

# Health Consultation

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NJ NATURAL GAS CO/BAY DIV OPER CTR

ANALYSIS OF CANCER INCIDENCE NEAR THE  
ATLANTIC HIGHLANDS MANUFACTURED GAS PLANT

ATLANTIC HIGHLANDS, MONMOUTH COUNTY, NEW JERSEY

EPA FACILITY ID: NJD980530463

FEBRUARY 23, 2005

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES  
Public Health Service  
Agency for Toxic Substances and Disease Registry  
Division of Health Assessment and Consultation  
Atlanta, Georgia 30333

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An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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Prepared by:

New Jersey Department of Health and Senior Services  
Consumer and Environmental Health Services  
Under Cooperative Agreement with the  
U.S. Department of Health and Human Services  
Agency for Toxic Substances and Disease Registry

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## **Purpose**

This health consultation evaluated cancer incidence among people living near the former Atlantic Highlands Manufactured Gas Plant (MGP) in Atlantic Highlands, Monmouth County, New Jersey. The investigation, requested by New Jersey Department of Environmental Protection (NJDEP) staff, evaluated total cancer incidence and 13 specific cancer types. The specific cancers types were selected because they represent cancer groupings that may be more sensitive to the effects of environmental exposure. They are not necessarily related to the specific contaminants found at the Atlantic Highlands MGP.

## **Background and Statement of Issues**

The former Atlantic Highlands MGP is located within the Borough of Atlantic Highlands, about ½ mile south of Sandy Hook Bay. It operated from approximately 1910 through 1949. The Atlantic Highlands MGP facility extracted natural gas (short-chain hydrocarbon molecules, such as methane and propane) from coal, leaving heavier hydrocarbons behind as residue (NJDOH 1995). These residues consist primarily of semivolatile organic compounds known as polycyclic aromatic hydrocarbons (PAHs). In addition, the residue may also contain volatile organic compounds, including benzene, toluene, ethylbenzene, and xylenes.

Off-site characterization of the soil and sediment near the site identified numerous PAH contaminants in the environment. Analysis of soil samples from the Many Mind Creek north of Highland Avenue (EBASCO 1993) and east and west of the site between Highland Avenue and Route 36 (Enserch Environmental 1994) detected many PAHs. Those included acenaphthylene, anthracene, benzo(a)pyrene, benzofluoranthene, benzo(b)fluoranthene, chrysene, benzo(a)phenanthrene, naphthalene, and pyrene. Potential past and possibly current human pathways of exposure include skin contact with contaminated soil and, to a lesser extent, inhalation of vapors from the contaminated soil.

Exposure to PAHs has been documented to cause tumors in laboratory animals (ATSDR 1995). The results of animal experiments indicate that PAHs are a probable human carcinogen (American Cancer Society 2004a). Epidemiologic studies show that people exposed for long periods to PAHs by breathing or skin contact may also have increased risk of developing cancer, especially lung and skin cancers (ATSDR 1995).

In 1995, at the request of the New Jersey State Police and the New Jersey Department of Law and Public Safety, a health consultation was conducted for the Atlantic Highlands MGP site. The health consultation concluded that there was no apparent health hazard associated with the site. Despite the continued potential for human exposure to contaminants, there also appeared to be no increased risk of cancer associated with that potential exposure (NJDOH 1995). However, because of a recent request by NJDEP staff, this evaluation of cancer incidence was initiated for Atlantic Highlands.

## **Methods**

### **Study Area and Population**

The Atlantic Highlands study area for the evaluation of cancer incidence consisted of the entire population residing in the Borough. Population counts for the area were determined from 1980, 1990, and 2000 U.S. Census Bureau data (US Census Bureau 1980, 1990, 2000).

### **Cancer Case Ascertainment and Study Period**

The New Jersey State Cancer Registry was used to determine cancer cases. The cancer registry is a population-based cancer incidence registry covering the entire state of New Jersey. By law, all cases of newly diagnosed cancer are reportable to the registry, except for certain carcinomas of the skin. In addition, the Registry has reporting agreements with the states of New York, Pennsylvania, Delaware, Maryland, North Carolina, and Florida. Information on New Jersey residents who are diagnosed in those states is supplied to the cancer registry. The registry has been in operation since October 1, 1978.

