

Health Consultation

Incidence of Selected Cancer Types in the Neighborhood near the

GARFIELD GROUND WATER CONTAMINATION SITE
(a/k/a E.C. Electroplating Corporation)

GARFIELD, BERGEN COUNTY, NEW JERSEY

EPA FACILITY ID: NJN000206317

**Prepared by the
New Jersey Department of Health and Senior Services**

OCTOBER 17, 2011

Prepared under a Cooperative Agreement with the
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

A health consultation is a verbal or written response from ATSDR or ATSDR's Cooperative Agreement Partners 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 or ATSDR's Cooperative Agreement Partner which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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Environmental and Occupational Health Surveillance Program
New Jersey Department of Health and Senior Services
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Summary

Introduction

In an April 2010 Health Consultation on the E.C. Electroplating (Garfield Chromium Groundwater Contamination area) site, the New Jersey Department of Health and Senior Services (NJDHSS) and the U.S. Agency for Toxic Substances and Disease Registry (ATSDR) concluded that people could be exposed to harmful levels of hexavalent chromium by accidentally swallowing contaminated dusts in residences where groundwater infiltration had occurred. A Public Health Advisory by ATSDR in September 2010 recommended that the U.S. Environmental Protection Agency (USEPA) take short-term and long-term steps to prevent exposure. The USEPA subsequently added the “Garfield Ground Water Contamination Site” to the National Priorities List in September 2011.

In the April 2010 Health Consultation, NJDHSS and ATSDR recommended analysis of the incidence of cancer types potentially related to hexavalent chromium exposure in the Garfield Chromium Groundwater Contamination area. This Health Consultation describes the methods and results of these analyses.

The survey area for the evaluation of cancer incidence was the entire population residing in census blocks approximately above the Garfield Chromium Groundwater Contamination area. The survey period for the primary analysis of this investigation was 1993 through 2008, a 16-year period that begins approximately 10 years after a spill occurred that contaminated the groundwater. This lag time allows a minimal time to elapse before potential exposure, or effects from exposure, could have occurred.

NJDHSS and ATSDR selected the following cancer types for analysis, based on their potential to be related to hexavalent chromium exposure: lung and bronchus; oral cavity and pharynx; esophagus; stomach; and small intestine. The observed incidences of these cancers in the survey area were compared to expected numbers of cases that would be expected in the population based on statewide cancer rates.

NJDHSS and ATSDR have reached the following conclusion in this Health Consultation.

Conclusion

Based on the analyses presented in this Health Consultation, NJDHSS and ATSDR conclude that the incidence of cancers potentially related to exposure to hexavalent chromium, in the population residing in the neighborhood above the Garfield Chromium Groundwater Contamination Area, is similar to what would be expected based on state-wide cancer rates.

**Basis for
Conclusion**

In the 16-year primary analysis period, 1993-2008, the incidences of cancer types potentially related to hexavalent chromium exposure were not statistically different from the expected numbers of cases. The incidence of lung and bronchus cancer, the cancer type most strongly associated with exposure to hexavalent chromium (by inhalation), was slightly higher than expected among males and lower than expected among females, but neither difference was considered statistically significant. The incidence of stomach cancer was higher than expected among males and lower than expected among females, but neither difference was statistically significant.

Although the incidence of stomach cancer and lung cancer in males during the primary analysis period was elevated, incidence was also elevated in the years before site-related exposure or the effects of that exposure could have occurred.

Given that the latency period of cancers may range from years to decades, it is possible that this analysis was conducted too recently following the beginning of exposure to have been able to detect an increase in cancer incidence.

Next Steps

Because of the long latency period for development of cancers, the NJDHSS and ATSDR should consider continuing surveillance of chromium-related cancers in the population residing above the Garfield Chromium Groundwater Contamination Area.

The NJDHSS and ATSDR should continue to work with the USEPA and community representatives to determine the most appropriate health educational materials and outreach strategies to inform the general population about health and environmental issues related to the chromium-contaminated groundwater.

