	5	7.9	1.0
	Combined	10	9.1	5	7.9	0.9
FNS-Frequent	Combined	4	3.6	1	1.6	2.4
FNS-Saw M.D.	Combined	7	6.4	5	7.9	0.7
FS-All Level	Upper	1	4.5	1	4.5	0.9
	Lower	12	54.5	1	4.5	8.5*
	Combined	13	19.7	1	4.5	5.2
FS-Frequent	Combined	9	13.6	1	4.5	3.3
FS-Saw M.D.	Combined	9	13.6	1	4.5	3.4
MNS-All Level	Upper	1	2.5	1	2.2	0.8
	Lower	12	20.3	1	2.2	11.4*
	Combined	13	13.1	1	2.2	6.1
MNS-Frequent	Combined	3	3.0	0	-	-
MNS-Saw M.D.	Combined	10	10.1	0	-	-
MS-All Level	Upper	1	3.1	5	15.2	0.2
	Lower	7	14.9	5	15.2	1.1
	Combined	8	10.1	5	15.2	0.7
MS-Frequent	Combined	1	1.3	0	-	-
MS-Saw M.D.	Combined	4	5.1	2	6.1	0.9

G.E.M.S. Study
Medical Problems
Number and % of Cases

Complaint Level-Sex-Smoking Status-Residence Location (Upper vs. Lower)		EXPOSED		UNEXPOSED		RELATIVE RISKS
		#	%	#	%	
FNS-All Level	Upper	11	19.0	13	20.6	0.8
	Lower	13	25.0	13	20.6	1.2
	Combined	24	21.8	13	20.6	1.0
FS-All Level	Upper	6	26.1	4	18.2	1.5
	Lower	15	34.9	4	18.2	2.4
	Combined	21	31.8	4	18.2	2.1
MNS-All Level	Upper	5	12.5	5	11.1	1.2
	Lower	20	33.9	5	11.1	4.5*
	Combined	25	25.3	5	11.1	3.0
MS-All Level	Upper	6	18.8	7	21.2	0.8
	Lower	14	29.8	7	21.2	1.8
	Combined	20	25.3	7	21.2	1.3

G.E.M.S. Study
Shortness of Breath
Number and % of Cases

Complaint Level-Sex-Smoking Status-Residence Location (Upper vs. Lower)		EXPOSED		UNEXPOSED		RELATIVE RISKS
		#	%	#	%	
FNS-All Level	Upper	4	6.9	2	3.2	2.1
	Lower	8	15.4	2	3.2	4.8*
	Combined	12	10.9	2	3.2	3.4
FNS-Frequent	Combined	5	4.5	1	1.6	2.4
FNS-Saw M.D.	Combined	9	8.2	2	3.2	2.4
FS-All Level	Upper	2	8.7	7	31.8	0.2
	Lower	12	27.9	7	31.8	0.9
	Combined	14	21.2	7	31.8	0.6
FS-Frequent	Combined	10	15.2	3	13.6	1.2
FS-Saw M.D.	Combined	7	10.6	3	13.6	0.8
MNS-All Level	Upper	0	-	2	4.4	0.0
	Lower	10	16.9	2	4.4	4.9
	Combined	10	10.1	2	4.4	2.2
MNS-Frequent	Combined	4	4.0	0	-	-
MNS-Saw M.D.	Combined	8	8.1	0	-	-
MS-All Level	Upper	2	6.3	1	3.0	2.4
	Lower	6	12.8	1	3.0	5.2
	Combined	8	10.1	1	3.0	4.0
MS-Frequent	Combined	3	3.8	0	-	-
MS-Saw M.D.	Combined	4	5.1	0	-	-

G.E.M.S. Study
Wheezing
Number and % of Cases

Complaint Level-Sex-Smoking Status-Residence Location (Upper vs. Lower)		EXPOSED		UNEXPOSED		RELATIVE RISKS
		#	%	#	%	
FNS-All Level	Upper	5	8.6	7	11.1	0.7
	Lower	6	11.5	7	11.1	1.1
	Combined	11	10.0	7	11.1	0.9
FNS-Frequent	Combined	2	1.8	3	4.8	0.4
FNS-Saw M.D.	Combined	8	7.3	7	11.1	0.7
FS-All Level	Upper	1	4.3	4	18.2	0.2
	Lower	14	32.6	4	18.2	2.7
	Combined	15	22.7	4	18.2	1.4
FS-Frequent	Combined	9	13.6	0	-	-
FS-Saw M.D.	Combined	7	10.6	3	13.6	0.8
MNS-All Level	Upper	3	7.5	1	2.2	3.6
	Lower	15	25.4	1	2.2	14.5*
	Combined	18	18.2	1	2.2	9.4*
MNS-Frequent	Combined	7	7.1	1	2.2	3.5
MNS-Saw M.D.	Combined	11	11.1	1	2.2	5.8
MS-All Level	Upper	5	15.6	5	15.2	1.2
	Lower	8	17.0	5	15.2	1.1
	Combined	13	16.5	5	15.2	1.1
MS-Frequent	Combined	4	5.1	2	6.1	0.9
MS-Saw M.D.	Combined	4	5.1	2	6.1	0.7

G.E.M.S. Study
Cough
Number and % of Cases

Complaint Level-Sex-Smoking Status-Residence Location (Upper vs. Lower)		EXPOSED		UNEXPOSED		RELATIVE RISKS
		#	%	#	%	
FNS-All Level	Upper	10	17.2	18	28.6	0.5
	Lower	11	21.2	18	28.6	0.6
	Combined	21	19.1	18	28.6	0.6
FNS-Frequent	Combined	3	2.7	5	7.9	0.3
FNS-Saw M.D.	Combined	13	11.8	9	14.3	0.8
FS-All Level	Upper	8	34.8	7	31.8	1.1
	Lower	16	37.2	7	31.8	1.3
	Combined	24	36.4	7	31.8	1.2
FS-Frequent	Combined	12	18.2	3	13.6	1.4
FS-Saw M.D.	Combined	7	10.6	3	13.6	0.8
MNS-All Level	Upper	6	15.0	13	28.9	0.5
	Lower	19	32.2	13	28.9	1.2
	Combined	25	25.3	13	28.9	0.9
MNS-Frequent	Combined	8	8.1	2	4.4	2.0
MNS-Saw M.D.	Combined	9	9.1	11	24.4	0.3
MS-All Level	Upper	12	37.5	12	36.4	0.8
	Lower	14	29.8	12	36.4	0.8
	Combined	26	32.9	12	36.4	0.8
MS-Frequent	Combined	12	15.2	3	9.1	1.8
MS-Saw M.D.	Combined	6	7.6	3	9.1	0.8

G.E.M.S. Study
Sore Throat
Number and % of Cases

Complaint Level-Sex-Smoking Status-Residence Location (Upper vs. Lower)		EXPOSED		UNEXPOSED		RELATIVE RISKS
		#	%	#	%	
FNS-All Level	Upper	11	19.0	20	31.7	0.6
	Lower	16	30.8	20	31.7	0.8
	Combined	27	24.5	20	31.7	0.7
FNS-Frequent	Combined	6	5.5	3	4.8	1.2
FNS-Saw M.D.	Combined	11	10.0	14	22.2	0.4
FS-All Level	Upper	8	34.8	10	45.5	0.6
	Lower	11	25.6	10	45.5	0.4
	Combined	19	28.8	10	45.5	0.5
FS-Frequent	Combined	4	6.1	2	9.1	0.7
FS-Saw M.D.	Combined	5	7.6	4	18.2	0.4
MNS-All Level	Upper	12	30.0	12	26.7	1.3
	Lower	20	33.9	12	26.7	1.4
	Combined	32	32.3	12	26.7	1.3
MNS-Frequent	Combined	4	4.0	1	2.2	2.0
MNS-Saw M.D.	Combined	13	13.1	8	17.8	0.7
MS-All Level	Upper	6	18.8	11	33.3	0.5
	Lower	6	12.8	11	33.3	0.2
	Combined	12	15.2	11	33.3	0.3
MS-Frequent	Combined	1	1.3	2	6.1	0.2
MS-Saw M.D.	Combined	2	2.5	3	9.1	0.1

G.E.M.S. Study
Nasal Irritation-
Number and % of Cases

Complaint Level-Sex-Smoking Status-Residence Location (Upper vs. Lower)		EXPOSED		UNEXPOSED		RELATIVE RISKS
		#	%	#	%	
FNS-All Level	Upper	21	36.2	20	31.7	1.1
	Lower	20	38.5	20	31.7	1.3
	Combined	41	37.3	20	31.7	1.2
FNS-Frequent	Combined	19	17.3	5	7.9	2.3
FNS-Saw M.D.	Combined	25	22.7	10	15.9	1.5
FS-All Level	Upper	9	39.1	8	36.4	1.0
	Lower	26	60.5	8	36.4	3.3*
	Combined	35	53.0	8	36.4	2.1
FS-Frequent	Combined	18	27.3	5	22.7	1.3
FS-Saw M.D.	Combined	17	25.8	4	18.2	1.6
MNS-All Level	Upper	14	35.0	9	20.0	2.0
	Lower	23	39.0	9	20.0	2.7
	Combined	37	37.4	9	20.0	2.3
MNS-Frequent	Combined	12	12.1	4	8.9	1.4
MNS-Saw M.D.	Combined	19	19.2	4	8.9	2.3
MS-All Level	Upper	13	40.6	15	45.5	0.7
	Lower	19	40.4	15	45.5	0.9
	Combined	32	40.5	15	45.5	0.8
MS-Frequent	Combined	19	24.1	4	12.1	2.4
MS-Saw M.D.	Combined	14	17.7	5	15.2	1.1

