CANCER INCIDENCE
NEAR THE BROOKHAVEN LANDFILL

CENSUS TRACTS 1591.03, 1591.06, 1592.03, 1592.04 AND 1593.00
TOWN OF BROOKHAVEN, SUFFOLK COUNTY, NEW YORK, 1983-1992

WITH UPDATED INFORMATION ON CANCER INCIDENCE
THROUGH 1996

Prepared by the:

Cancer Surveillance Program
Bureau of Chronic Disease Epidemiology and Surveillance
New York State Department of Health

with the assistance of
New York State Cancer Registry staff
and
Community Exposure Research Section
Bureau of Environmental and Occupational Epidemiology

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SUMMARY OF METHODS AND FINDINGS

INVESTIGATION OF CANCER INCIDENCE AROUND THE BROOKHAVEN LANDFILL HAZARDOUS WASTE SITE
CENSUS TRACTS 1591.03, 1591.06, 1592.03, 1592.04 AND 1593.00

Investigation of newly diagnosed cancer cases in Census Tracts 1591.03, 1591.06, 1592.03, 1592.04 and 1593.00 in the Town of Brookhaven in Suffolk County, was undertaken for the years 1983-1992, and updated for 1993-1996. This investigation was prompted by citizen concern about the Brookhaven Landfill.

METHODS

• The expected numbers of newly diagnosed cancer cases, by sex and location in the body, were calculated based on the age and sex distribution of persons in the study area.
• The actual observed numbers of newly diagnosed cancer bases, by sex and location in the body, were counted from New York State Cancer Registry records.

FINDINGS (1983-1992)

Cancer Cases Among Males
• Overall, the actual number of newly diagnosed cancer cases was not significantly different from the number expected (325 cases observed; 326 cases expected).
• Among specific cancer sites, none exhibited a significant excess or deficit in numbers of cases observed compared with the numbers expected.

Cancer Cases Among Females
• Overall, the actual number of newly diagnosed cancer cases was not significantly different from the number expected (360 cases observed; 332 cases expected).
• Among specific cancer sites, none exhibited a significant excess or deficit in numbers of cases observed compared with the numbers expected.

Cancer Cases Among Children and Young Adults
• Overall, the actual number of newly diagnosed cancer cases among children (ages 0 to 14 years) and young adults (ages 15 to 24 years) was not significantly different from the number expected (10 cases observed; 16 cases expected).
• Among specific cancer sites, none exhibited excess or deficit in numbers of cases observed compared with the numbers expected.

UPDATE FINDINGS (1993-1996)

Cancer Cases Among Males
• Overall, the actual number of newly diagnosed cancer cases was not significantly different from the number expected (190 cases observed; 168 cases expected).
• Among specific cancer sites, bladder cancer and malignant melanoma of the skin exhibited significant excesses in the number of cases observed compared with the numbers expected. Additional review of male bladder cancers showed no obvious clustering near the landfill.

Cancer Cases Among Females
• Overall, the actual number of newly diagnosed cancer cases was not significantly different from the number expected (185 cases observed; 164 cases expected).
• Among specific cancer sites, uterine cancer exhibited a significant excess in the number of cases observed compared with the numbers expected. Additional review of female uterine cancers showed no obvious clustering near the landfill. Uterine cancer has no known environmental risk factors.

Cancer Cases Among Children and Young Adults
• Overall, the actual number of newly diagnosed cancer cases among children (ages 0 to 14 years) and young adults (ages 15 to 24 years) was not significantly different from the number expected (fewer than 6 cases observed; 6 cases expected).
• Among specific cancer sites, none exhibited excess or deficit in numbers of cases observed compared with the numbers expected.

COMBINED TIME PERIOD FINDINGS (1983-1996)
Cancer Cases Among Males
• Overall, the actual number of newly diagnosed cancer cases was not significantly different from the number expected (515 cases observed; 494 cases expected).
• Among specific cancer sites, none exhibited a significant excess or deficit in numbers of cases observed compared with the numbers expected.

Cancer Cases Among Females
• Overall, the actual number of newly diagnosed cancer cases was significantly greater than the number expected (545 cases observed; 496 cases expected).
• Among specific cancer sites, uterine cancer exhibited a significant excess in the number of cases observed compared with the numbers expected. Review of the uterine cancers that accounted for this elevation (uterine cancers diagnosed from 1993 to 1996), showed no obvious clustering near the landfill.

Cancer Cases Among Children and Young Adults
• Overall, the actual number of newly diagnosed cancer cases among children (ages 0 to 14 years) and young adults (ages 15 to 24 years) was not significantly different from the number expected.
• Among specific cancer sites, none exhibited excess or deficit in numbers of cases observed compared with the numbers expected.

For further information on the occurrence of cancer or for additional questions regarding this investigation, please contact Ms. Aura L. Weinstein, New York State Department of Health, Cancer Surveillance Program at (518) 474-2354.
Background

In August of 1994, the Bureau of Environmental and Occupational Epidemiology of the New York State Department of Health notified the Cancer Surveillance Program that residents living near Brookhaven Landfill in the Town of Brookhaven, Suffolk County NY, had expressed concerns about the possible adverse effects of the landfill on the health of residents in the surrounding community. Parents of children attending the Hampton Avenue School expressed particular concern. The school is located approximately one mile from the landfill. An investigation was therefore initiated to examine cancer occurrence among residents living in the area served by the school. This report presents the results of the investigation conducted by the Cancer Surveillance Program of the incidence of cancer among residents living in Census Tracts 1591.03, 1591.06, 1592.03, 1592.04 and 1593.00 in Suffolk County.