The study period for this investigation was January 1, 1979, through December 31, 2000. A “case” was defined as an individual who was diagnosed with a new primary malignant cancer during the study period while residing in Atlantic Highlands. Registry cases identified only through search of death records were excluded from this evaluation. Information on important cancer risk factors, such as genetics, personal behaviors (e.g., diet and smoking), or occupational history, is not available from the cancer registry.

### **Data Analysis**

Analyses were completed for all malignant cancer types combined and for select cancer types for the entire Borough of Atlantic Highlands. In addition, a portion of the borough consisting of selected census blocks closest to the MGP facility, termed the focus area (see Figure 1 and Table 1), was evaluated separately. The select cancer types analyzed include bladder, brain and central nervous system (CNS), female breast, colorectal, esophageal, pancreas, lung, leukemia, non-Hodgkin lymphoma, liver, bone, stomach, and kidney. These cancer types were evaluated because they represent cancer groupings that may be more sensitive to the effects of environmental exposures. Males and females were evaluated separately.

Standardized incidence ratios (SIRs) were used for the quantitative analysis of cancer incidence in the study areas (Kelsey et al. 1986; Breslow and Day 1987). The SIR is calculated by dividing the observed number of cases (from the registry) by an expected number for the surveyed population over the time period reviewed.

The expected number was derived by multiplying a comparison population’s age-sex-specific incidence rates and the study area age-sex-specific population figures. The comparison rates used to derive the expected number of cases were the New Jersey average annual incidence rates for 1979 to 1999. The study area age-sex-specific population was determined from 1980, 1990, and

2000 U.S. Census data (US Census Bureau 1980, 1990, 2000). The analysis used 18 age-specific population groups.

The observed and expected numbers are evaluated by interpreting the ratio of these numbers. If the observed number of cases equals the expected number of cases, the SIR will equal 1.0. An SIR less than 1.0 indicates that fewer cases are observed than expected. An SIR greater than 1.0 indicates that more cases than expected are observed.

Random fluctuations may account for some SIR deviations from 1.0. The statistical significance of deviations from SIR equal to 1.0 was evaluated using a 95% confidence interval (CI). The 95% CI was used to evaluate the probability that the SIR may be greater or less than 1.0 due to chance alone, and was based on the Poisson distribution (Breslow and Day 1987; Checkoway et al. 1989). If the CI includes 1.0, then the estimated SIR is not considered to be statistically significantly different than 1.0.

## Results

Table 2 presents the Atlantic Highlands population by race and sex for the years 1980, 1990, and 2000. The borough population, all races combined, dropped slightly from 1980 (4,950) to 1990 (4,629) and then rose in 2000 (4,705). The borough's white population comprised more than 94% of the total population throughout the study period. The proportion of females citywide was slightly higher than males. The focus area population as a proportion of the total borough decreased slightly from 1990 (63%) to 2000 (58%). Because census block population data were not available for 1980, the focus area population was estimated using the proportion recorded for the 1990 population. The proportion of whites and females in the focus area was similar to the total borough.

Table 3 presents the number of malignant incident cancer cases by race, sex, and age group for Atlantic Highlands and the focus area. For the town as a whole, a total of 599 cases were diagnosed in city residents during the years 1979–2000. Of those cases, 282 were residents of the focus area at the time of diagnosis. A total of 28 of the Atlantic Highlands cases could not be geographically identified within the community due to a missing or incomplete address (7) or because the address was a rural route or post office (P.O.) box (21). Slightly more than half of the cases were males and more than 95% were white in both the borough and the focus area. The distribution of age at time of diagnosis was similar for the borough and the focus area.

Table 4 presents cancer incidence by cancer type for all race-sex groups combined. The most frequently diagnosed cancer types for both Atlantic Highlands and the focus area include colorectal, lung, breast, and prostate, representing between 56%–58% of all incident cancers. The frequency of these cancer types is consistent with New Jersey statewide cancer incidence data.