**For More
Information**

Copies of this Health Consultation will be provided to concerned residents via the township libraries and the Internet. NJDHSS will notify area residents that this report is available for their review and provide a copy upon request.

Questions about this Health Consultation should be directed to:

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Purpose

The New Jersey Department of Health and Senior Services (NJDHSS) and the U.S. Agency for Toxic Substances and Disease Registry (ATSDR) released a Health Consultation dated April 22, 2010 on the E.C. Electroplating site located at 125 Clark Street in Garfield, Bergen County, New Jersey (ATSDR 2010a). The Health Consultation reviewed environmental data and evaluated the public health implications of hexavalent chromium groundwater contamination associated with this site. The E.C. Electroplating Site is thought to be responsible, at least in part, for contamination of local groundwater with hexavalent chromium, in a part of Garfield designated the “Garfield Chromium Groundwater Contamination Area.” In the April 2010 Health Consultation, NJDHSS and ATSDR concluded that people could be exposed to harmful levels of hexavalent chromium by accidentally swallowing contaminated dusts in residences where groundwater infiltration had occurred.

Subsequently, in response to new data collected by the U.S. Environmental Protection Agency (USEPA), NJDHSS issued a Letter Health Consultation (NJDHSS 2010a) that concluded that hexavalent chromium levels in the dust of one property’s basement may pose an immediate and significant threat to human health, and that other nearby properties may pose a similar hazard over time. ATSDR then determined that exposures warranted the issuance of a Public Health Advisory to USEPA (ATSDR 2010b). The Advisory recommended that USEPA take short-term and long-term steps to prevent exposure and address the contaminated groundwater. The USEPA subsequently proposed adding the “Garfield Ground Water Contamination Site” to the National Priorities List on March 10, 2011, and added the site on September 16, 2011.

In the Public Health Action Plan of the April 2010 Health Consultation, NJDHSS and ATSDR committed to examine the incidence of cancer types potentially related to hexavalent chromium exposure in the Garfield Chromium Groundwater Contamination Area. This Health Consultation describes the methods used to examine cancer incidence and the results of these analyses.

Background and Statement of Issues

The E.C. Electroplating site is located in a mixed residential and commercial area of Garfield. In December 1983, approximately 3,640 gallons of chromium plating solution (chromic acid) containing about 5,400 pounds of chromium was discharged from a partially below ground storage tank, contaminating groundwater beneath the site. Wells were installed to monitor groundwater and partially recover some of the discharged product.

In June 1993, chromium-contaminated groundwater and crystals were discovered in the nearby Garfield Fire House #3, which was subsequently taken out of service. Groundwater sampling indicated maximum concentrations of hexavalent chromium as high as 1,490,000 micrograms per liter ($\mu\text{g/L}$) (NJDEP 2002). The groundwater results prompted additional investigation, revealing chromium-contaminated groundwater within the basement sumps of several residences and commercial properties in the immediate vicinity. The USEPA examined

chromium contamination in dusts and sump water of basements of residences with water-infiltration problems. These tests revealed that groundwater contaminated with high levels of hexavalent chromium had entered basements of some residences located above the contaminated groundwater, resulting in hexavalent chromium concentrations in dust wipe samples as high as 2,640,000 $\mu\text{g}/\text{m}^2$ (NJDHSS 2010a). Through evaporation, basement dusts can become enriched with chromium, resulting in the potential for people to become exposed to harmful levels of hexavalent chromium by accidentally swallowing or breathing in contaminated dusts where groundwater infiltration had occurred.

Hexavalent chromium is a known human carcinogen when breathed in, causing cancer of the lung (NTP 2005, ATSDR 2008). Exposure to hexavalent chromium may also result in the development of oral, stomach or small intestine cancers when swallowed. In 2008, the National Toxicology Program released a report of a carcinogenesis bioassay of oral exposure to hexavalent chromium in rodents, which showed an increased risk of oral cancer in rats and small intestine cancers in mice (NTP 2008). A study of a Chinese population exposed to hexavalent chromium in drinking water provided evidence of an increased risk of stomach cancer (Beaumont et al. 2008).