REPORT

BRIAR LAKE HEALTH SURVEY-
APPENDUM TO "A HEALTH SURVEY OF
THE POPULATION LIVING NEAR THE
GLOUCESTER ENVIRONMENTAL MANAGEMENT
SERVICES (GEMS) LANDFILL "- CONDUCTED
BY THE ENVIRONMENTAL HEALTH HAZARD EVALUATION PROGRAM
NEW JERSEY STATE DEPARTMENT OF HEALTH

DECEMBER, 1982

REPORT
BRIAR LAKE HEALTH SURVEY
DECEMBER 1982

Briar Lake, located near Erial Road and a short distance downstream from GEMS Landfill in Gloucester Township, Camden County, lies next to a small development of new homes. Holly Run, a stream which is immediately adjacent to the landfill, empties into Briar Lake. Analyses of samples collected from the stream by DEP show contamination near the landfill and close to Briar Lake from leachate containing high levels of organic chemicals, some of which are known carcinogens.

The earliest residents of the fourteen occupied homes in the Briar Lake development moved into their homes in January 1980 and the most recent resident moved in just one month prior to the interviews conducted for this study. Concern has mounted in these people about health effects from possible exposure to the organic chemicals through air, surface water, etc. They requested an epidemiologic study of the Briar Lake area as follow up to the earlier survey of the Fox Chase residents.

This survey consisted of the same questionnaire used in the Fox Chase survey. It was administered to each household member to gather information on exposure to toxic substances, the presence of symptoms and reported medical problems. In addition, the same control group data was used for analysis to determine whether health symptoms were more prevalent in residents living in the area of the landfill.

SUBJECT AND METHODS

The data for the present analysis is from a cross-sectional study of reported respiratory symptoms and illness in the population residing in the vicinity of GEMS Landfill compared to another population residing in another part of Camden County. Maps of the surveyed populations are shown on pages 31-32.

The analysis of relative risks were done separately by sex and smoking status. This was done because it was felt that exposure for men and women might differ because of differences in the amount of time men and women might be around their home. Smoking is an important confounding factor to be considered in evaluating respiratory symptoms.

RESULTS

The sample sizes, the proportion of households successfully interviewed, the distribution by sex, age, tobacco use, chemical exposure and perception of odor are shown in Table I. As in the study of the Fox Chase area, differences between the exposed and unexposed populations are small. The only exception to this is the perception of odors where 100% of the exposed respondents complained of odors, only 13% of the unexposed respondents answered yes to this question.

The data presented in Table II are tabulated relative risks of complaints in the exposed population compared to complaints in the unexposed population. A relative risk greater than one (1) indicated that the risk of the specific symptom is greater in the exposed population. An asterisk (*) by a relative risk indicated a statistically significant risk at the 5% probability level.

Female non-smoker was the only subgroup with a significantly high relative risk. The reported symptom that was significantly high was eye irritation. As indicated in Table II, the exposed population in general, smoker and non-smoker, reported more symptoms than the unexposed group. None of these other relative risks were statistically significant. The general increase in reported symptoms among Briar Lake residents is consistent with the findings from the earlier Fox Chase study.

The exposed women did not report an excessive number of overall pregnancy problems as seen in Table III. This also is consistent with the Fox Chase area study. The same is true for reported medical problems as described in Table IV. (The heart problems in Table IV represent unrelated complaints summarized to one organ system).

DISCUSSION

A number of respiratory symptoms and odor complaints were reported in excess by the exposed population. However, medical and pregnancy problems were <u>not</u> reported in excess by the exposed population.

These results are similar to those found in comparing the adjacent Fox Chase area residents to the control community. The major difference is the increase in eye irritation among non-smoking females which was not seen in the Fox Chase area.

Alternative explanations for these increased symptoms included (1) exposure to respiratory irritants, and (2) a heightened concern among residents around GEMS Landfill because of odors in the community and the publicity about chemicals at the site.

Further reports of air sampling in the home and ambient environment and pulmonary function testing have been conducted and will be reported. The report of increased symptoms will need to be examined in conjunction with this additional data in order to assess the potential of exposure from the landfill as a cause for the increase in symptoms.

BRIAR LAKE SURVEY
DISTRIBUTION OF POPULATION SURVEYED

TABLE I

		EXPOSED POPULATION		UNEXPOSED POPULATION	
Total sample size of households		14		61	
Respondent households		14	(100%)	42	(69%)
SEX					
Male		24	(52%)	78	(48%)
Female		22	(48%)	85	(52%)
Total Respondents		46	(100%)	163	(100%)
AGE					
0-9		13	(28%)	56	(34%)
10-19		4	(9%)	18	(11%)
20-59		26	(56%)	88	(54%)
60+		3	(7%)	1	(1%)
Total		46	(100%)	163	(100%)
Tobacco use and/or chemical exposure	No	22	(48%)	108	(66%)
	Yes	24	(52%)	55	(34%)
	Total	46	(100%)	163	(100%)
Bothered by odors	No	0-		136	(87%)
	Yes	41	(100%)	20	(13%)
	Total	41*	(100%)	156*	(100%)

*Does not include those children too young to respond

BRIAR LAKE STUDY-GEMS

RELATIVE RISKS OF REPORTED SYMPTOMATOLOGY

(ALL COMPARISONS ARE MADE TO THE APPROPRIATELY MATCHED CONTROL GROUP) TABLE II

SEX AND SMOKING STATUS	EYE IRRITATION	NASAL IRRITATION	SORE THROAT	COUGH	WHEEZING	TIGHTNESS IN CHEST	SHORTNESS OF BREATH	MEDICAL PROBLEMS
Female non-smoker	6.45*	1.42	0.54	1.17	0.90	1.42	-	0.39
Female smoker	4.08	4.95	0.45	2.22	2.12	1.90	1.06	2.83
Male non-smoker	6.61	1.51	0.23	1.31	8.63	6.00	2.75	2.66
Male smoker	1.53	0.30	0.85	0.75	-	1.40	3.55	0.92

BRIAR LAKE SURVEY

REPORTED PREGNANCY PROBLEMS

TABLE III

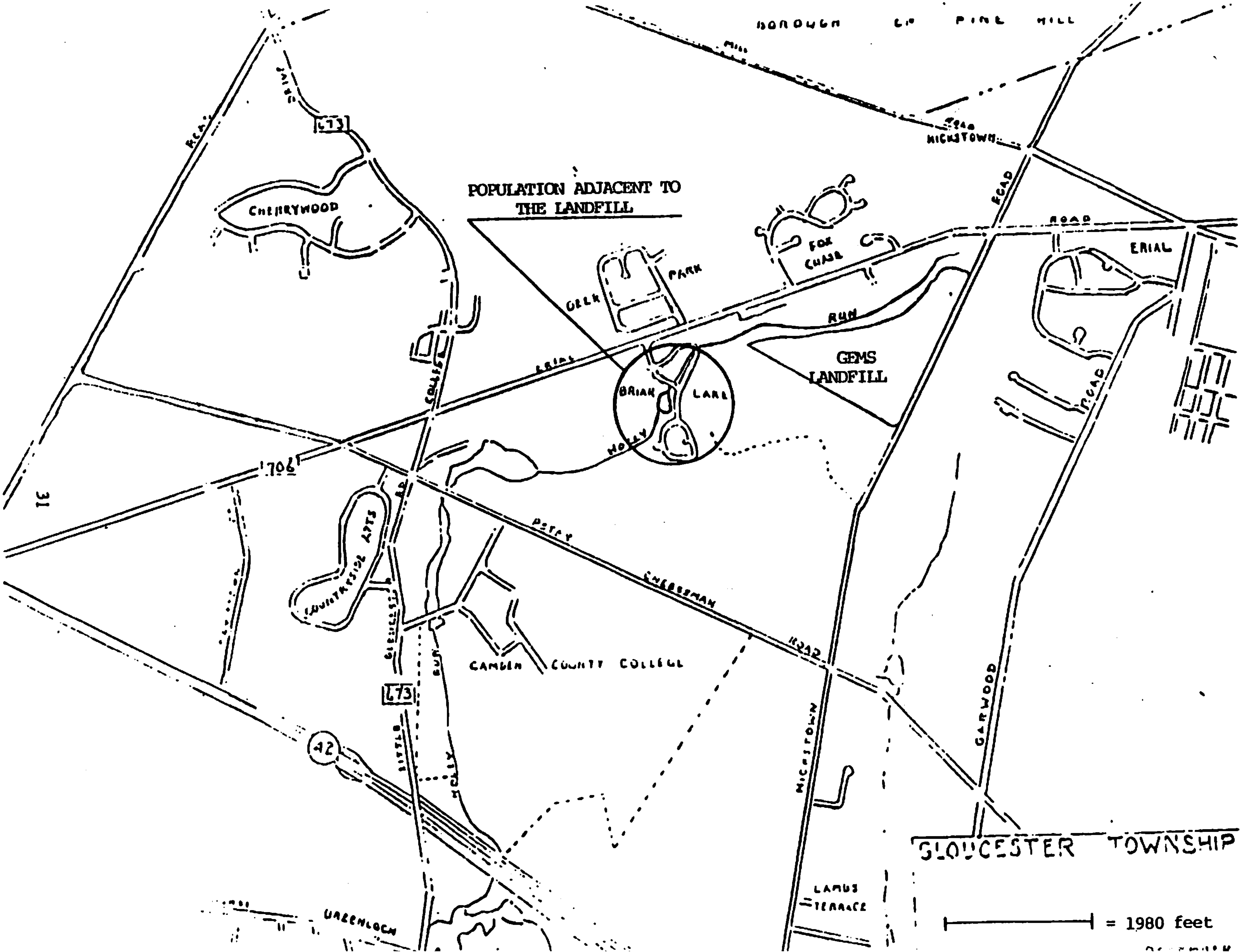
	EXPOSED		UNEXPOSED	
PREGNANCY PROBLEM	#	%	#	%
Miscarriage			4	10.5
Difficulty conceiving			1	2.6
Premature delivery			1	2.6
"Difficulty with pregnancy"	1	8.3		

