COMMUNITY RESPIRATORY STATUS RELATIVE TO A BURNING LANDFILL

PREPARED BY

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INTRODUCTION

The potential health impact of community air pollution exposures is an issue of increasing concern. The New Jersey State Department of Health (NJDOH) conducted a range-finding study to address possible acute and long term respiratory health effects due to a burning landfill in Jersey City, New Jersey. There was some evidence of increased hospitalization rates for asthma among children from residential areas closest to the landfill. No increased risk was demonstrated for emergency room visits or for lung cancer.

BACKGROUND

PJP Landfill is located in Jersey City, New Jersey. It occupies a roughly triangular block with its western border the Hackensack River and with open land to the south and southeast (Figure 1). The east and north edges abut primarily residential areas. A truck terminal, a major roadway and a coal burning electrical generating plant are also in the vicinity. Approximately 10,000 people live within a half mile radius of the landfill including residents of a large housing development within 500 meters of the landfill border.

For decades the landfill was used for both public dumping and as a private landfill. Subsurface burning has been occurring for at least 20 years, resulting in occasional smoke plumes and continuous low level fires. Attempts to extinguish the fires with water failed. An excavating, extinguishing, and compacting project begun in 1985 successfully eliminated the surface fires and controlled the landfill.

A community action group requested a health study of the neighborhood in the vicinity of the landfill. No previous surveys or summary health evaluations existed. Complaints from nearby residents and workers related primarily to smoke odors and respiratory symptoms. Concerns were raised regarding possible acute and long term adverse health impacts resulting from intermittent exposure to the burning landfill.

The NJDOH surveyed existing data bases for evidence of either acute or long-term adverse health effects among residents in the vicinity of the landfill. Hospitalization rates were used as a measure of severe respiratory illness. Emergency room visits were used as a measure of persisting acute respiratory illness after quenching of the fires. Lung cancer incidence was used as a measure of long term health effects. Study results were reviewed by an independent Health Effects Committee composed of professionals with expertise in relevant fields.

METHODS

I. Study Population and Exposure Assessment

Demographic characteristics of Jersey City residents were obtained from the 1980 United States Census.

Distance and direction from the landfill were used as surrogates of exposure. Newark Airport wind rose maps obtained from the DEP indicated that prevailing wind patterns would carry smoke from the landfill primarily to the northeast, southwest, and west.

When feasible case mapping was based on the 62 census tracts in Jersey City. Each census tract was given both a distance and a direction designation. One kilometer arcs around the landfill out to a distance of 5 kilometers were used to divide the census tracts into exposure levels (Figure 3). Tracts were designated as lying primarily between the lines (e.g. 0-1 km) or as being equally divided by the kilometer line (e.g. 1 km line). Closer arcs were predicted to have higher exposure to smoke from the landfill. Wind patterns were used to divide the census tracts into eight direction sectors of 45 degrees each; only five of the eight sectors had sufficient population to analyze (Figure 4). Tracts were designated as lying primarily within a sector (e.g. sector 1) or as being equally divided by a sector (e.g. sector 1,3 dividing line). Sector 1 was predicted to have the highest exposure to smoke and sector 5 the lowest.

When census tract of residence was not available, mapping was based on zipcode of residence. The five zipcodes comprising Jersey City and five additional large municipalities in Hudson County were compiled as the study file. The landfill was within a single zipcode which was assumed to have the highest exposure to smoke from the landfill. Based on wind patterns, two zipcodes immediately adjacent to the landfill zipcode were assumed to have intermediate exposure. Remaining zipcodes were considered remote from the landfill.

II. Hospital Discharge Data

Hospitalizations for respiratory illnesses were studied using computerized New Jersey Diagnostic Related Group (DRG) data and selected International Classification of Disease (ICD) codes. A case was defined as any Hudson County resident hospitalized from 1979 to 1982 in any New Jersey hospital with a primary discharge diagnosis of asthma (ICD code 493), bronchitis (ICD codes 466, 490, 491), emphysema (ICD codes 492, 496), or upper respiratory infections (URI) (ICD code 465). The age, sex, race, diagnosis, zipcode and municipality of residence, were extracted for each respiratory case. Three age catagories were used: less than 15 years old, 15 to 74 years old, and 75 years or older. The denominator data estimating population at risk were extrapolated from United States 1980 census information.

Crude annual discharge rates by diagnosis, age group, and location were derived. Age-sex-race specific rates were indirectly standardized. Average rates for the adjacent and remote locations were computed. A z-score of proportions was used to compare rates of hospitalizations from the landfill zipcode and from either adjacent or remote locations.

The frequency of repeat admissions was estimated by comparing the total number of discharges with the number of individuals discharged for each location as an index of chronic severe respiratory disease.

III. Emergency Room Visits

A case-control study of emergency room visits was done using records from the medical facility closest to the landfill, a major provider of emergency care in the city. The hospital records room staff collected records of visits for respiratory complaints seen in the emergency room from September 16, 1985 through January 14, 1986, and not requiring admission. The principal investigator reviewed the diagnoses. A case was defined as a Jersey City resident with a diagnosis of acute URI, acute bronchitis, bronchitis, chronic bronchitis, chronic obstructive pulmonary disease, emphysema, or asthma. Charts were excluded if the discharge diagnosis included pharyngitis. The control group consisted of every fourth patient logged into the emergency room seen for other than a respiratory illness. Date of visit, age, race, gender, census tract, census block, and diagnosis were entered as a record for each respiratory case. Date of visit, age, census tract, and census block entered were as a record for each control visit.