It is not known when the potential for exposure to hexavalent chromium in relation to the groundwater contamination began. The known discharge from the E.C. Electroplating spill occurred in December 1983, so some number of years would have elapsed for the contamination to travel from the source via groundwater to affected basements. In addition, cancers may take many years to develop following exposure. This “latency period” from exposure to clinical recognition of disease may range from a few years to decades, depending on the type of cancer, magnitude of exposure, and individual characteristics (Adami et al. 2002).

Methods

Survey Area and Population

The survey area for the evaluation of cancer incidence consisted of the entire population residing in census blocks approximately above the Garfield Chromium Groundwater Contamination Area. A map of the survey area is presented in Figure 1. Specifically, the survey area consisted of the following areas of Garfield as defined by the U.S. Census Bureau in the year 2000:

- Census Tract 215 (in part)
 - Block Group 6 (all)
 - Block Group 5 (in part)
 - Blocks 5000, 5001, 5002

- Census Tract 216 (in part)
 - Block Group 1 (all)
 - Block Group 2 (all)

Block Group 3 (in part)
Blocks 3003, 3004, 3005, 3006, 3007

Population counts for the area were determined from the 2000 and 2010 U.S. Census data using census tract, block group, and block information (U.S. Census Bureau 2011). For this analysis, population data for the year 2000 were used as sex- and age-specific populations over the period 1979 through 2000. The gender and age-specific population distributions by block group were compared using the 1990 and 2000 U.S. Census data to determine whether there were population shifts over the time period. The age-specific population distribution by gender was consistent across these two time periods. For years 2001 through 2008, age-specific populations were determined by linear interpolation between the 2000 and 2010 U.S. Census figures. For each sex, eighteen age-specific population groups were used in the analysis.

Cancer Case Ascertainment and Survey Period

The New Jersey State Cancer Registry (NJSCR) was used to determine cancer cases. The NJSCR 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 NJSCR, except for certain carcinomas of the skin. In addition, the NJSCR 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 NJSCR. The NJSCR has been in operation since October 1, 1978 and maintains complete years of cancer data in New Jersey beginning in 1979. At the time the analysis for this Health Consultation was conducted, incidence data were considered complete for all years from 1979 through 2008.

The survey period for the primary analysis of this investigation was January 1, 1993 through December 31, 2008. This 16-year analysis period begins 10 years after the spill occurred in December 1983. This lag time was chosen to allow a minimal time to elapse before potential exposure would have occurred, and in consideration of the latency between exposure and the incidence of cancer. The beginning date also coincides with the year when hexavalent chromium crystals were first reported from the Garfield Fire House #3. To help provide context for the interpretation of the primary analysis, cancer incidence in an earlier time period (1979 to 1992) was also completed.

A "case" was defined as an individual who was diagnosed with a new primary malignant cancer during the survey period while residing in the survey area, for any of the following cancer types:

- Lung and Bronchus (SEER Site Recode 22030)
- Oral Cavity and Pharynx (SEER Site Recode 20010-20100)
- Esophagus (SEER Site Recode 21010)
- Stomach (SEER Site Recode 21020)
- Small Intestine (SEER Site Recode 21030)

Cancers of the lung and bronchus, oral cavity and pharynx, stomach and small intestine cancers were chosen because of evidence provided by epidemiologic and animal studies; esophageal cancer was added because the esophagus is contiguous with the oral and stomach anatomic sites.

NJSCR cases identified only through search of death or autopsy records were excluded from this evaluation.

All cancer cases from the New Jersey State Cancer Registry identified as residents of Garfield at the time of diagnosis were reviewed to determine the specific geographic location of residence at within the Borough. Census block location was determined using NJSCR data fields and the U.S. Census Bureau website (American FactFinder).

Information on important individual cancer risk factors, such as genetics, personal behaviors (e.g., diet and smoking), or occupational history, is not available from the NJSCR.