Tables 5 and 6 present SIR results for Atlantic Highlands and the focus area. Citywide (Table 5), statistically significantly elevated SIRs include all cancers combined in males (SIR=1.14; 95% CI=1.02, 1.28), all cancers combined in females (SIR=1.12; 95% CI=1.00, 1.26), and lung

cancer in females (SIR=1.39; 95% CI=1.00, 1.88). Although not statistically significant, the male lung cancer SIR (1.30) was similar to the female lung cancer SIR (1.39). Other slightly elevated, but not statistically significant, SIRs include non-Hodgkin lymphoma in males and females and colorectal cancer in males. None of the SIRs citywide were statistically significantly low. For the focus area, none of the SIRs were statistically significantly elevated, while one SIR, all cancer combined in females, was statistically significantly low (SIR=0.80; 95% CI=0.67, 0.96). Focus area males had slightly elevated, though not statistically significant, lung cancer (1.3).

## **Discussion**

The purpose of this investigation was to evaluate cancer incidence in a population living relatively near to areas contaminated by the Atlantic Highlands MGP. For the entire Borough of Atlantic Highlands, the occurrence of cancer (all sites combined) over the 22-year observation period was slightly higher than expected (on the basis of average state rates). Lung cancer in females citywide was also significantly higher than expected. In the focus area, the incidence of all cancers combined for females was significantly lower than expected.

Cancer is a group of more than 100 different diseases (i.e., cancer types and subtypes), each with their own set of risk factors. The multifactorial nature of cancer etiology, where a given type of cancer may have more than one cause, complicates the evaluation of potential risk factors and specific disease outcomes. Benzene and PAHs, the primary contaminants at MGP sites, have been identified as possible risk factors to exposed populations for certain cancer types, primarily leukemia (benzene) and lung cancer (PAHs). In the current analysis, the incidence of leukemia citywide and in the focus area was lower than expected over the study period. Lung cancer incidence, however, was statistically significantly higher in females citywide, but not in males citywide or either sex in the focus area. Cancer incidence rates in the population living closest to the MGP facility were not higher than expected.

While there are multiple risk factors for lung cancer, tobacco smoking is considered the most important risk factor, estimated to account for more than 85% of all lung cancer cases (National Cancer Institute 1996). Other known risk factors for lung cancer include indoor exposure to radon and environmental (second-hand) tobacco smoke, occupational exposure to asbestos, and other cancer-causing agents in the workplace (including radioactive ores; chemicals such as arsenic, vinyl chloride, nickel, chromates, coal products, mustard gas, and chloromethyl ethers; fuels such as gasoline; and diesel exhaust), and exposure to air pollution (American Cancer Society 2004b).

A limitation of cancer studies of this type is the inability to assess past exposure levels in the population. Important information needed to assess a cause-effect relationship includes data on actual personal exposure to the contamination and other relevant risk factors over time. That is, who was exposed and who was not exposed and the magnitude of the exposure that did occur. Because personal exposure information does not exist, residential proximity to the contaminated site was used as a surrogate measure for potential past exposure. This was accomplished by analyzing separately the population living in the section of Atlantic Highlands closest to the location of the MGP. Although proximity to the site may be a reasonable surrogate for past



potential exposures, it is also unlikely that all of the residents in the area were exposed to the contamination. This would result in misclassifying some of the study cases as exposed, when they are not. Additionally, the length of residence of each case is unknown, thereby potentially adding to exposure misclassification. The consequence of exposure misclassification would be to bias the results toward not finding an association (i.e., no exposure-health outcome relationship).

Another interpretation problem is that cancer is a chronic disease that takes many years after exposure to reveal itself as a clinical disease. The information supplied by the cancer registry provides only an address at time of diagnosis for each case. No information is available on the length of time an individual may have lived at their address before diagnosis. It is possible that some cases are new, short-term residents with little or no exposure to the site. Furthermore, former residents who moved out of the study area before diagnosis are not included in this analysis. Population mobility cannot be accounted for in this analysis.

Additionally, when researchers independently examine statistical associations for a large number of comparisons, it is likely that some number of statistically elevated or low SIRs will occur by chance alone. While it is possible to statistically correct for this concern, opinions differ on whether such corrections are needed. In this analysis, confidence intervals are presented without adjustment for multiple comparisons.