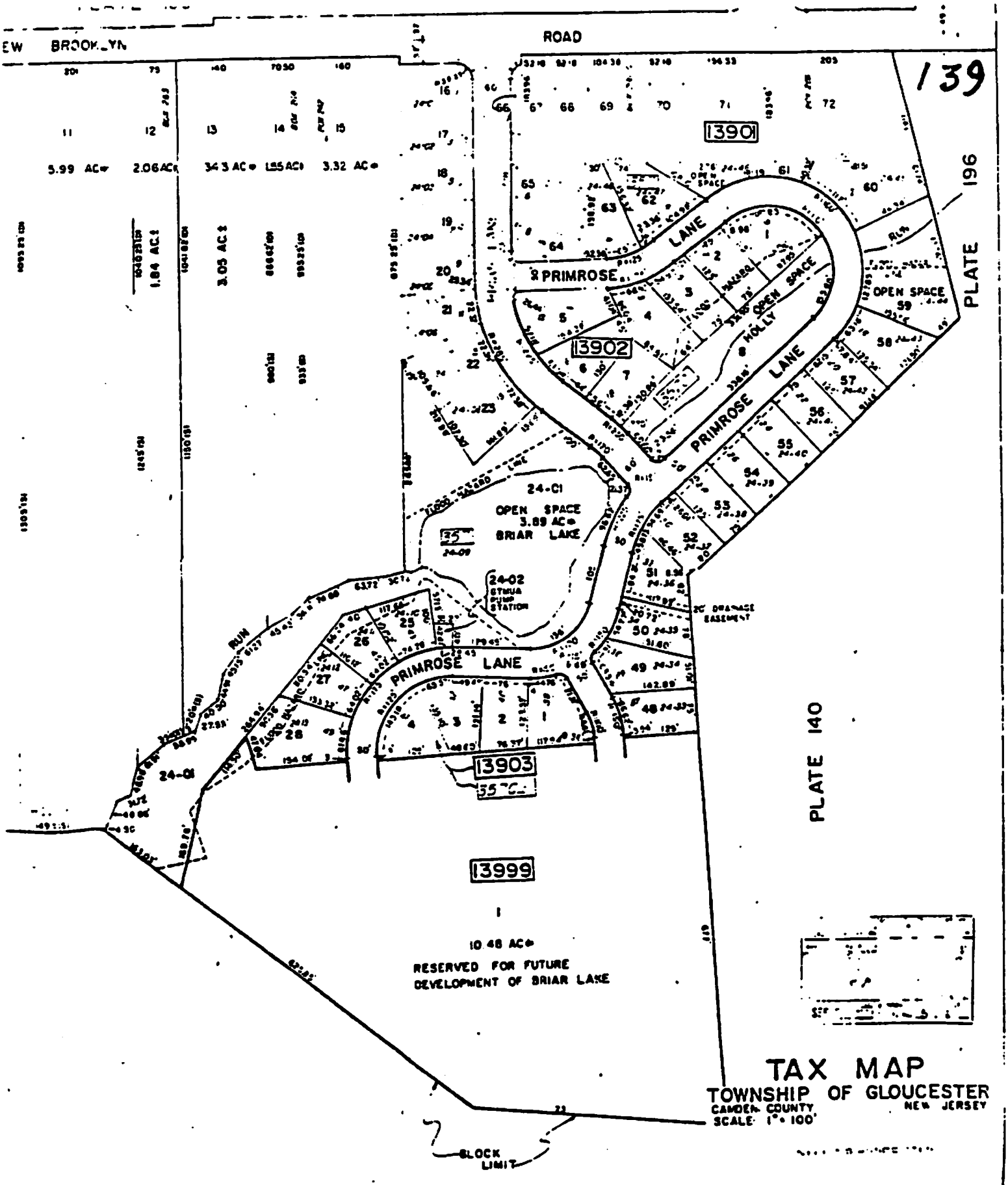
12 exposed and 38 unexposed females responded to the question of pregnancy problems

BRIAR LAKE STUDY-GEMS
REPORTED MEDICAL PROBLEMS IN THE EXPOSED AND UNEXPOSED POPULATIONS - TABLE IV

MEDICAL PROBLEM	EXPOSED		UNEXPOSED	
	#	%	#	%
HEART PROBLEM	4	8.7	1	0.6
AGENT ORANGE EXPOSURE	1	2.2	-	-
SINUSITIS	1	2.2	2	1.2
PNEUMONIA	1	2.2	-	-
BRONCHITIS	2	4.3	1	0.6
ALLERGIES	2	4.3	5	3.0
DIABETES	1	2.2	1	0.6
HYPERTENSION	2	4.3	6	3.6
ASTHMA	2	4.3	5	3.0
OSTEOARTHRITIS	1	2.2	-	-
EAR PROBLEM	-	-	3	1.8
ULCERS	-	-	1	0.6
ASBESTOSIS	-	-	1	0.6
BLADDER INFECTION	-	-	1	0.6
SARCOIDOSIS	-	-	1	0.6
ANEMIA	-	-	2	1.2
CEREBRAL PALSY	-	-	1	0.6
ADENOID PROBLEM	-	-	1	0.6
"CYSTIC"	-	-	1	0.6
SEIZURE DISORDER	-	-	1	0.6
STREP MENINGITIS	1	2.2	-	-

Revised 2/10/83


POPULATION ADJACENT TO THE LANDFILL
GEMS LANDFILL
BOROUGH OF PINE HILL
GLOUCESTER TOWNSHIP
= 1980 feet
CHERRYWOOD
FOX CHASE
PARK
ERIAL
ROAD
RUN
BRIAR
LAKE
HOLLY
COLLEGE
RD
706
PETTY
CHEESEMAN
CAMDEN COUNTY COLLEGE
673
42
LITTLE
GARWOOD
HICKSTOWN
LAMUS TERRACE
GREENLOCH


ROAD
139
13901
PRIMROSE LANE
OPEN SPACE
13902
HOLLY
PRIMROSE LANE
PLATE 196
24-C1
OPEN SPACE
3.89 AC±
BRIAR LAKE
24-02
PUMP STATION
PRIMROSE LANE
13903
24-01
13999
10.48 AC±
RESERVED FOR FUTURE
DEVELOPMENT OF BRIAR LAKE
PLATE 140
TAX MAP
TOWNSHIP OF GLOUCESTER
CAMDEN COUNTY
NEW JERSEY
SCALE 1" = 100'
BLOCK LIMIT
531

Complaint Level-Sex-Smoking Status-Residence Location (Upper vs. Lower)	G.E.M.S. Study Eye Irritation Number and % of Cases				RELATIVE RISKS
	EXPOSED		UNEXPOSED		
	#	%	#	%	
FEMALE NON-SMOKER	6	60.0	14	22.2	6.45*
FEMALE SMOKER	7	58.3	6	27.3	4.08
MALE NON-SMOKER	5	41.7	4	8.9	6.61
MALE SMOKER	5	41.7	10	30.3	1.53

G.E.M. Study
Medical Problem
Number and % of Cases

Complaint Level-Sex-Smoking Status-Residence Location (Upper vs. Lower)	EXPOSED		UNEXPOSED		RELATIVE RISKS
	#	%	#	%	
FEMALE NON-SMOKER	1	10.0	13	20.6	0.39
FEMALE SMOKER	5	41.7	4	18.2	2.83
MALE NON-SMOKER	3	25.0	5	11.1	2.66
MALE SMOKER	2	16.7	7	21.2	0.92

G.E.M. Study
Shortness of Breath
Number and % of Cases

Complaint Level-Sex-Smoking Status-Residence Location (Upper vs. Lower)	EXPOSED		UNEXPOSED		RELATIVE RISKS
	#	%	#	%	
FEMALE NON-SMOKER	-	-	2	3.2	-
FEMALE SMOKER	4	33.3	7	31.8	1.06
MALE NON-SMOKER	1	8.3	2	4.4	2.75
MALE SMOKER	2	16.7	1	3.0	3.55