Cases and controls were counted for exposed and unexposed regions according to proximity to the landfill. The emergency room visits were analyzed by estimating relative risk ratios. Using the method from Lyons, et. al., expanding concentric circles of 1 kilometer or additional 45 degree sectors were added to progressively increase the exposed population to a limit of 2 km. In order to reduce the possibility of selection bias contributing more mild respiratory cases for tracts closer to the Medical Center, asthma cases were analyzed separately as a measure of more severe illness.

IV. Cancer Statistics

The New Jersey Cancer Registry requires reporting of new cancer diagnoses in all New Jersey citizens including reciprocal agreements with neighboring states. The Registry has case listings beginning with 1979 and contains completed entries through 1983. Standardized incidence ratios were obtained for all cancer and for lung cancer in Jersey City basing expected numbers of cases on the annual statewide age-sex standardized and site specific incidence rates. Significance was tested with the Poisson model to obtain a 95% confidence interval.

For the exposure study a case was defined as a Jersey City resident reported with a new diagnosis of lung cancer. Exposure estimate was done in the same manner as for emergency room visits, with a distance and a direction sector identified for each tract. Sex specific age standardized rates of lung cancer cases per 1000 population by census trate were calcuated using Jersey City as the reference population. Trends were sought using linear regression and Chi-square trend tests.

RESULTS

I. Study Population

The zipcode including the landfill and the two adjacent zipcodes did not differ from the other locations in age and gender distribution (Table 1). Racial distributions varied markedly among the ten locations. Median income for the landfill zipcode was fourth lowest out of the ten locations.

II. Hospital Discharge Data

There were 10943 total admissions for 8305 individuals. Race standardized hospitalization rates for those under 75 years showed a stastistically significantly increased rate for combined respiratory diseases for the landfill zipcode as compared to the remote sites (table 2). For those

75 years or older, the hospitalization rate for combined respiratory diseases for the landfill and the adjacent locations were significantly lower than for the remote locations. There were increases in hospitalization rates for asthma among those under 15 years and for COPD among those 15 to 74 years in the landfill zipcode but not at a statistically significant level.

The landfill zipcode was compared to four locations of similar median income. For all age groups and for individuals under 15 years the landfill zipcode had a significantly higher rate of hospitalizations for combined respiratory disease and for asthma as compared to two remote zipcodes and a significantly lower rate as compared to one zipcode (Table 3).

The ratio of total number of hospitalizations to number of individuals hospitalized was 1.3 for combined respiratory diagnoses. Ratios were higher for asthma and lower for bronchitis and upper respiratory infections. The landfill zipcode did not have higher ratios of total over individual admission rates as compared to the other locations.

III. Emergency Room Visits

There were 1158 emergency room visits for repiratory conditions of which 539 were for asthma. No pattern was seen for the relative risk of emergency room visits for respiratory conditions according to distance from the landfill or wind direction sector (Tables 4-5). The arc from 0 to <2 kilometers had an increased risk for asthma in ages less than 15 years. The combined sector and distance analysis identified increased relative risks for two sectors (Tables 8-11). Sector 3 had increased risk for total emergency room visits for 0 to <2 kilometers, asthma for 0 to <1 kilometer, and asthma in children for 0 to <2 kilometers. Sector 5 had increased relative risk for asthma for 0 to <2 kilometers and 0 to 2 kilometers.

IV. Cancer Statistics

From 1979 through 1983 there were 556 cases of lung cancer within Jersey City that could be coded by census tract. There was no statistical difference for cancer incidence rates in Jersey City for all cancers combined or for lung cancers in either sex when the race-specific age standardized rates were compared to the state rates (Table 12).

For distance arcs age standardized annual lung cancer rates per 10,000 ranged from 6.22 to 12.27 for males and 0 to 4.98 for females. For sectors, age standardized annual lung cancer rates per 10,000 ranged from 6.18 to 12.19 for males and 0.56 to 7.15 for females (Table 13). Linear regression and Chi-square trend tests did not show any significant trends in age standardized race and sex specific rates of lung cancer in Jersey City by distance and sector (Table 14).

DISCUSSION

Numerous epidemiology studies have attempted to address the health effects of air pollution. Levy et. al. found that hospital admissions for acute episodes of bronchitis, emphysema, pneumonia, and asthma were increased relative to air pollution indices. Bates and Sizto found that $SO2$ and $O3$ levels were highly correlated with excess in respiratory admissions in summer months but that only temperature consistently correlated for summer and winter months. Buechley et. al. found that from 1962-1966 $SO2$ levels correlated positively with prediction of death in a metropolitan area.

Goldstein and Block found that the number of emergency room visits correlated with the $SO2$ level in only one of two urban areas investigated. Carnow found that acute illness increased among patients 55 years or older with moderate to severe chronic bronchopulmonary disease in relation to $SO2$ air levels. Lawther identified a decline in symptoms among individuals with bronchitis in parallel with declines in levels of air pollution. Whittemore and Korn found asthmatic individuals experienced increased numbers of attacks on the average for days with high oxidant and particulate pollution and days with lower temperatures.