Data Analysis

Analyses were completed for each of the selected cancer types for the survey area population for the following periods: the primary 16-year analysis period 1993-2008; and an earlier 14-year period 1979-1992. Incidence among males and females was evaluated separately since the background risks of these cancers may vary by sex.

Standardized incidence ratios (SIRs) were used for the quantitative analysis of cancer incidence in the study area (Kelsey et al. 1996; Breslow and Day 1987). The SIR is calculated by dividing the observed number of cases (from the NJSCR) by an expected number for the surveyed population over the survey time period. The expected number was derived by multiplying a comparison population's age-sex-specific cancer 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 1993-2007 and 1979-1992 for the respective analysis periods.

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 SIRs being higher or lower than 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 confidence interval includes 1.0, then the estimated SIR is not considered to be statistically significantly different than 1.0.

In this report, case counts less than 5 are not presented to protect confidentiality. However, SIR analyses were conducted and these relative risks are presented.

Results

Table 1 presents demographic information for the Garfield survey area. Based on the 2000 census data, a total of 3,444 people resided in the survey area (1,659 males and 1,785 females). Based on the 2010 census data, a total of 3,651 people resided in the survey area (1,685 males and 1,966 females). The survey population represented approximately 12% of the total Garfield population in 2000 and 2010.

In each of the time periods examined, lung and bronchus cancers were the most frequent of the cancers selected for analysis. There were no cases of small intestinal cancer in the survey area during any of the time periods. About three-quarters of the cancer cases were diagnosed at age 60 years or older, and more cases of the selected cancers occurred among males than in females.

Table 2 presents the standardized incidence ratio (SIR) results for the survey area by sex for the 1993 to 2008 primary analysis period, when there was a potential for exposure to have occurred. There were no statistically significantly elevated SIRs for the cancers analyzed in this time period. The observed number of cancer cases was close to the expected number for oral cavity and pharyngeal cancer in males and females, esophageal cancer in males and females, and stomach cancer in females. In males, the observed number of lung and bronchus cancer cases was slightly higher than the expected number (23 observed vs. 18.4 expected); among females, the incidence of lung and bronchus cancer was lower than expected (11 vs. 17.0). The observed number of stomach cancer cases in males was higher than the expected number (7 vs. 3.0); however the SIR was not statistically significantly elevated (SIR=2.4, 95% CI=0.9, 4.9).

Table 3 presents the SIR results for the survey area by sex for the earlier 1979 to 1992 period when exposures could not have or were unlikely to have occurred. These results showed a similar pattern to the later, primary analysis period (1993-2008), and there were no statistically significant findings. In males, the observed number of stomach cancer cases was approximately two times higher than expected but the difference was not statistically significant (SIR=2.2, 95% CI=0.9, 4.6, based on 7 observed cases). Lung and bronchus and oral cavity and pharynx cancers were higher than expected in males, but neither of these differences was statistically significant.

Discussion

The purpose of this investigation was to evaluate the incidence of selected cancer types in a population residing in the neighborhood approximately above the Garfield Chromium Groundwater Contamination Area, in Garfield, New Jersey. The selected cancers are of those anatomic sites that have been associated with increased cancer incidence in workers or experimental animals exposed to hexavalent chromium (lung and bronchus, oral cavity and pharynx, stomach and small intestine), plus a contiguous anatomic site (esophagus).

In the 16-year primary analysis period, 1993-2008, the incidences of cancer types potentially related to hexavalent chromium exposure were not statistically different from expected numbers of cases. The incidence of stomach cancer in males during the primary analysis period was about 2.4 higher than expected. However, the incidence of stomach cancer in males was also elevated to a similar degree in the earlier analysis period 1979-1992, when it was very unlikely that site-related exposure or the potential carcinogenic effects of that exposure could have occurred. The incidence of lung and bronchus cancer, the cancer type most strongly associated with exposure to hexavalent chromium (by inhalation), was slightly higher than expected among males and lower than expected among females.