G.E.M. Study
Tightness in Chest
Number and % of Cases

Complaint Level-Sex-Smoking Status-Residence Location (Upper vs. Lower)	EXPOSED		UNEXPOSED		RELATIVE RISKS
	#	%	#	%	
FEMALE NON-SMOKER	1	10.0	5	7.9	1.42
FEMALE SMOKER	1	8.3	1	4.5	1.90
MALE NON-SMOKER	2	16.7	1	2.2	6.00
MALE SMOKER	3	25.0	5	15.2	1.40

G.E.M. Study
Wheezing
Number and % of Cases

Complaint Level-Sex-Smoking Status-Residence Location (Upper vs. Lower)	EXPOSED		UNEXPOSED		RELATIVE RISKS
	#	%	#	%	
FEMALE NON-SMOKER	1	10.0	7	11.1	0.90
FEMALE SMOKER	3	25.0	4	18.2	2.12
MALE NON-SMOKER	3	25.0	1	2.2	8.63
MALE SMOKER	1	8.3	5	15.2	-

G.E.M. Study
Cough
Number and % of Cases

Complaint Level-Sex-Smoking Status-Residence Location (Upper vs. Lower)	EXPOSED		UNEXPOSED		RELATIVE RISKS
	#	%	#	%	
FEMALE NON-SMOKER	3	30.0	18	28.6	1.17
FEMALE SMOKER	6	50.0	7	31.8	2.22
MALE NON-SMOKER	5	41.7	13	28.9	1.31
MALE SMOKER	4	33.3	12	36.4	0.75

G.E.M. Study
Sore Throat
Number and % of Cases

Complaint Level-Sex-Smoking Status-Residence Location (Upper vs. Lower)	EXPOSED		UNEXPOSED		RELATIVE RISKS
	#	%	#	%	
FEMALE NON-SMOKER	2	20.0	20	31.7	0.54
FEMALE SMOKER	3	25.0	10	45.5	0.45
MALE NON-SMOKER	1	8.3	12	26.7	0.23
MALE SMOKER	3	25.0	11	33.3	0.85

G.E.M. Study
Nasal Irritation
Number and % of Cases

Complaint Level-Sex-Smoking Status-Residence Location (Upper vs. Lower)	EXPOSED		UNEXPOSED		RELATIVE RISKS
	#	%	#	%	
FEMALE NON-SMOKER	4	40.0	20	31.7	1.42
FEMALE SMOKER	8	66.7	8	36.4	4.95
MALE NON-SMOKER	3	25.0	9	20.0	1.51
MALE SMOKER	4	33.3	15	45.5	0.30

REPORT

PULMONARY FUNCTION TESTING OF A POPULATION LIVING NEAR THE GLOUCESTER ENVIRONMENTAL MANAGEMENT SERVICES (GEMS) LANDFILL CONDUCTED BY THE ENVIRONMENTAL HEALTH HAZARD EVALUATION PROGRAM, NEW JERSEY STATE DEPARTMENT OF HEALTH IN COOPERATION WITH THE CAMDEN COUNTY HEALTH DEPARTMENT

DECEMBER 1982

A questionnaire health survey was administered to members of households in the vicinity of the Gloucester Environmental Management Services (GEMS) Landfill to gather information on their reported medical problems, the presence of respiratory symptoms, and their exposure to toxic substances. Control households were also selected for comparison to the exposed group of individuals. The unexposed controls were located five miles from GEMS Landfill and were similar to the exposed in terms of race and socioeconomic status.

Analysis of the survey data indicated that certain subgroups in the exposed population did have significantly higher reports of respiratory symptoms such as wheezing, tightness in chest and nasal irritation. Male non-smokers are the subgroup that reported the most symptoms but when females did report symptoms, it was the smokers who had the most complaints. That observation may imply that those males have a greater exposure to an environment that causes respiratory problems. In order to determine whether these reported symptoms are associated with a decrement in breathing functions, we followed up the questionnaire survey with pulmonary function testing (PFT).

SUBJECT AND METHOD

We chose to invite all exposed and unexposed non-smokers (male and female who were at least five years old) as well as male and female smokers who reported shortness of breath and tightness in chest respectively, to participate in a study of pulmonary functions. This generated a total of 238 candidates, 166 exposed and 72 unexposed.

Clinic sites and individual appointments were arranged by the Camden County Health Department. The pulmonary function tests were performed by respiratory therapy technicians from local hospitals using a Collins Eagle One and Jones Pulmonar equipment.

The participant was asked to breath normally. At the completion of a normal expiration, the participant was asked to take a deep breath, then to exhale into the machine as fast and long as possible or until a plateau was reached on the expiratory curve. This was repeated three (3) times using the best response, with the person seated and nose clip in place to measure the forced vital capacity (FVC) and the forced expiratory volume (FEV 1), the volume of air expired during the first second.

Actual FVC meaurements less than 80% of the predicted FVC and/or FEV_1 less than 76% of the actual FVC based on the person's age, height and weight were considered abnormal.[1]

RESULTS

Eighty-six (86) (52%) of the 166 exposed and 25 (35%) of the 72 unexposed candidates participated in the study. Because a very high percentage had abnormal findings, to a degree normally seen in hospitalized individuals, we speculated that a problem must have occurred either with the equipment or the technicians. Accordingly arrangements were made to do retesting, 81% of those who were initially abnormal, were normal on retesting. The results from the retesting, rather than the abnormal results from the initial testing, were used in calculating the statistical summary.

Two individuals who gave a poor effort, ten who did not return for retesting and six non-smokers who on requestioning gave a history of cigarette smoking were not included in the attached summary tables. Only individuals who reported they never smoked are included in the summary tables. There were 15 smokers or ex-smokers tested nine of whom had normal results and six of whom had abnormal results.

Table I presents the percentage of abnormal findings and mean values for the FVC and FEV_1 by age group, sex, and exposure history. There was no significant difference between the percentage of abnormal results of FVC and FEV_1 for the exposed and unexposed groups using the Fisher's Exact Test. With the exception of the adult males, the mean values for the FVC and FEV_1 were lower for the exposed population tested although the only differences statistically significant were the FVC and FEV_1 for adult female. This difference was found even though the male exposed population would have been expected to have better results on the breathing tests based on published predicted normals.*

1. R.C. Kory, H.G. Goren, J.C. Syner. American Journal of Medicine. Vol. 30, pg. 243-258. 1961

*Predicted normals are based on age, sex and height. Based on these parameters exposed males should have done slightly better than nonexposed males.

The results were not consistent with the questionnaire survey where male non-smokers and female smokers had the most respiratory complaints. Table II compares pulmonary function among exposed individuals who reported respiratory symptoms versus those not reporting respiratory symptoms. Except for females less than 18 years of age the symptomatic individuals performed better than the nonsymptomatic individuals. None of the differences were statistically significant. The trend was the opposite of what would be expected with the symptomatic individuals having better pulmonary functions than the nonsymptomatic individuals.

DISCUSSION

Of the 69 exposed individuals included in the summary, 6 (8.7%) had an abnormal FVC. No one had an abnormal FEV_1. Of the 24 unexposed individuals who participated, 2 (8.3%) had an abnormal FVC and 2 (8.3%) had an abnormal FEV_1.

In conclusion, our findings were:

1. There was no significant difference in the percentage of abnormal pulmonary functions between the exposed and unexposed populations tested.

2. There was a general trend toward lower pulmonary functions for the exposed versus the unexposed population tested.

3. Adult females were the only group showing a statistically significant difference in the mean FVC and FEV_1.

4. Individuals reporting respiratory symptoms had comparable pulmonary functions results with individuals not reporting respiratory symptoms.

TABLE I GEMS

PULMONARY FUNCTION SUMMARY OF NONSMOKERS

Sex and Age Group	PULMONARY FUNCTION (PFT)	COMMUNITY ADJACENT TO GEMS LANDFILL	CONTROL COMMUNITY SEVERAL MILES FROM GEMS LANDFILL
MALES < 18	MEAN FVC	1975	2192
	(Predicted Mean FVC)	1903	1750
	(Mean % of predicted FVC)	100%*	124%*
	% Abnormal FVC	0%	0%
	Total Number	18	5
	MEAN FEV_1	1705	1790
	(Predicted Mean FEV_1)	1447	1330
	(Mean % predicted FEV_1)	115%*	134%*
	% Abnormal FEV_1	0%	0%
MALES ≥ 18	MEAN FVC	4861	5006
	(Predicted Mean FVC)	5360	5180
	(Mean % of predicted FVC)	90%	97%
	% Abnormal FVC	33%	33%
	Total Number	9	3
	MEAN FEV_1	4261	3893
	(Predicted Mean FEV_1)	4071	3937
	(Mean % of predicted FEV_1)	104%	99%
	% Abnormal FEV_1	0%	33%
FEMALES < 18	MEAN FVC	1750	1988
	(Predicted Mean FVC)	1697	1776
	(Mean % of predicted FVC)	106%	116%
	% Abnormal FVC	9%	14%
	Total Number	23	7
	MEAN FEV_1	1597	1634
	(Predicted Mean FEV_1)	1292	1350
	(Mean % of predicted FEV_1)	124%	125%
	% Abnormal FEV_1	0%	14%
FEMALES ≥ 18	MEAN FVC	3260*	3713*
	(Predicted Mean FVC)	3604	3604
	(Mean % of predicted FVC)	91%*	103%*
	% Abnormal FVC	5%	0%
	Total Number	19	9
	MEAN FEV_1	2810	3111
	(Predicted Mean FEV_1)	2737	2738
	(Mean % of predicted FEV_1)	103%*	114%*
	% Abnormal FEV_1	0%	0%

* $p < 0.05$ by T test for difference in mean between exposed and unexposed subjects.