Mostardi and Leonard compared urban and rural high school students and identified a higher incidence of respiratory infections in industrial areas. Work from the Netherlands by Kerrebijn and Mourmans found increased prevalence of coughs and symptoms in children from regions with higher levels of air pollution. A longitudinal study by Ferris et. al. in New Hampshire demonstrated no consistent difference in symptoms over a six year period when measurements of air quality showed decreases in suspended particulate pollution and increases in sulfation.

Samet found a weak correlation between number of emergency room visits and indices of air quality. Emerson found no relationship for pollution and chronic airway obstructive disease.

Components of air pollution with biological plausibility for causing malignancy include polycyclic hydrocarbons from combustion of fossil fuels, asbestos, aresenic, and radon. Vena reported that suspended particulate pollutants in the Buffalo area had positive Ames test mutagenic activity. Migrating populations show lung cancer rates paralleling the ambient pollution levels, suggesting that additional factors of exposure besides cigarette smoking contribute to lung cancer rates. A study by Carnow using multiple regression to analyze exposures showed elevated urban cancer rates correlated with benzo(a)pyrene but not with total suspended particulates. In a county in New York with three coke ovens investigated by Vena the lung cancer rates correlated with total suspended particles for all males, white males, and all whites but not for nonwhites or females. Carnow and Meier summarized four types of studies related to air pollution and lung cancer incidence, using benzo(a)pyrene as an index of air pollution. Comparison of urban and rural cancer rates generally show a two-fold increases of urban over rural areas, including studies controlling for smoking.

This study identified significant increases in hospitalization rates for asthma and bronchitis for those under 15 years and a significant decrease in rates for COPD, bronchitis, and asthma in older individuals considered exposed to a point source of air pollution. When median income was controlled for the difference in rates of hospitalization for asthma persisted in the young age group, which is less likely to have occupational or smoking exposure. Repeated admissions did not appear to be more frequent for individual residing near the landfill, suggesting no difference in severity of illness experienced by individuals.

A dose/response relationship was hypothesized with distance as the measure of exposure and hospital admission as outcome. The lack of clear pattern for the hospital admissions with varying distance from the landfill may be due to the absence of a relationship between exposure to the burning landfill and respiratory outcome, lack of correlation between distance from the landfill and total exposure to air pollution, or to dominance by other factors in the city which determine respiratory outcome more than exposure to the landfill. The tracts closer to the landfill as measured by distance or by sector did not appear to have an increase in proportion of emergency room visits due to respiratory conditions. Few differences were found for emergency room visits for respiratory complaints between the more exposed and less exposed census tracts as measured by distance and wind direction. No specific dose-response pattern emerged.

Lung cancer incidence rates according to census tract did not show a pattern according to distance as measured by proximity to the landfill.

Studies addressing the association between respiratory disease and pollution exposures are complicated by several factors. Exposure and exposed population are difficult to document. Migration of individuals may vary by health status. Latency in the development of illness may be extensive. Differential use of medical facilities may occur. There are common strong confounders including direct cigarette smoking, passive smoking, indoor air pollution, and occupational exposure. Doll estimated that in the absence of cigarette smoking, an excess of lung cancer cases of 5/100,000/year occurs in European populations. Extrapolating this estimate to the Jersey City population would lead to an expected increase of 11 cases per year which may be too small a number to detect in the presence of confounding factors.

CONCLUSIONS

Hospital discharge data suggest that the locations in closer proximity to the landfill had increased rates of discharges for asthma among children. The emergency room data did not indicate ongoing increases in rates of respiratory disease for census tracts with higher exposure to the landfill smoke. The study raises the possibility of increased respiratory disease during the period of time that the landfill was burning but failed to find a persisting effect after fires were extinguished. Air pollution sources other than the burning landfill may contribute the more important air pollution exposures and resulting respiratory effects in Jersey City.

TABLE 1 Demographics of Selected Locations in Hudson County

location	pop.	% <15y	% ≥75y	% female	median income
07302	29327	26.6	3.5	52.2	$9,909
07304	43284	25.5	4.2	53.8	$11,048
07305	59118	25.5	4.1	53.9	$13,948
07306	52100	21.0	5.5	52.3	$11,789
07307	39694	21.9	4.9	51.6	$13,309
Bayonne	65047	17.1	5.2	52.6	$16,886
Harrison	12242	19.3	3.5	52.0	$17,168
Hoboken	42460	23.1	3.8	49.9	$11,639
Kearny	35735	19.3	4.6	52.2	$18,844
Union	55593	20.5	4.4	52.7	$12,511

location	% white	% black	% hispanic	% other races
07302	29.9	12.4	51.1	6.6
07304	33.8	50.2	11.0	4.9
07305	40.4	49.7	7.2	2.7
07306	57.9	10.7	20.1	11.2
07307	78.3	0.6	18.0	3.1
Bayonne	89.3	4.0	5.6	1.1
Harrison	77.0	0.2	20.5	2.3
Hoboken	51.6	3.5	40.2	4.5
Kearny	89.2	0.2	9.0	1.6
Union	33.3	0.9	63.9	1.9

source: 1980 United States Census

TABLE 2 Race Standardized Annual Rates of Admissions of Individuals from Selected Locations in Jersey City

Upper Respiratory Infections

	all ages	< 15 Y	15-74 Y	≥ 75 Y
07306	0.58	1.00	0.32	2.69
adjacent	0.60	1.39	0.38	0.66
remote	0.54	0.66	0.32	1.15