NJDHSS and ATSDR conducted similar analyses of cancer incidence in Jersey City, another community where historic residential exposure to hexavalent chromium was a concern. The investigation found that lung cancer incidence was higher in populations living closer to chromium-contaminated sites than in other parts of Jersey City (ATSDR 2008b), but oral and stomach cancer incidence rates were not similarly elevated (ATSDR 2010c). Esophageal cancer incidence rates among males were higher in potentially exposed areas, but the rates did not seem to increase with increasing potential for exposure.

Cancer Risk Factors

Cancer is a group of more than 100 different diseases (i.e., cancer types and subtypes), each with its own set of risk factors. Consequently, any evaluation of potential risk factors and specific cancer types is complicated since most cancer types have more than one known cause or risk factor.

Lung cancer is the second most common cancer diagnosed in both males and females, and is the leading cause of cancer mortality for both sexes in New Jersey and the country (American Cancer Society 2010, NJDHSS 2010b). Recent trends indicate that incidence and mortality rates have been declining nationwide for males, but are rising or beginning to plateau for females. While hexavalent chromium is a known human lung carcinogen, there are many other causes of lung cancer in people, the most important being cigarette smoking, which accounts for an estimated 85% of all cases (NCI 2011a). Other known risk factors for lung cancer include indoor exposure to radon and environmental tobacco smoke, occupational exposure to asbestos and other cancer-causing agents in the workplace, and exposure to air pollution (NCI 2011a).

The most important risk factor for oral cavity and pharynx cancers is tobacco use, including tobacco smoking and chewing tobacco. Other risk factors are alcohol use, infection with human papillomavirus, and sunlight (lip cancer) (NCI 2011b). Other risk factors for oropharyngeal cancers include radiation, and occupational exposure to wood dust, nickel dust or asbestos. Risk factors for esophageal cancer include tobacco smoking, alcohol use, a diet low in fruits and vegetables, and acid reflux (NCI 2011c). Risk factors for stomach cancers include infection with the bacterium *Helicobacter pylori*, tobacco use, and a diet high in smoked, salted or pickled foods and low in fruits and vegetables (NCI 2011d).

Limitations

This investigation is a descriptive analysis of cancer incidence, and is not designed to reach cause-effect inferences. A limitation of cancer incidence investigations of this type is the inability to assess actual past exposure levels to individuals in the population. The ability to assess a cause-effect relationship is strengthened when the analysis 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 and timing of the exposure that did occur. Because personal exposure information does not exist, residence in an area above the contaminated groundwater area was used as a surrogate measure for potential past environmental exposure. It is very unlikely that all of the residents in the designated areas were exposed to hexavalent chromium from the groundwater contamination, since the pathway of exposure depends on a pattern of water infiltration, evaporation and dust enrichment, and frequent use of basement areas.

Another limitation is that cancers are chronic diseases that may take many years after exposure to be revealed as a clinical disease. The information supplied by the state 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 the address before diagnosis. It is possible that some cases were new, short-term residents with little or no exposure to the contamination. Furthermore, former residents who moved out of the investigation area before diagnosis are not available for analysis. Population mobility cannot be accounted for in this type of analysis. Therefore, some cases would be incorrectly associated with a potential exposure while some cases that should have been associated with a potential exposure would have been missed.

These limitations result in misclassifying some of the population as exposed when they are not, and vice versa. In general, the consequence of exposure misclassification would be to bias the results toward *not* finding an association, even if such an association truly existed (Kelsey et al 1996).

Given that the latency period of cancers may range from years to decades, it is possible that this analysis was conducted too recently following the beginning of exposure to have been able to detect an increase in cancer incidence.

Important information on potential risk factors (such as genetics, individual life style, or occupation) that might explain differences in cancer rates were not available for this analysis.

Conclusions

NJDHSS and ATSDR conclude the following based on the analyses presented in this Health Consultation.