Mean values represent milliliters of air.

TABLE II

MEAN PERCENT OF PREDICTED FORCED VITAL CAPACITY (FVC) AND FORCED EXPIRATORY VOLUME (FEV_1) IN NONSMOKING INDIVIDUALS REPORTING AND NOT REPORTING RESPIRATORY SYMPTOMS

AGE GROUP AND SEX	PULMONARY FUNCTION	MEAN % OF PREDICTED FVC & FEV_1 BY PRESENCE OF SYMPTOMS	
		ASYMPTOMATIC	SYMPTOMATIC
MALE <18	FVC	98.5%	103.7%
	FEV_1	112.9%	118%
	#	12	6
MALE ≥18	FVC	86.9%	103%
	FEV_1	100.7%	117.5%
	#	7	2
FEMALE <18	FVC	110.6%	94.4%
	FEV_1	126.5%	119.1%
	#	16	7
FEMALE ≥18	FVC	90.4%	92%
	FEV_1	103.3%	101%
	#	15	4
TOTAL MALE & FEMALE ALL AGE GROUPS	FVC	98.32%	97.73%
	FEV_1	112.68%	114.8%
	#	50	19

SYMPTOMS = COUGH, WHEEZING, TIGHTNESS IN CHEST & SHORTNESS OF BREATH

REPORT

Environmental Air Sampling

Both Within and Outside of Homes Located Near
THE GLOUCESTER ENVIRONMENTAL MANAGEMENT SERVICES (GEMS) Landfill
Conducted by the
ENVIRONMENTAL HEALTH HAZARD EVALUATION PROGRAM,
NEW JERSEY STATE DEPARTMENT OF HEALTH
during
Winter 1981-1982 and Summer 1982.

Methods

Air sampling was conducted in developments near GEMS landfill during December 1981 and January 1982. The interiors of 26 homes and a Catholic retreat house were tested, as well as 15 exterior samples, 4 of which were collected at the landfill itself. The samples were analyzed by the State Health Department, Division of Laboratories, for volatile organics. Sampling was done using SKC charcoal tubes and Dupont constant flow air sampling pumps at a sample rate of no more than 1 liter of air per minute with a minimum of 200 liters of air collected per sample. Interior samples were taken in the basements or otherwise lowest level of the homes.

Additional air sampling was conducted in developments near the GEMS landfill site and a control community in Winslow Township during July-September 1982, by the New Jersey State Department of Health. The interior of 16 homes in Fox Chase and Briar Lake developments and 11 control homes in Winslow were sampled, as well as 11 exterior air samples near GEMS and 4 exterior samples in the control community. The second set of samples were analyzed and collected in the same fashion as the first set collected in December 1981. Maps of the areas sampled are shown on pages 51-53.

During discussions amongst staff of State and local agencies and with citizen groups, concern had been raised that the sampling which was conducted during December 1981 may not accurately represent the potential exposure to these volatile organic chemicals during other seasons of the year, especially during the summer. Futhermore, there was concern that the surface water contamination problem was greater in the Briar Lake section as compared to Fox Chase vicinity. Therefore, this second air sampling included additional sites in the Briar Lake area. A control group of homes had not been included in the first air sampling because at that time the control group used for the health questionnaire and breathing tests had not yet been identified.

Results and Discussion

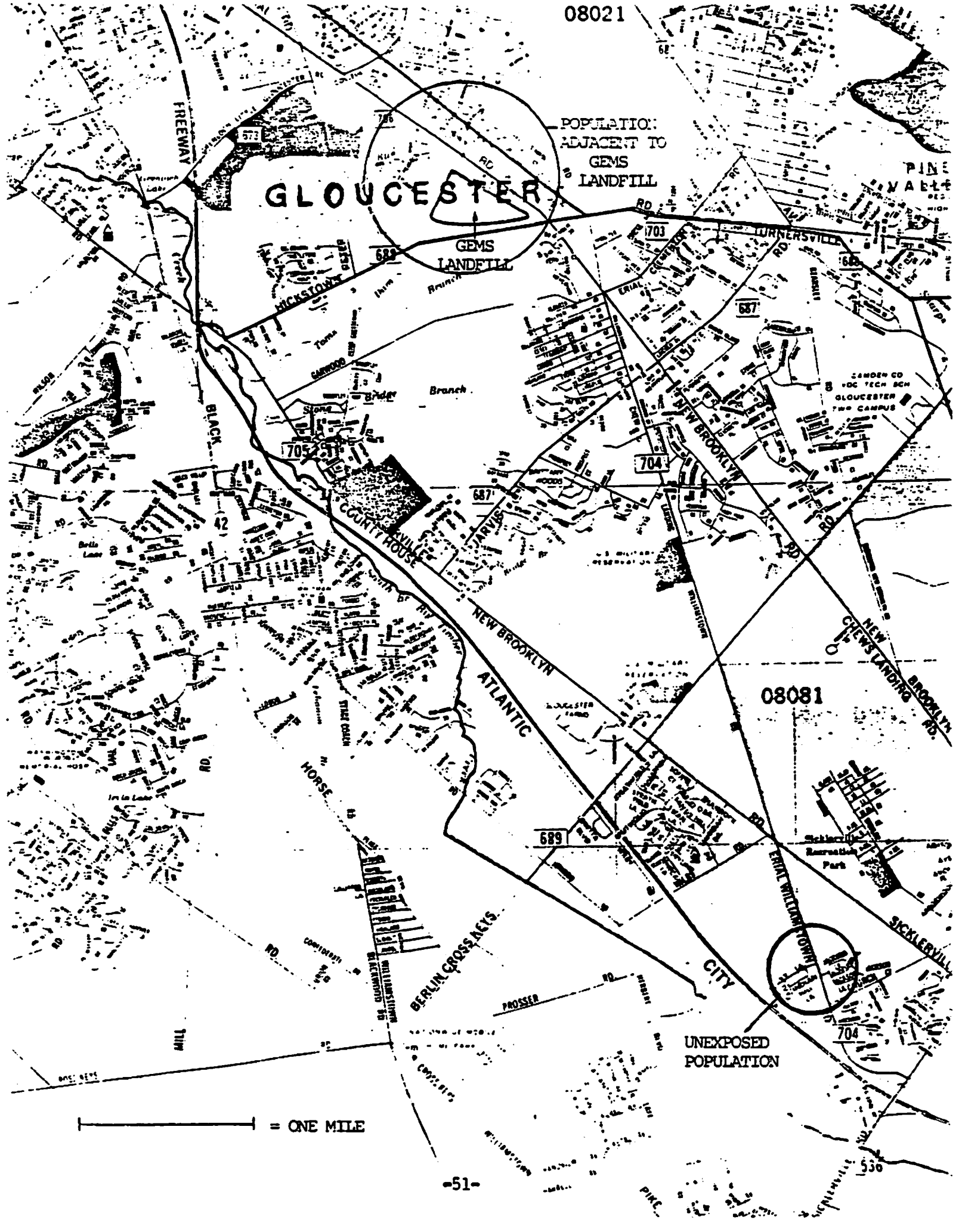
The ideal situation would be the absence of any contaminants in these interior air samples but that was not the case. Levels in the parts per billion were found in the majority of homes. Comparison between the level of air contaminants in homes near GEMS were made with levels found in the control homes in Winslow Township.