Bronchitis

	all ages	< 15 Y	15-74 Y	≥ 75 Y
07306	14.07	33.72	8.52	29.08
adjacent	13.05	28.85	7.70	28.47
remote	14.72	31.67	8.30	56.70#

COPD

	all ages	< 15 Y	15-74 Y	≥ 75 Y
07306	15.04	1.16	14.36	86.59
adjacent	12.29	0.38	11.69	84.08
remote	13.57	0.19	10.84	111.09

Asthma

	all ages	< 15 Y	15-74 Y	≥ 75 Y
07306	22.44	43.06	17.02	19.74
adjacent	21.06	38.71	15.90	14.56
remote	19.21	34.42	18.20	20.18

Combined Respiratory Diseases

	all ages	< 15 Y	15-74 Y	≥ 75 Y
07306	52.10	78.90	40.19	137.99
adjacent	46.68	67.81	37.14	122.78
remote	47.48	61.48'	32.05'	189.50*#

' zipcode 07306 rate significantly higher
* zipcode 07306 rate significantly lower
# adjacent rate significantly lower

TABLE 3 Comparison of Race Standardized Annual Discharge Rates Per 10,000 Population Among Locations of Similar Median Income

Upper Respiratory Infections

	all ages	< 15 Y	15-74 Y	≥ 75 Y
07306	0.58	1.00	0.32	2.69
07304	0.53	0.99	0.34	0
07302	0.77	2.02	0.16	0
Hoboken	0.73	1.52	0.45	1.61
Union	0.17	0.24	0.18	0

Bronchitis

	all ages	< 15 Y	15-74 Y	≥ 75 Y
07306	14.07	33.72	8.52	29.08
07304	12.98	29.03	7.07	32.24
07302	24.09*	60.19*	6.46	74.90
Hoboken	9.98	20.71	4.74	57.03
Union	10.52	11.44'	9.21	74.36*

COPD

	all ages	< 15 Y	15-74 Y	≥ 75 Y
07306	15.04	1.16	14.36	86.59
07304	12.63	0	12.92	83.08
07302	19.03	0.72	17.14	206.68*
Hoboken	13.55	0.23	9.17	179.99*
Union	16.38	0	15.32	115.57

Asthma

	all ages	< 15 Y	15-74 Y	≥ 75 Y
07306	22.44	43.06	17.02	19.74
07304	20.32	37.04	15.03	14.64
07302	28.15	51.88	19.42*	10.06
Hoboken	18.37	25.16'	16.21	20.95
Union	14.63'	25.81'	29.97*	21.78

Combined Respiratory Diseases

	all ages	< 15 Y	15-74 Y	≥ 75 Y
07306	52.10	78.90	40.19	137.99
07304	46.79	66.0	35.46	129.75
07302	71.98*	111.63*	43.41	290.73*
Hoboken	42.62'	46.33'	31.10	260.33*
Union	40.05'	36.56'	34.57	211.23

' zipcode 07306 rate significantly higher
* zipcode 07306 rate significantly lower

TABLE 4 Comparison of Cumulative Cases ER Visits Within Sector or by Distance for Combined Respiratory Diagnoses in All Ages

Sector	Exposed cases	Unexposed cases	Exposed controls	Unexposed controls	Relative risk
1	191	967	462	2377	1.016
1,3	250	908	608	2231	1.010
2	256	902	620	2219	1.016
2,4	281	877	695	2114	0.975
3	734	424	1778	1061	1.033
3,5	913	245	2117	722	1.271*
4	967	191	2316	523	1.143
4,5	989	169	2377	462	1.137

Distance	Exposed cases	Unexposed cases	Exposed controls	Unexposed controls	Relative risk
0-<1	101	1057	216	2623	1.160
0-<2	364	794	850	1989	1.073
0-2	428	730	978	1861	1.116

* $p < 0.05$

TABLE 5 Comparison of Cumulative Cases ER Visits Within Sector or by Distance for Combined Respiratory Diagnoses in Individuals Under 15 Years

Sector	Exposed cases	Unexposed cases	Exposed controls	Unexposed controls	Relative risk
1	97	410	118	531	1.065
1,3	125	382	152	497	1.070
2	127	380	155	494	1.065
2,4	139	368	164	485	1.117
3	347	160	420	229	1.183
3,5	432	75	505	144	1.643*
4	451	56	546	103	1.519*
4,5	456	51	561	88	1.403

Distance	Exposed cases	Unexposed cases	Exposed controls	Unexposed controls	Relative risk
0-<1	47	460	48	601	1.279
0-<2	156	351	174	475	1.213
0-2	180	327	209	440	1.159

* $p < 0.05$

TABLE 6 Comparison of Cumulative Cases ER Visits Within Sector or by Distance for Asthma in All Ages

Sector	Exposed cases	Unexposed cases	Exposed controls	Unexposed controls	Relative risk
1	88	451	462	2377	1.004
1,3	108	431	608	2231	0.920
2	110	429	620	2219	0.918
2,4	120	419	695	2114	0.871
3	334	205	1778	1061	0.972
3,5	433	106	2117	722	1.393*
4	454	85	2316	523	1.206
4,5	463	76	2377	462	1.184

Distance	Exposed cases	Unexposed cases	Exposed controls	Unexposed controls	Relative risk
0-<1	50	489	216	2623	1.242
0-<2	169	370	850	1989	1.069
0-2	199	340	978	1861	1.114