In the 16-year primary analysis period, 1993-2008, the incidences of cancer types potentially related to hexavalent chromium exposure were not statistically different from the expected numbers of cases. The incidence of lung and bronchus cancer, the cancer type most strongly associated with exposure to hexavalent chromium (by inhalation), was slightly higher than expected among males and lower than expected among females, but neither difference was considered statistically significant. The incidence of stomach cancer was higher than expected among males and lower than expected among females, but neither difference was statistically significant.

Although the incidence of stomach cancer and lung cancer in males during the primary analysis period was elevated, incidence was also elevated in the years before site-related exposure or the effects of that exposure could have occurred.

Given that the latency period of cancers may range from years to decades, it is possible that this analysis was conducted too recently following the beginning of exposure to have been able to detect an increase in cancer incidence.

Public Health Action Plan

Because of the long latency period for development of cancers, the NJDHSS and ATSDR should consider continuing surveillance of chromium-related cancers in the population residing above the Garfield Chromium Groundwater Contamination Area.

The NJDHSS and ATSDR should continue to work with the USEPA and community representatives to determine the most appropriate health education materials and outreach strategies to inform the general population about health and environmental issues related to the chromium-contaminated groundwater.

References

Adami H-OH, David; Trichopoulos, Dimitrios, Editors 2002. Textbook of Cancer Epidemiology. New York: Oxford University Press.

[ATSDR] Agency for Toxic Substances and Disease Registry 2008a. Toxicological profile for chromium. Atlanta: U.S. Department of Health and Human Services, September 2008.

[ATSDR] Agency for Toxic Substances and Disease Registry 2008b. Analysis of Lung Cancer Incidence near Chromium-Contaminated Sites in Jersey City. ATSDR, U.S. Department of Health and Human Services, Atlanta GA, September 30, 2008.

[ATSDR] Agency for Toxic Substances and Disease Registry 2010a. Health Consultation: E.C. Electroplating (a/k/a Garfield Chromium Groundwater Contamination Site), Garfield, Bergen County, New Jersey. Atlanta: U.S. Department of Health and Human Services, April 26, 2010.

[ATSDR] Agency for Toxic Substances and Disease Registry 2010b. Public Health Advisory: E.C. Electroplating (a/k/a Garfield Chromium Groundwater Contamination Site), Garfield, Bergen County, New Jersey. Atlanta: U.S. Department of Health and Human Services, September 29, 2010.

[ATSDR] Agency for Toxic Substances and Disease Registry 2010c. Analysis of Oral, Esophageal and Stomach Cancer Incidence Near Chromium-Contaminated Sites in Jersey City. ATSDR, U.S. Department of Health and Human Services, Atlanta GA, December 1, 2010.

American Cancer Society, 2010. Cancer Facts and Figures 2010. Atlanta: American Cancer Society.

Breslow NE, Day NE 1987. Statistical methods in cancer research: Vol II. The design and analysis of cohort studies. IARC Scientific Publication No. 82. Lyon: International Agency for Research on Cancer.

Checkoway H, Pearce NE, Crawford-Brown DJ 1989. Research Methods in Occupational Epidemiology (Monographs in Epidemiology and Biostatistics, vol. 13). New York: Oxford University Press.

Kelsey JL, Whittemore AS, Evans AS, Thompson WD 1996. Methods in Observational Epidemiology, 2nd Ed., (Monographs in Epidemiology and Biostatistics, Vol. 26). New York: Oxford University Press.

[NCI] National Cancer Institute 2011a. What You Need to Know About Lung Cancer. Accessed on-line February 10, 2011 at: <http://www.cancer.gov/cancertopics/wyntk/lung>.

[NCI] National Cancer Institute 2011b. What You Need to Know About Oral Cancer. Accessed on-line February 10, 2011 at: <http://www.cancer.gov/cancertopics/wyntk/oral>.

[NCI] National Cancer Institute 2011c. What You Need to Know About Cancer of the Esophagus. Accessed on-line February 10, 2011 at: <http://www.cancer.gov/cancertopics/wyntk/esophagus>.

[NCI] National Cancer Institute 2011d. What You Need to Know About Stomach Cancer. Accessed on-line February 10, 2011 at: <http://www.cancer.gov/cancertopics/wyntk/stomach>.