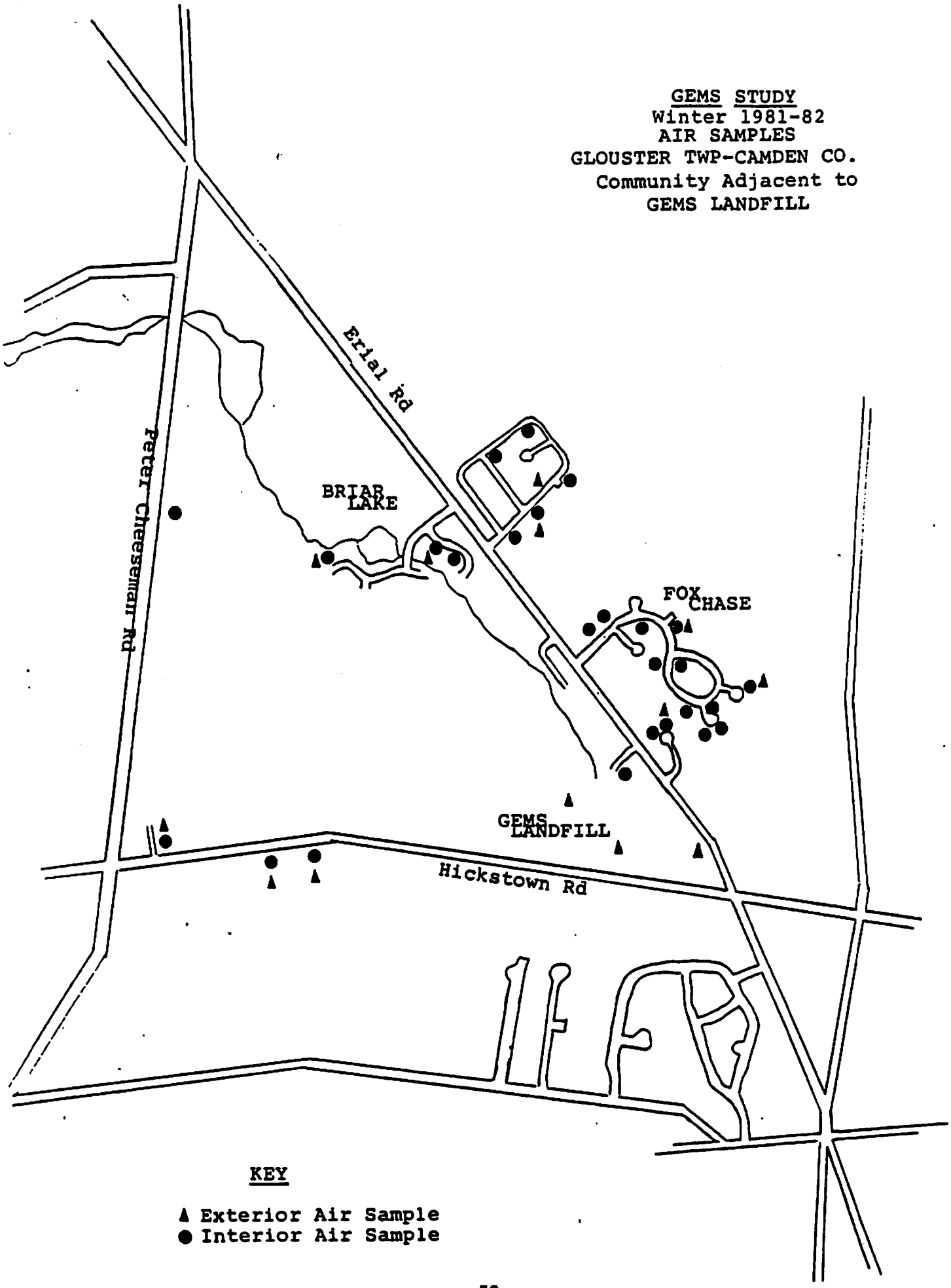
In most cases, the contaminants which were detected in the samples obtained during the summer of 1982 (Table 1 & 5) were generally lower than those found during December 1981 (Table 3 & 4). We expected higher values during the summer because higher ambient temperatures should cause increased volatilization. The opposite was found. Sealing of homes for energy conservation with a ground water source and volatilization into homes could explain these results. The results from the Briar Lake section were even lower (Table 6). A comparison of results from homes near the landfill (Table 1, 5 & 6) with results from the control homes (Tables 2 & 7) showed comparable low levels in both sets of homes. However, the mean level of all volatile organics found in homes adjacent to GEMS was .29 ppm as compared to .09 in nonadjacent homes. This was nearly statistically significant (P=.08). Also, there were a number of substances found only in the homes near the landfill. For example, toluene was detected in 8 of the 17 interior samples obtained from the homes adjacent to GEMS while toluene was not detected in any of the control homes. Toluene had also been detected in the surface water samples collected by DEP from Brair Lake and Holly Run in the vicinity of the landfill. One or two air samples from homes adjacent to the landfill had substances such as benzene, zylene, hexane, 1,1,1-trichloroethane which were not found in control homes.

Despite these differences, levels found in homes adjacent to GEMS were all at levels that are at least 100 and many times 1,000 times less than those allowed at work sites (Tables 4-7). The levels were similar to those found in the ambient air of urban areas of Northern New Jersey. Exterior air samples were all nondetectable except one sample near Briar Lake (Table 7). All sampling was done during the day or early evening. Although arrangements were made to sample in the early morning when some residents said the odors were sometimes worse, no resident called in the early morning. This was despite the fact that a special telephone number was given out to initiate the sampling during the early morning.

APPENDIX I

MAPS AND TABLES FOR GEMS LANDFILL AIR SAMPLING


08021
POPULATION ADJACENT TO GEMS LANDFILL
GLOUCESTER
GEMS LANDFILL
FREEWAY
HICKSTOWN
BLACK
COUNTY HOUSE
JARVIS
NEW BROOKLYN
ATLANTIC
HORSE
BERLIN CROSSKEYS
CITY
PROSSER
TURNERSVILLE
NEW BROOKLYN RD.
NEW CHEWS LANDING
BROOKLYN RD.
ERIAL WILLIAMSTOWN
SICKLERVILLE
08081
UNEXPOSED POPULATION
= ONE MILE


GEMS STUDY
Winter 1981-82
AIR SAMPLES
GLOUSTER TWP-CAMDEN CO.
Community Adjacent to
GEMS LANDFILL
Erial Rd
Peter Cheesman Rd
BRIAR LAKE
FOX CHASE
GEMS LANDFILL
Hickstown Rd
KEY
▲ Exterior Air Sample
● Interior Air Sample

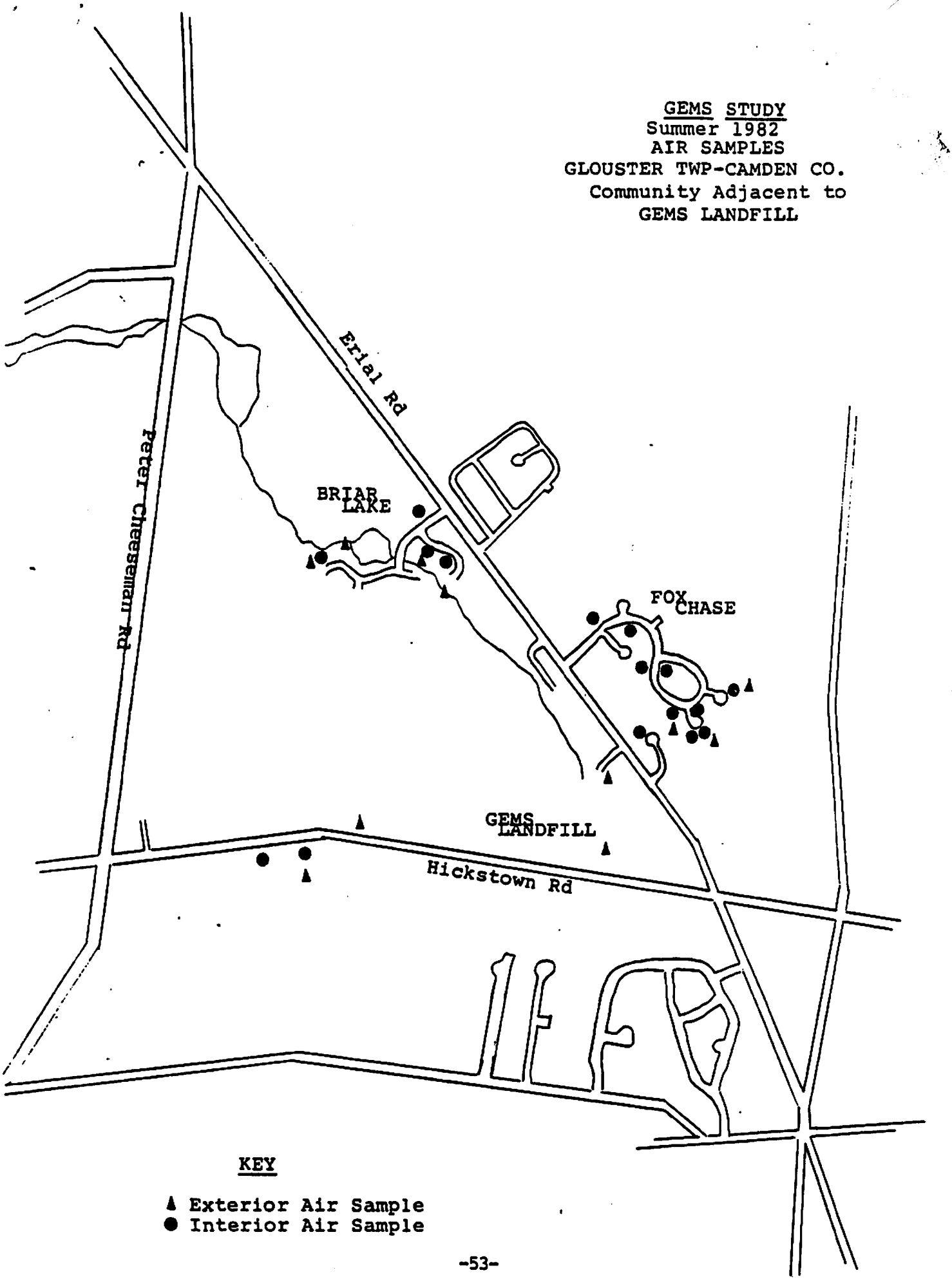

GEMS STUDY
Summer 1982
AIR SAMPLES
GLOUSTER TWP-CAMDEN CO.
Community Adjacent to
GEMS LANDFILL
Erial Rd
Peter Cheesman Rd
BRIAR LAKE
FOX CHASE
GEMS LANDFILL
Hickstown Rd
KEY
Exterior Air Sample
Interior Air Sample