* $p < 0.05$

TABLE 7 Comparison of Cumulative Cases ER Visits Within Sector or by Distance for Asthma in Individuals Under 15 Years

Sector	Exposed cases	Unexposed cases	Exposed controls	Unexposed controls	Relative risk
1	49	224	118	531	0.984
1,3	59	214	152	597	0.902
2	59	214	152	597	0.879
2,4	64	209	164	485	0.906
3	189	84	420	229	1.227
3,5	239	34	505	144	2.004*
4	248	25	546	103	1.871*
4,5	252	21	561	88	1.882*

Distance	Exposed cases	Unexposed cases	Exposed controls	Unexposed controls	Relative risk
0-<1	27	246	48	601	1.374
0-<2	91	182	174	475	1.365*
0-2	105	168	209	440	1.316

* $p < 0.05$

TABLE 8 Comparison of Cumulative ER Visits by Sector of Distances Two Kilometers or Less to Distances Over Two Kilometers for Combined Respiratory Diagnoses in All Ages

Sector	Distance	Exposed cases	Unexposed cases	Exposed controls	Unexposed controls	Relative Risk
1	0-<1 km	0	191	0	452	
1	0-<2 km	12	179	50	412	0.552
1	0-2 km	12	179	50	412	
2	0-<1 km	0	6	0	12	
2	0-<2 km	6	0	12	0	
2	0-2 km	6	0	12	0	
2,4	0-<1 km	20	5	50	25	2.000
2,4	0-<2 km	20	5	50	25	
2,4	0-2 km	20	5	50	25	
3	0-<1 km	67	386	124	959	1.342
3	0-<2 km	220	233	434	649	1.412*
3	0-2 km	220	233	434	649	
3,5	0-<1 km	0	179	0	339	
3,5	0-<2 km	31	148	61	278	0.955
3,5	0-2 km	65	114	144	195	0.772
4,5	0-<1 km	14	8	42	19	0.792
4,5	0-<2 km	14	8	42	19	
4,5	0-2 km	22	0	61	0	
5	0-<1 km	0	169	0	462	
5	0-<2 km	61	108	201	261	0.733
5	0-2 km	83	86	227	235	0.999

* $p < 0.05$

TABLE 9 Comparison of Cumulative ER Visits by Sector of Distances Two Kilometers or Less to Distances Over Two Kilometers for Combined Respiratory Diagnoses in Individuals Less Than 15 Years Old

Sector	Distance	Exposed cases	Unexposed cases	Exposed controls	Unexposed controls	Relative Risk
1	0-<1 km	0	97	0	118	
1	0-<2 km	5	92	14	104	0.404
1	0-2 km	5	92	14	104	
2	0-<1 km	0	2	0	3	
2	0-<2 km	2	0	3	0	
2	0-2 km	2	0	3	0	
2,4	0-<1 km	11	1	6	3	5.500
2,4	0-<2 km	11	1	6	3	
2,4	0-2 km	11	1	6	3	
3	0-<1 km	31	177	31	225	1.271
3	0-<2 km	104	104	96	160	1.667
3	0-2 km	104	104	96	160	
3,5	0-<1 km	0	85	0	85	
3,5	0-<2 km	12	73	12	73	
3,5	0-2 km	28	57	33	52	0.774
4,5	0-<1 km	5	0	11	4	
4,5	0-<2 km	5	0	11	4	
4,5	0-2 km	5	0	15	0	
5	0-<1 km	0	51	0	88	
5	0-<2 km	17	34	32	56	0.875
5	0-2 km	25	26	42	46	1.053

* $p < 0.05$

TABLE 10 Comparison of Cumulative ER Visits by Sector of Distances Two Kilometers or Less to Distances Over Two Kilometers for Asthma in All Ages

Sector	Distance	Exposed cases	Unexposed cases	Exposed controls	Unexposed controls	Relative Risk
1	0-<1 km	0	88	0	452	
1	0-<2 km	4	84	50	412	0.392
1	0-2 km	4	84	50	412	
2	0-<1 km	0	2	0	12	
2	0-<2 km	2	0	12	0	
2	0-2 km	2	0	12	0	
2,4	0-<1 km	7	3	50	25	1.167
2,4	0-<2 km	7	3	50	25	
2,4	0-2 km	7	3	50	25	
3	0-<1 km	37	177	124	959	1.617*
3	0-<2 km	104	104	434	649	1.495*
3	0-2 km	104	104	434	649	
3,5	0-<1 km	0	99	0	339	
3,5	0-<2 km	21	78	61	278	1.223
3,5	0-2 km	39	60	144	195	0.880
4,5	0-<1 km	6	3	42	19	0.905
4,5	0-<2 km	6	3	42	19	
4,5	0-2 km	9	0	61	0	
5	0-<1 km	0	76	0	462	
5	0-<2 km	19	57	201	261	0.433*
5	0-2 km	28	48	227	235	0.604*

* $p < 0.05$

TABLE 11 Comparison of Cumulative ER Visits by Sector of Distances Two Kilometers or Less to Distances Over Two Kilometers for Asthma in Individuals Less Than 15 Years Old