The approach used for this descriptive cancer investigation was census-based. The entire population of Atlantic Highlands and the State of New Jersey were reviewed to calculate age standardized incidence rate ratios for the study area. This census approach (ecologic design) is a practical surveillance or screening method for cancer incidence. Although this approach is well suited for providing a picture of cancer incidence in the specific localities, cause-effect relationships cannot be evaluated. Important information on potential risk factors (such as genetics, behavior, environmental factors, occupation, etc.) that might explain the results was not available for analysis using this type of study design.

## **Conclusions and Recommendations**

The overall cancer incidence (all cancers combined) was slightly elevated in Atlantic Highlands. In the section of town (focus area) closest to the MGP site, however, cancer incidence was either equal to or lower than expected. Lung cancer in females was also statistically significantly higher than expected for the borough, but not in the focus area. No other cancer types evaluated for the borough and focus area were significantly higher than expected.

The findings of the 1995 health consultation and this analysis of cancer incidence in the Borough of Atlantic Highlands and focus area provide no evidence that the rate of cancer in the study population has been affected by the potential exposure to MGP contamination.

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## **Certification**

This health consultation was prepared by the New Jersey Department of Health and Senior Services under a cooperative agreement with the Agency for Toxic Substances and Disease Registry. It is in accordance with approved methodology and procedures existing at the time the health consultation was initiated.

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The Division of Health Assessment and Consultation, ATSDR, has reviewed this health consultation and concurs with its findings.

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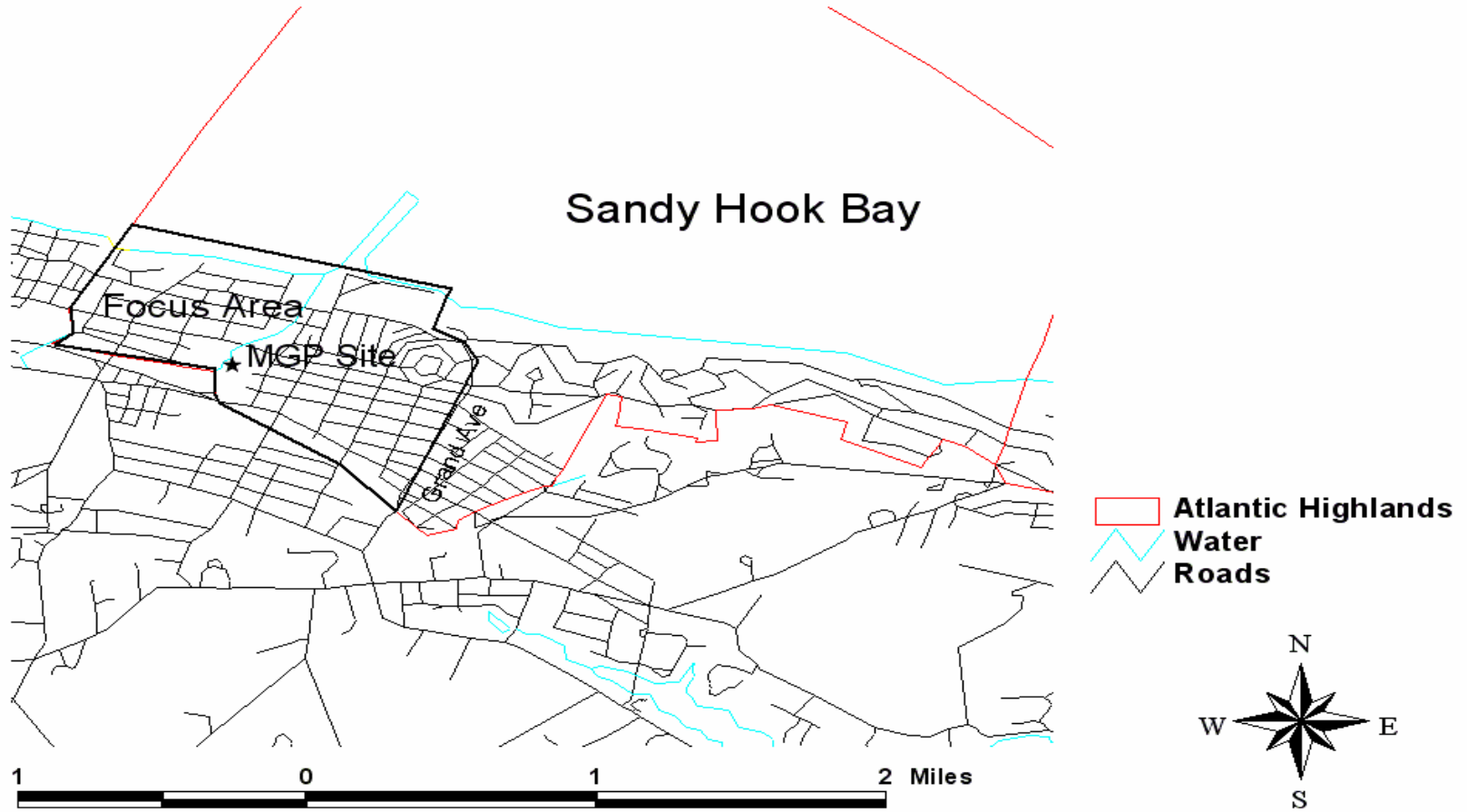
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## **Figure and Tables**