TABLE I
HOMES ADJACENT TO LANDFILL
GEMS STUDY - SUMMER '82
INTERIOR VOLATILE ORGANIC AIR SAMPLES
CONCENTRATIONS IN PARTS PER MILLION (ppm)

Household #	Toluene	Hexane	Xylene	Undecane	1,1,1-Trichloroethane	Isopropanol	P-Dichloro benzene	Gasoline	Pinene	Napthalene	Kerosene	Ethyltoluene	2-Methylbutane	2-Methylpentane	3-Methylhexane	Limonene	Isooctane	Other	Total
1.	.0075		.0018	.0012					.0017					.0016				A,B	.016
2.	.043	.0036		.0018		.0056			.0042							.0026			.068
3.	.0066																		.007
4.	.007								.031				.008					C	.368
5.								.993	.010			.050			.004				1.057
6.								.245	.009		.076								.330
7.							.013	.138		.067									.218
8.							.014	.504	.013		.837								1.368
9.					.083				.004										.087
10.	.010								.003										.013
11.							.145												.145
12.	.008				.395	.009			.006	.016							.005	D	.726
13.	.015			.003					.008							.003			.029
14.									.006									E	.065
15.	.022	.026	.019						.004			.008	.007	.025	.007		.008	F,G,H,I	.166
16.																			0.000

A. Decane .001, B. Nonane .001, C. Stoddard Solvent .322
D. Petroleum Distillate .287, E. Butane .059 F. Pentane .012
G. Benzene .009 H. 1,2,4 Trimethylbenzene .007
I. 3-Methylpentane .012

TABLE 2
HOMES NOT ADJACENT TO LANDFILL
GEMS STUDY - SUMMER '82
INTERIOR VOLATILE ORGANIC AIR SAMPLES
CONCENTRATIONS IN PARTS PER MILLION (ppm)

Household #	Butane	Isopropanol	P-Dichlorobenzene	Gasoline	Pinene	2-Methyl-butane	Limonene	Ethanol	Isooctane	Dimethylpentane	Cineole	P-cymene	Camphene	Total
1.														0.00
2.		.091			.011		.015		.080	0.34	.007	.006	.005	.380
3.														0.00
4.				.257										.257
5.						.005		.020						.025
6.														0.00
7.														0.00
8.														0.00
9.	.036			.231	.003			.076						.350
10.														0.00
11.			.013											.013

TABLE 3

HOMES ADJACENT TO LANDFILL
GEMS STUDY - WINTER '81-'82
INTERIOR VOLATILE ORGANIC AIR SAMPLES
CONCENTRATIONS IN PARTS PER MILLION (ppm)

Household #	Toluene	Pentane	Butane	Hexane	Xylene	Octane	Decane	Undecane	Benzene	Nonane	1,2,4 Trimethyl-benzene	Propylbenzene	Ethylbenzene	Mesitylene	Methyl Cyclo Hexane	1,1,1-Trichloroethane	C15 1,3 Dimethyl Cyclo Hexane	Isopropanol	Para-Dichlorobenzene	Total
1	.006	.006																		.012
2	.004		.057					.001												.061
3	.013	.027	.039	.024	.007				.003											.113
4			.007																	.007
5	.005	<.009	.097																	.102
6	<.005		.106																	.106
7		<.009			.010				<.006		.045	.008		.019						.082
8			.035																	.035
9	.032	.116	.083	.030	.012	.008	.012	.007	.008	.007					.008		.006			.329
10			.308		.041	.013	.023	.014		.017			.015							.431
11	<.005	.008	.107																	.115
12	.080		.028		.018	.038	.012	.007		.017	.041	.013		.019			.025			.298
13	.004	<.007					.004	.004										.039		.051
14	.005				.004			.002												.011
15	.008																			.008

TABLE 3 (CONTINUED)

HOMES ADJACENT TO LANDFILL
GEMS STUDY - WINTER '81-'82
INTERIOR VOLATILE ORGANIC AIR SAMPLES
CONCENTRATIONS IN PARTS PER MILLION (ppm)

Household #	Toluene	Pentane	Butane	Hexane	Xylene	Octane	Decane	Undecane	Benzene	Nonane	1,2,4 Trimethyl-benzene	Propylbenzene	Ethylbenzene	Mesitylene	Methyl Cyclo Hexane	1,1,1-Trichloroethane	C15 1,3 Dimethyl Cyclo Hexane	Isopropanol	Para-Dichlorobenzene	Total
16	.005				.004														.331	.340
17	<.005	.008	.048																	.056
18	.008	.019	.073	.009	.005				<.006							<.025				.114
19	.005																			.005
20	<.005																			<.005
21			.056																	.056
22			.108		.034		.152	.057		.075	.016									.412
23			.108					.003												.111
24	.029	.048		.033	.016	.014	.022	.014			.005		.010		.005	.286	.015			.497
25	.007	.008																		.015
26	.041															.411			.023	.475
27	<.005	<.004																		<.009

TABLE 4

GEMS STUDY - TLV's RANGES AND FREQUENTLY OF DETECTION OF CHEMICALS FOUND IN INTERIOR AIR SAMPLES IN PARTS PER MILLION (ppm)
SAMPLING CONDUCTED WINTER 1981-1982 IN 27 HOMES ADJACENT TO GEMS LANDFILL.

CHEMICAL	TLV/100* OR PEL/100	DETECTED RANGE IN PPM	FREQUENCY OF DETECTION IN PPM			
			NONE DETECTED	≤.01	.01-.09	.1-.9
Toluene	2 ppm	0-.080	7	15	5	0
Pentane	10 ppm	0-.116	15	8	3	1
Butane	8 ppm	0-.308	12	1	9	5
Hexane	5 ppm	0-.033	23	1	3	0
Xylene	1 ppm	0-.041	17	4	6	0
Octane	5 ppm	0-.038	23	1	3	0
Decane		0-.152	21	1	4	1
Undecane		0-.057	18	6	3	0
Benzene	.01 ppm	0-.008	23	4	0	0
Nonane		0-.075	24	1	3	0
1,2,4 Trimethylbenzene	.25 ppm	0-.045	23	1	3	0
Propylbenzene		0-.013	25	1	1	0
Ethylbenzene	1 ppm	0-.015	25	0	2	0
Mesitylene		0-.019	25	0	2	0
Methyl Cyclo Hexane	1 ppm	0-.008	25	2	0	0
1,1,1 Trichloro-	3.5 ppm	0-.911	24	0	1	2
C15 1,3 Dimethyl Cyclo Hexane		0-.025	24	1	2	0
Isopropanol		0-.039	26	0	1	0
Para-Dichloro-benzene	.75 ppm	0-.331	25	0	1	1

*PEL (Permissible Exposure Limit) and TLV (Threshold Limit Value) are the maximum allowable concentration of contaminant that a worker may be exposed to over an eight hour shift and 40 hour work week without any adverse health effects. TLV/100 & PEL/100 is an arbitrary number which has an additional safety factor. Since people may occupy their homes for up to 24 hours per day, the TLV & PEL are divided by 100.

TABLE 5

GEMS STUDY - TLV'S, RANGES AND FREQUENCY OF DETECTION OF CHEMICALS FOUND IN INTERIOR AIR SAMPLES IN PARTS PER MILLION (ppm) IN 16 HOMES ADJACENT TO GEMS LANDFILL. SAMPLING CONDUCTED SUMMER 1982

CHEMICAL	TLV/100* OR PEL/100	DETECTED RANGE IN ppm	FREQUENCY OF DETECTION IN ppm			
			NONE DETECTED	≤.01	.01-.09	.1-9
Tolune	2 ppm	0-.043	8	4	4	0
Pentane	10 ppm	0-.012	15	0	1	0
Butane	8 ppm	0-.059	15	0	1	0
Hexane	5 ppm	0-.026	14	1	1	0
Xylene	1 ppm	0-.019	14	1	1	0
Decane		0-.001	15	1	0	0
Undecane		0-.003	13	3	0	0
Benzene	.01 ppm	0-.009	15	1	0	0
Nonane	2 ppm	0-.009	15	1	0	0
1,2,4 Trimetnyl-methyl benzene	.25 ppm	0-.007	15	1	0	0
1,1,1 Tri-chloroethane	3.5 ppm	0-.395	15	0	1	1
Isopropanol		0-.009	14	2	0	0
Para Di-chlorobenzene	.75 ppm	0-.145	13	0	2	1
Gasoline		0-.993	12	0	0	4
Petroleum Distillate		0-.287	15	0	0	1
Pinene		0-.031	4	9	3	0
Napthalene	.1 ppm	0-.067	14	0	2	0
Kerosene		0-.837	14	0	1	1
Ethyltoluene		0-.050	14	1	1	0
2-Methyl Butane		0-.008	14	2	0	0
2-Methyl Pentane		0-.025	14	1	1	0

TABLE 5 (Continued)

GEMS STUDY - TLV'S, RANGES AND FREQUENCY OF DETECTION OF CHEMICALS FOUND IN INTERIOR AIR SAMPLES IN PARTS PER MILLION (ppm) IN 16 HOMES ADJACENT OT GEMS LANDFILL. SAMPLING CONDUCTED SUMMER 1982

CHEMICAL	TLV/100* OR PEL/100	DETECTED RANGE IN ppm	FREQUENCY OF DETECTION IN ppm			
			NONE DETECTED	≤.01	.01-.09	.1-9
3-Methyl Pentane		0-.012	15	0	1	0
3-Methyl Hexane		0-.007	14	2	0	0
Limonene		0-.003	14	2	0	0
Stoddard solvent	1 ppm	0-.322	15	0	0	1
Isooctane		0-.008	14	2	0	0

*PEL (Permissible Exposure Limit) and TLV (Threshold Limit Value) are the maximum allowable concentration of contaminant that a worker may be exposed to over an eight hour shift and 40 hour work week without any adverse health effects. TLV/100 & PEL/100 is an arbitrary number which has an additional safety factor. Since people may occupy their homes for up to 24 hours per day, the TLV & PEL are divided by 100.