Sector	Distance	Exposed cases	Unexposed cases	Exposed controls	Unexposed controls	Relative risk
1	0-<1 km	0	49	0	118	
1	0-<2 km	1	48	14	104	0.155
1	0-2 km	1	48	14	104	
2	0-<1 km	0	0	0	3	
2	0-<2 km	0	0	3	0	
2	0-2 km	0	0	3	0	
2,4	0-<1 km	5	0	6	3	
2,4	0-<2 km	5	0	6	3	
2,4	0-2 km	5	0	6	3	
3	0-<1 km	18	107	31	225	1.221
3	0-<2 km	66	59	96	160	1.864*
3	0-2 km	66	59	96	160	
3,5	0-<1 km	0	50	0	85	
3,5	0-<2 km	10	40	12	73	1.521
3,5	0-2 km	20	30	33	52	1.051
4,5	0-<1 km	4	0	11	4	
4,5	0-<2 km	4	0	11	4	
4,5	0-2 km	4	0	15	0	
5	0-<1 km	0	21	0	88	
5	0-<2 km	5	16	32	56	0.547
5	0-2 km	9	12	42	46	0.821

* p 0.05

TABLE 12 Observed Cases of Lung Cancer in Jersey City 1979-1983

	male		female	
	cases	C.I.	cases	C.I.
all cancers:	1848	.767-.841	1987	.732-.800
lung cancer:	391	.762-.931	165	.609-.832

TABLE 13 Age Standardized Annual Rates of Lung Cancer per 10,000 in Jersey City by Distance from Landfill

	Female		Male	
Distance	cases	rate	cases	rate
0-1 km	8	2.98	26	12.27
1-2 km	40	3.90	93	10.02
2 km	5	1.71	19	6.73
2-3 km	35	3.29	91	10.51
3 km	8	2.67	18	6.22
3-4 km	32	3.34	82	9.80
4 km	0	0	1	9.61
4-5 km	18	4.98	25	8.32

	Female		Male	
Sector	cases	rate	cases	rate
1	38	3.98	77	8.88
1,3	12	7.15	13	8.22
2	1	0.56	10	6.18
2,4	4	2.57	15	10.58
3	29	3.61	69	11.40
3,5	7	1.98	24	8.11
4	25	4.00	67	12.19
4,5	7	4.21	11	8.31
5	23	2.74	69	8.42

TABLE 14 Age Standardized Rates of Lung Cancer in Jersey City per 10,000 by Sector and Distance from Landfill

		Female		Male	
Sector	Distance	cases	rate	cases	rate
1	1-2 km	6	5.78	14	11.93
1	2-3 km	5	3.67	12	8.68
1	3 km	1	1.70	5	8.62
1	3-4 km	8	2.94	21	8.25
1	4-5 km	18	4.98	25	8.32
1,3	3 km	6	6.40	9	9.71
1,3	3-4 km	6	8.28	4	6.36
2	1-2 km	1	0.56	10	6.18
2,4	0-1 km	3	3.94	10	14.49
2,4	2-3 km	1	1.37	5	6.72
3	0-1 km	1	0.82	13	14.96
3	1-2 km	18	6.56	18	7.87
3	2-3 km	7	2.57	22	14.47
3	3 km	0	0	3	8.55
3	3-4 km	3	2.41	13	13.17
3,5	1-2 km	2	1.42	11	9.60
3,5	2 km	2	2.00	5	3.96
3,5	2-3 km	3	3.32	8	12.12
4	2-3 km	18	4.15	41	10.48
4	3-4 m	7	3.61	26	16.70
4,5	0-1 km	4	5.59	3	5.71
4,5	2 km	3	3.23	8	10.85
5	1-2 km	13	4.49	40	13.38
5	2 km	0	0	6	5.84
5	2-3 km	1	2.00	3	6.55
5	3 km	1	0.93	1	1.03
5	3-4 km	8	2.80	18	6.71
5	4 km	0	0	1	9.61