[NJDEP] New Jersey Department of Environmental Protection 2002. E.C. Electroplating Site - site description and background summary via fax dated October 7, 2002.

[NJDHSS] New Jersey Department of Health and Senior Services 2010a. Letter Health Consultation: E.C. Electroplating (a/k/a Garfield Chromium Groundwater Contamination Site), Garfield, Bergen County, New Jersey. Atlanta: U.S. Department of Health and Human Services, September 28, 2010.

[NJDHSS] New Jersey Department of Health and Senior Services 2010b. Cancer incidence and mortality in New Jersey, 2003-2007. Trenton, NJ.

[NTP] National Toxicology Program 2005. Report on Carcinogens, 11th Edition. Research Triangle Park, N.C.: U.S. Department of Health and Human Services.

[NTP] National Toxicology Program 2008. NTP technical report on the toxicology and carcinogenesis studies of sodium dichromate dihydrate (CAS No. 7789-12-0) in F344/N rats and B6C3F1 mice (drinking water studies). Washington, DC: National Toxicology Program. NTP TR 546. August 13, 2008. Accessed online at: http://ntp.niehs.nih.gov/files/546_web_FINAL.pdf.

U.S. Census 2001. Census 2000 Summary File 1 New Jersey, prepared by the U.S. Census Bureau, 2001.

Report Preparation

This Health Consultation for the Garfield Ground Water Contamination Site was prepared by the New Jersey Department of Health and Senior Services under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with the approved agency methods, policies, procedures existing at the date of publication. Editorial review was completed by the cooperative agreement partner. ATSDR has reviewed this document and concurs with its findings based on the information presented. ATSDR's approval of this document has been captured in an electronic database, and the approving agency reviewers are listed below.

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Figure and Tables

Figure 1. Survey Area for Cancer Incidence Analysis in Garfield, New Jersey.