TABLE 6

GEMS STUDY - TLV'S, RANGES AND FREQUENCY OF DETECTION OF CHEMICALS FOUND IN INTERIOR AIR SAMPLES IN PARTS PER MILLION (ppm) IN 5 HOMES@ IN BRIARLAKE SECTION ADJACENT TO GEMS LANDFILL.
SAMPLING CONDUCTED SUMMER 1982

CHEMICAL	TLV/100* OR PEL/100	DETECTED RANGE IN ppm	FREQUENCY OF DETECTION IN ppm			
			NONE DETECTED	.01	.01-.09	.1-9
Toluene	2 ppm	0-.015	4	0	1	0
Pentane	10 ppm	0	5	0	0	0
Butane	8 ppm	0	5	0	0	0
Hexane	5 ppm	0	5	0	0	0
Xylene	1 ppm	0	5	0	0	0
Octane	5 ppm	0	5	0	0	0
Gasoline		0-.138	4	0	0	1
Undecane		0-.003	4	1	0	0
Benzene	.01 ppm	0	5	0	0	0
Pinene		0-.008	3	2	0	0
Limonene		0-.003	4	1	0	0
1,1,1 Trichloro-ethane	3.5 ppm	0-.083	4	0	1	0
Napthalene	.1 ppm	0-.067	4	0	1	0
Para-Di-chlorobenzene	.75 ppm	0-.013	4	0	1	0

*PEL (Permissible Exposure Limit) and TLV (Threshold Limit Value) are the maximum allowable concentration of contaminant that a worker may be exposed to over an eight hour shift and 40 hour work week without any adverse health effects. TLV/100 & PEL/100 is an arbitrary number which has an additional safety factor. Since people may occupy their homes for up to 24 hours per day, the TLV & PEL are divided by 100.

@Includes 1 sample in crawlspace below living areas.

TABLE 7

GEMS STUDY - TLV'S, RANGES AND FREQUENCY OF DETECTION OF CHEMICALS FOUND IN INTERIOR AIR SAMPLES IN PARTS PER MILLION (ppm) IN 11 HOMES NOT ADJACENT TO GEMS LANDFIL SAMPLING CONDUCTED SUMMER 1982

CHEMICAL	TLV/100* OR PEL/100	DETECTED RANGE IN ppm	FREQUENCY OF DETECTION IN ppm			
			NONE DETECTED	≤.01	.01-.09	.1-9
Toluene	2 ppm	0	11	0	0	0
Pentane	10 ppm	0	11	0	0	0
Butane	8 ppm	0-.036	10	0	1	0
Gasoline		0-.257	9	0	0	2
Pinene		0-.011	9	1	1	0
2-Methyl-Butane		0-.005	10	1	0	0
Limonene		0-.015	10	0	1	0
Ethanol	10 ppm	0-.076	9	0	2	0
Isooctane		0-.080	10	0	1	0
Dimethyl-Pentane		0-.034	10	0	1	0
Cineole		0-.007	10	1	0	0
P-Cymene		0-.005	10	1	0	0
Camphene		0-.005	10	1	0	0
Isopropanol		0-.091	10	0	1	0
Para-Di-chlorobenzene	.75 ppm	0-.013	10	0	1	0

*PEL (Permissible Exposure Limit) and TLV (Threshold Limit Value) are the maximum allowable concentration of contaminant that a worker may be exposed to over an eight hour shift and 40 hour work week without any adverse health effects. TLV/100 & PEL/100 is an arbitrary number which has an additional safety factor. Since people may occupy their homes for up to 24 hours per day, the TLV & PEL are divided by 100.

TABLE 8

GEMS STUDY - EXTERIOR AIR SAMPLES

LOCATION	1981 #	1981 N.D.	1981 POSITIVE	1982 #	1982 N.D.	1982 POSITIVE
HOMES ADJACENT TO GEMS LANDFILL	15	15	0	9	9	0
HOMES NOT ADJACENT TO GEMS LANDFILL	0			4	4	0
GEMS LANDFILL PROPERTY	3	3	0	2	2	0
ADJACENT TO BRIAR LAKE	0			2	1	1*

N.D.= No detectable levels of volatile organic chemicals found

Notes: *.004 ppm Toluene, .014 ppm Isopropanol

APPENDIX II

QUESTIONNAIRE USED FOR SURVEYS

State of New Jersey

DEPARTMENT OF HEALTH
JOHN FITCH PLAZA
CN 360, TRENTON, N.J. 08625

JOANNE E. FINLEY, M.D., M.P.H.
COMMISSIONER

CONSENT FORM

I have been informed that the New Jersey State Department of Health is conducting a study of environmental factors and their effect on the health of individuals. This study involves obtaining information from me about my residence, and health, as well as some information about other substances I may have been exposed to. The interview will require approximately 15 minutes of my time. I understand it may be necessary to contact me again.

I have agreed to take part in this study and to give information to the interviewer understanding that:

1. My responses will be kept completely confidential.

2. My participation is voluntary and I am free to discontinue participation at any time.

3. The information in this study will be summarized by New Jersey State Department of Health to determine whether environmental factors in this area may be contributing to health problems.

Name (Print) _____

Participant Signature _____

Date: _____

Houschold
Number _____

Interviewer's
Name _____

Respondent's Name _____

Address _____
Mailing address if diffrent
_____

Now I want to ask you about all persons who live in this household. (Interviewer to circle race of household here: White Non-white)

What are the names of all persons who live here?

What are the ages?

Does or did anyone smoke cigarettes regularly (at least once a day for a year or 20 packs in a lifetime)?

(CODE 1 = Current Smoker

2 = Ex smoker (quit more than 1 year ago.)

3 = Non-smoker

Does anyone in this household have a regular exposure either at a job or hobby to dusts, like coal, metal, or sawdust, or chemical fumes?

(Code 1 = Dust; 2 = Chemical Fumes; 3 = None)

		Name	Age	Sex	Smoking Status	Dust or Fume Exposure
Subject #	1					
	2					
	3					
	4					
	5					
	6					

What kind of fuel do you use most for heating your house?

1. ☐ Gas from underground pipes serving the neighborhood
2. ☐ Gas: bottled, tank or LP
3. ☐ Electricity
4. ☐ Fuel oil, kerosene, etc.
5. ☐ Coal or coke
6. ☐ Wood
7. ☐ Other fuel
8. ☐ No fuel used

What kind of fuel do you use most for cooking?

1. ☐ Gas from underground pipe serving the neighborhood
2. ☐ Gas: Bottled, tank or LP
3. ☐ Electricity
4. ☐ Fuel oil, Kerosene, etc.
5. ☐ Coal or coke
6. ☐ Wood
7. ☐ Other fuel

When did you move into your present home? _____ Month _____ Year

(Calculate total years of residence) ☐☐

Household _____
Subject _____

Are you bothered by any of the following:

If yes, to any of the below symptoms, ask: How frequently does this symptoms occur?

Code: 1 = Seldom
2 = Monthly
3 = Weekly
4 = Daily

Have you seen a physician for this symptoms?

	No	Yes	Frequency of Symptom	Seen by physicia: Yes	No
Eye irritation (itchy, red or watery eyes)	___	___	_____	___	___
Nasal irritation (sneezing, runny nose or stuffness)	___	___	_____	___	___
Sore throat	___	___	_____	___	___
Cough	___	___	_____	___	___
Wheezing	___	___	_____	___	___
Tightness in chest	___	___	_____	___	___
Shortness of breath	___	___	_____	___	___

Other respiratory or lung problem (specify) _____

_____

Have you been told by a physician that you have a medical problem?
No ___ Yes ___

If yes, describe condition and date of diagnosis.

_____

_____

_____

For any women living in the house: Have you had trouble becoming pregnant or with a pregnancy? No___ Yes ___

If yes, describe and list years.

_____

_____

_____

_____

Have you ever been bothered by odors in this community? No___ Yes ___

These are all the questions I have for you. Is there anything else that I haven't asked you about that you think is important?

In case I've forgotten to ask you something and my supervisor needs to call you back, may I have a phone number and a convient time to reach you?

Phone _____

Best Time _____ AM PM Time Ended _____ AM PM