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FIGURE 1

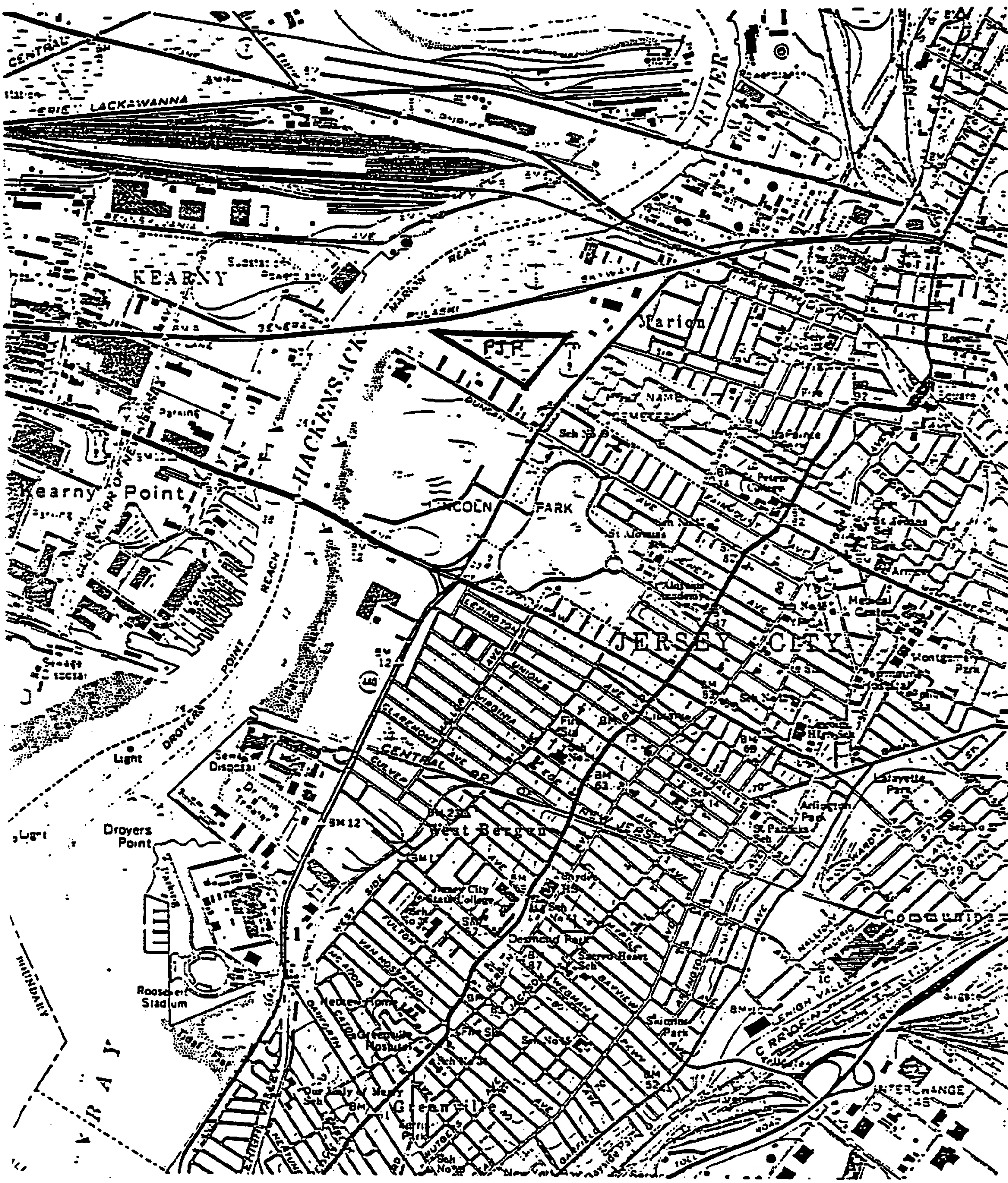
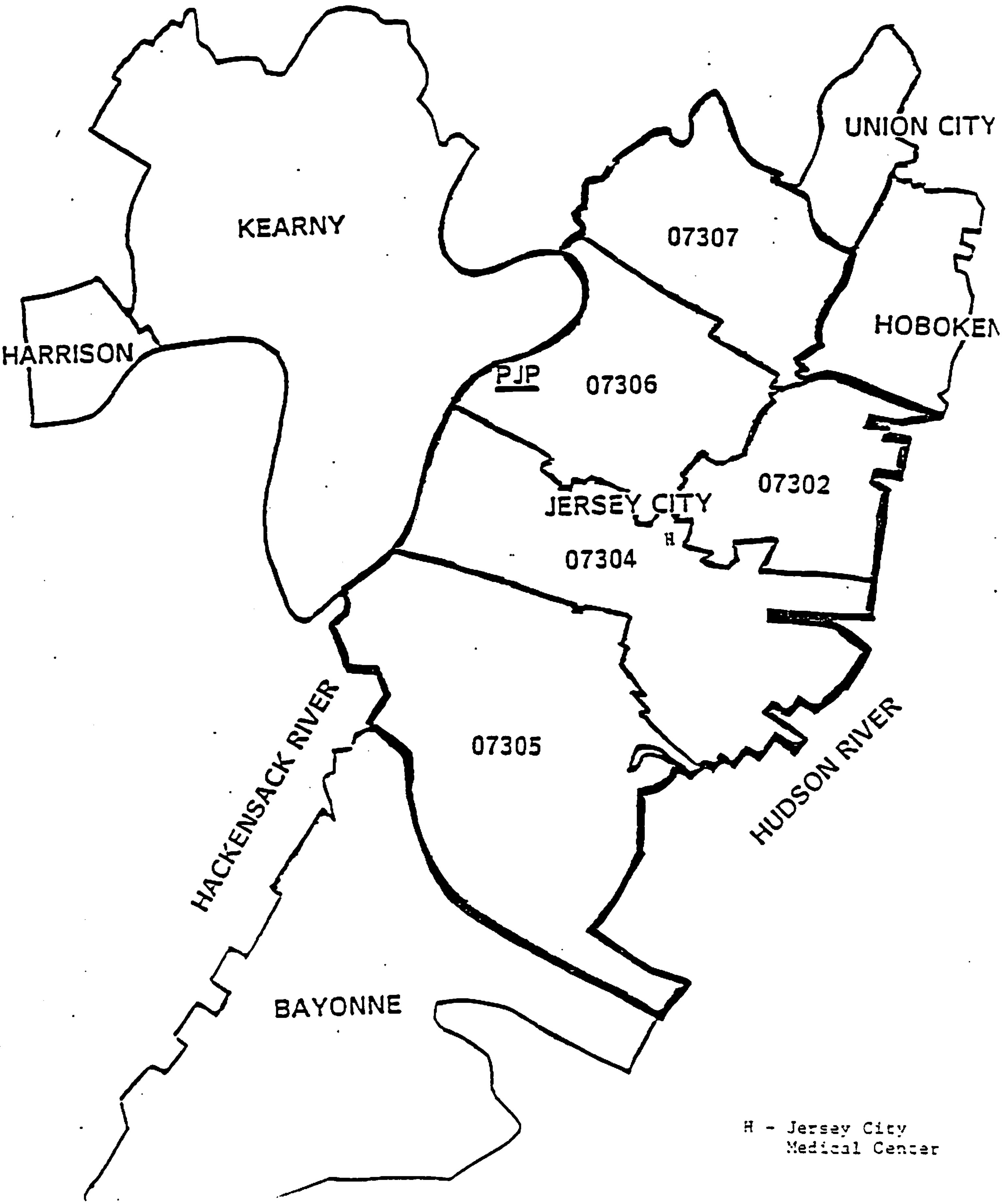