# Figure 1. Atlantic Highlands



**Table 1. Atlantic Highlands Focus Area Census Block Groups and Blocks**

<b>1980 and 1990</b>		<b>2000</b>	
<b>Census Block Groups</b>	<b>Census Blocks</b>	<b>Census Block Groups</b>	<b>Census Blocks</b>
2	2009 2010 2011 2012 2013	2	2009 2010 2011 2012 2013
4	all	3	all
5	all	4	all
6	all	5	all
7	all		
8	all		
9	all		

**Table 2. Atlantic Highlands Population by Race and Sex (U.S. Census Bureau Data)**

<b>Area</b>	<b>1980</b>	<b>1990</b>	<b>2000</b>
<b>Entire Municipality</b>			
Total	4,950	4,629	4,705
Sex			
Males	2,355	2,253	2,274
Females	2,595	2,376	2,431
Race*			
White	4,792	4,507	4,440
Black	134	76	108
Multiple Races	—	—	48
Other/Unknown	24	46	109
<b>Focus Area<sup>†</sup></b>			
Total	3,133	2,930	2,725
Sex			
Males	1,493	1,428	1,309
Females	1,640	1,502	1,416
Race			
White	3,015	2,820	2,565
Black	76	71	75
Multiple Races	—	—	24
Other/Unknown	42	39	61

\* Multiple race reporting began in the 2000 census.

† 1980 focus area population estimated from 1990 focus area population.



**Table 3. Atlantic Highlands Malignant Cancer Incidence (1979–2000) by Study Area  
Select Demographic Characteristics\***

<b>Demographic Characteristics</b>	<b>Entire Municipality</b>	<b>Focus Area</b>
<b>Total Cases</b>	599	282
<b>Sex</b>		
Male	303	154
Female	296	128
<b>Race</b>		
White	576	270
Black	14	8
Other/Unknown	9	<5
<b>Age at diagnosis (years)</b>		
0–19	10	6
20–44	42	21
45–69	270	133
70+	277	122

\* Data are from the New Jersey State Cancer Registry, New Jersey Department of Health and Senior Services.

**Table 4. Atlantic Highlands Malignant Cancer Incidence (1979–2000) by Cancer Type and Study Area: All Races Combined\***

<b>Cancer Type</b>	<b>Entire Municipality</b>	<b>Focus Area</b>
Oral Pharynx	11	8
Esophagus	<5	<5
Stomach	8	<5
Small Intestine	0	0
Colorectal	85	36
Liver	<5	0
Pancreas	12	7
Other Digestive	7	<5
Lung	101	53
Other Respiratory	13	9
Bones and Joints	<5	0
Soft Tissue	<5	0
Skin	15	10
Breast	83	35
Cervix	11	6
Uterus	26	9
Ovary	15	9
Other Female Genital	<5	0
Prostate	80	35
Other Male Genital	5	<5
Bladder	26	10
Kidney	10	7
Other Urinary	0	0
Eye	<5	<5
Brain and Central Nervous System	6	<5
Endocrine	5	<5
Hodgkin Disease	<5	<5
Non-Hodgkin Lymphoma	25	12
Myeloma	<5	<5
Leukemia	9	5
Miscellaneous/Other	27	13

\* Data are from the New Jersey State Cancer Registry, New Jersey Department of Health and Senior Services.