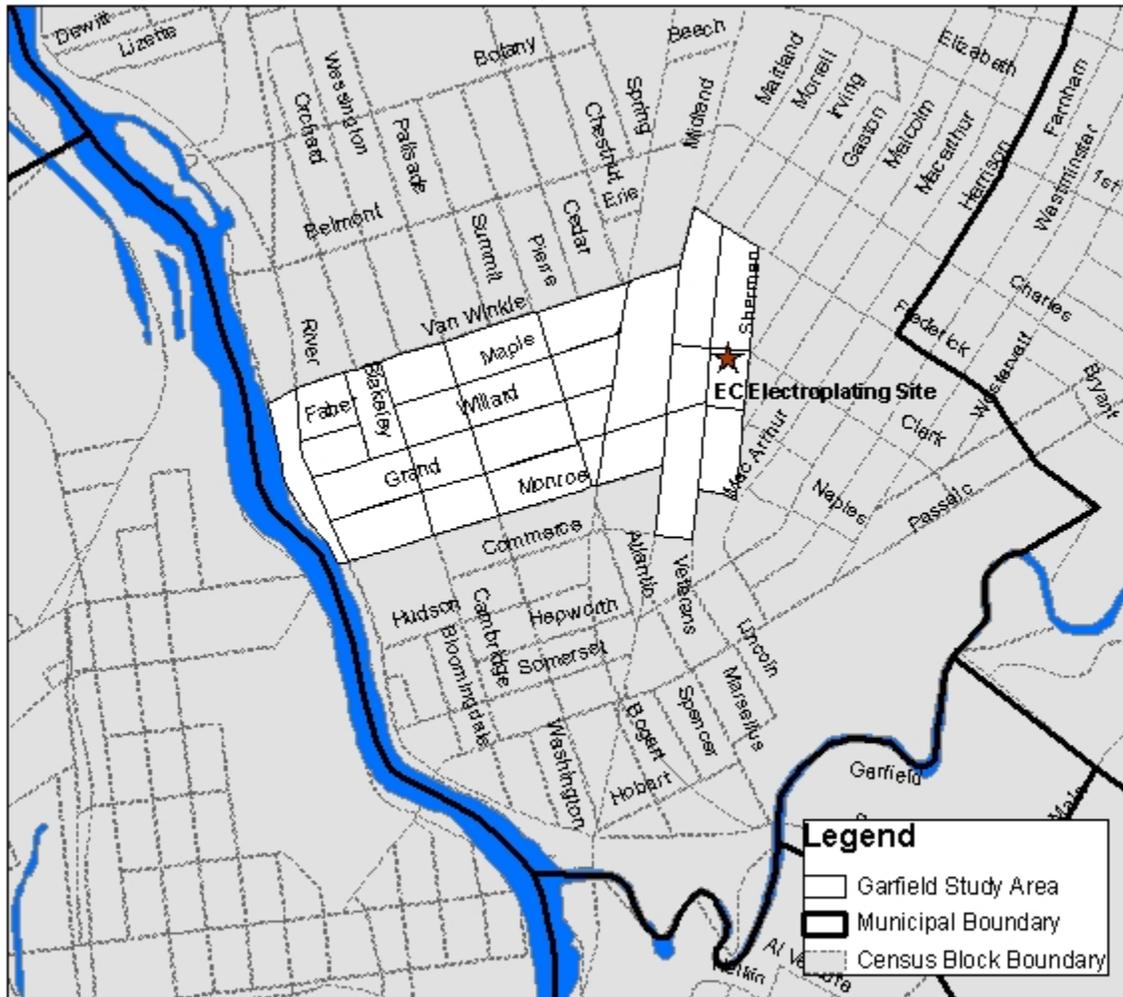


Table 1. Garfield Survey Area Population in the Years 2000 and 2010, based on census block group and block data from the U.S. Census Bureau.

Survey Area Population	Census Year 2000	Census Year 2010
Total	3,444	3,651
Sex		
Male	1,659	1,685
Female	1,785	1,966
Percent of Total Garfield Population	11.6 %	12.0%

Table 2. Garfield Survey Area, Standardized Incidence Ratio (SIR) Analysis by Cancer Type and Sex, 1993-2008.

Cancer Type	Sex	Observed	Expected	SIR	95 % Confidence Interval
Lung and Bronchus	Male	23	18.4	1.25	0.79, 1.87
	Female	11	17.0	0.65	0.32, 1.16
Oral Cavity and Pharynx	Male	<5	NR	0.9	0.2, 2.5
	Female	<5	NR	1.0	0.1, 3.8
Esophagus	Male	<5	NR	1.6	0.3, 4.6
	Female	0	0.8	--	--
Stomach	Male	7	3.0	2.4	0.9, 4.9
	Female	<5	NR	0.9	0.1, 3.4

Data are from the New Jersey State Cancer Registry, New Jersey Department of Health and Senior Services. Counts are suppressed when fewer than 5 cases to ensure confidentiality.

NR: Expected number is not reported (NR) when observed is suppressed, so that SIR may be shown.

Table 3. Garfield Survey Area, Standardized Incidence Ratio (SIR) Analysis by Cancer Type and Sex, 1979-1992.

Cancer Type	Sex	Observed	Expected	SIR	95 % Confidence Interval
Lung and Bronchus	Male	25	18.7	1.34	0.86, 1.97
	Female	8	11.6	0.69	0.30, 1.36
Oral Cavity and Pharynx	Male	6	3.5	1.7	0.6, 3.7
	Female	<5	NR	1.6	0.3, 4.7
Esophagus	Male	<5	NR	1.2	0.1, 4.5
	Female	<5	NR	1.4	0, 7.8
Stomach	Male	7	3.1	2.2	0.9, 4.6
	Female	<5	NR	0.8	0.1, 2.9

Data are from the New Jersey State Cancer Registry, New Jersey Department of Health and Senior Services. Counts are suppressed when fewer than 5 cases to ensure confidentiality.

NR: Expected number is not reported (NR) when observed is suppressed, so that SIR may be shown.