CENTRAL
ERIE LACKAWANNA
KEARNY
Kearny Point
HACKENSACK
REACH
DROYERS POINT
PJP
Marion
LINCOLN PARK
JERSEY CITY
West Bergen
Greenville
Droyers Point
Roosevelt Stadium
Light
Lafayette Park
INTERCHANGE

FIGURE 2
JERSEY CITY AND VICINITY
ZIP CODES AND MUNICIPALITIES



H - Jersey City
Medical Center

Figure 3

JERSEY CITY
Census Tracts and Vicinity
With 1 Kilometer Arcs

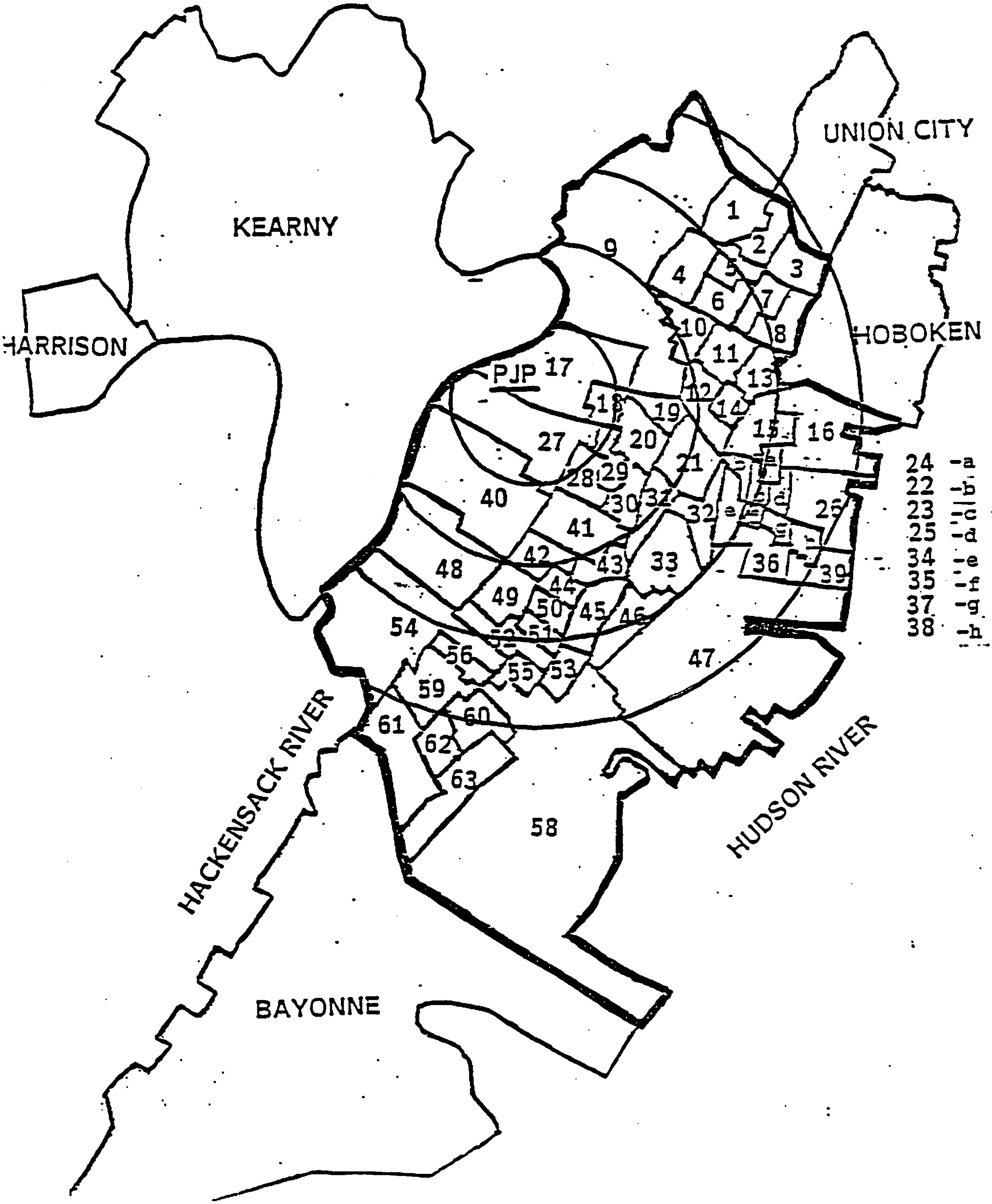


Figure 4
JERSEY CITY
Census Tracts and Vicinity
With Sectors by Wind Direction