**Table 5. Atlantic Highlands Malignant Cancer Incidence (1979–2000)  
SIR Analysis by Cancer Type and Sex: All Races Combined**

<b>Cancer Type</b>	<b>Sex</b>	<b>Observed</b>	<b>Expected</b>	<b>SIR<sup>1</sup></b>	<b>95% CI</b>
All Cancers Combined	Male	303	264.8	1.14 *	1.02–1.28
	Female	296	264.2	1.12 *	1.00–1.26
Bladder	Male	19	20.0	0.95	0.57–1.48
	Female	7	7.5	0.93	0.37–1.92
Brain/CNS	Male	<5	NR	0.77	0.16–2.26
	Female	<5	NR	0.92	0.18–2.68
Colorectal	Male	50	38.0	1.32	0.98–1.74
	Female	35	38.3	0.91	0.64–1.27
Esophageal	Male	<5	NR	0.24	0.00–1.34
	Female	<5	NR	0.64	0.01–3.55
Kidney	Male	6	7.3	0.83	0.30–1.80
	Female	<5	NR	0.86	0.23–2.20
Leukemia	Male	5	6.8	0.73	0.24–1.71
	Female	<5	NR	0.73	0.20–1.88
Liver	Male	<5	NR	0.95	0.11–3.42
	Female	0	1.0	0	—
NHL	Male	13	9.8	1.33	0.71–2.28
	Female	12	9.1	1.32	0.68–2.30
Stomach	Male	<5	NR	0.28	0.03–1.01
	Female	6	4.8	1.24	0.45–2.70
Lung	Male	60	46.1	1.30	0.99–1.67
	Female	41	29.5	1.39 *	1.00–1.88
Bone and Joint	Male	<5	NR	1.79	0.02–9.96
	Female	0	0.5	0	—
Breast	Female	83	78.9	1.05	0.84–1.30
Pancreas	Male	6	5.9	1.03	0.37–2.23
	Female	6	6.5	0.93	0.34–2.03

<sup>1</sup>Note: \*= statistically high, \*\*= statistically low, NR= not reported because observed <5.

Data are from the New Jersey State Cancer Registry, New Jersey Department of Health and Senior Services.

**Table 6. Atlantic Highlands Focus Area Malignant Cancer Incidence (1979–2000)  
SIR Analysis by Cancer Type and Sex: All Races Combined**

Cancer Type	Sex	Observed	Expected	SIR <sup>1</sup>	95% CI
All Cancers Combined	Male	154	152.6	1.01	0.86–1.18
	Female	128	159.2	0.80 **	0.67–0.96
Bladder	Male	9	11.5	0.78	0.36–1.49
	Female	<5	NR	0.22	0.00–1.23
Brain/CNS	Male	<5	NR	0.43	0.01–2.41
	Female	<5	NR	0	—
Colorectal	Male	21	21.8	0.96	0.60–1.47
	Female	15	23.2	0.65	0.36–1.07
Esophageal	Male	<5	NR	0.42	0.01–2.36
	Female	0	0.9	0	—
Kidney	Male	<5	NR	0.96	0.26–2.46
	Female	<5	NR	1.07	0.22–3.14
Leukemia	Male	<5	NR	0.75	0.15–2.19
	Female	<5	NR	0.60	0.07–2.17
Liver	Male	0	1.2	0	—
	Female	0	0.6	0	—
NHL	Male	6	5.7	1.05	0.38–2.28
	Female	6	5.5	1.09	0.40–2.37
Stomach	Male	<5	NR	0.24	0.00–1.35
	Female	<5	NR	1.02	0.20–2.98
Lung	Male	33	26.2	1.26	0.87–1.77
	Female	20	17.6	1.14	0.70–1.76
Bone and Joint	Male	0	0.3	0	—
	Female	0	0.3	0	—
Breast	Female	35	47.4	0.74	0.51–1.03
Pancreas	Male	<5	NR	1.19	0.32–3.06
	Female	<5	NR	0.77	0.15–2.25

<sup>1</sup> Note: \*= statistically high, \*\*= statistically low, NR= not reported because observed <5.

Data are from the New Jersey State Cancer Registry, New Jersey Department of Health and Senior Services.