Methods

Study Area: The study area was defined as 1990 Census Tracts 1591.03, 1591.06, 1592.03, 1592.04 and 1593.00 in Suffolk County, which together approximate the area served by Hampton Avenue School as closely as possible (see attached map). Census tracts are the smallest area for which exact population counts by age and sex are readily available from the U.S. Census. The time period for the investigation of cancer incidence was selected as 1983 through 1992, the most recent period for which cancer reporting was considered complete for analysis within small geographic areas at the time this study was initiated.

Identification of Observed Incident Cancers: In order to proceed with this investigation it was necessary to identify all cases of cancer diagnosed among residents of the study area between 1983 and 1992. The source for these data was the New York State Cancer Registry. The Cancer Registry contains information on all cases of cancer reported to the New York State Department of Health, as mandated by law.

Variation in cancer incidence among different geographic areas reflects not only true differences in cancer incidence, but also the practices of diagnosing, treating, and recording cancers in various areas of the state. The completeness and accuracy of the Cancer Registry
depend upon reporting from hospitals. It is estimated that over 95% of all cancer cases are reported to the Registry (1)

The computerized Cancer Registry files are continuously updated to reflect multiple reports on the same cancer; to eliminate reports on metastatic cancers which have spread from a primary site; to identify true multiple primary cancers; and to determine correct dates of diagnosis. Cancer incidence data presented in this report represent cancer cases diagnosed from 1983 through 1992, with information updated as of October, 1996.

In order to identify all cancer cases within the study area, a listing of all cancer cases with zip codes serving the towns and villages comprising and extending beyond the study area was obtained from the Cancer Registry. Each street address was then examined individually to determine whether the individual lived within Census Tracts 1591.03, 1591.06, 1592.03, 1592.04 and 1593.00 at the time of diagnosis. All cases with a street address located within the study area were then grouped by sex and age. These are referred to as "observed" cases.

**Calculation of Expected Incident Cancers:** In order to determine whether the number of observed cases was unusual, it was necessary to calculate the number of cancer cases that would be expected in an area with the same population size, and age and sex composition as the study area. Since cancer incidence varies between urban and rural areas, this calculation also considered the degree of urbanization of the study area. This was accomplished using standard cancer rates based on urbanization categories to generate expected numbers of cancer cases.

All of the zip codes of New York State, exclusive of New York City, have been assigned to one of four urbanization categories based on data from the 1990 US Census. The four groups are 1) 100% rural areas, 2) areas with a mixture of urban and rural residents, 3) urbanized areas which are not part of a central city and 4) urbanized areas which are part of a central city. For this investigation, the study area was considered urban, noncity.

According to the 1990 United States Census, the total population of the study area was 19,681 persons, with 9,980 males and 9,701 females. Based on data from the 1980 and 1990 United States Censuses, the total population of the study area in 1985 was estimated at 19,044 persons, with 9,523 males and 9,522 females. Cancer incidence rates by age and sex for urbanized, noncity areas of New York State, exclusive of New York City, for the years 1983 through 1987 were used to calculate the expected numbers of cases for the years 1983 through 1987 based on the estimated 1985 population of the study area. Cancer incidence rates by age
and sex for urbanized, noncity areas for the years 1988 through 1992 were used to calculate
the expected numbers of cases for the years 1988 through 1992 based on the 1990 population
of the study area. Expected numbers of cases in the two time periods were then summed to
obtain total numbers of cancer cases expected for the period 1983 through 1992. This
procedure allowed the calculation of expected numbers of cancer cases after adjustment for
differences in sex, age, and degree of urbanization among residents of the study area and for
changes with time in the standard cancer rates.

Sixteen of the most common cancer sites were examined among males, including lung,
colon, rectum, prostate, and bladder, and lymphomas and leukemias. Eighteen of the most
common sites were examined among females. In addition to the aforementioned sites (except
prostate), cancers of the breast and female reproductive organs were also included for females.

Statistical Testing: The Poisson model was used to determine the probability that chance alone
could explain an increase or decrease in the observed number of cancer cases compared to the
expected number (2). If the probability of observing an excess or deficit was 0.025 or less for
any cancer site, the result was considered to be statistically significant. Non-significant
excesses or deficits were considered to represent random variations in observed patterns of
disease.

Results

A total of 685 cancers were observed among males and females residing in the study
area during the 1983-1992 study period. Among males, 325 cancer cases were observed and
326 cases were expected, while among females 360 cancer cases were observed and 332
cases were expected for all anatomic sites combined. The difference between the number of
observed cases and the number expected was not statistically significant for either sex. These
results are summarized in Table 1.

Common cancer sites among males included lung, 66 cases observed (60 cases
expected); prostate, with 62 cases observed (58 cases expected) and colon, 31 cases observed
(33 cases expected). Fewer than six cases were observed for cancers of the liver, testis and
thyroid gland. (For cancer sites with fewer than six observed cases, the specific numbers of
observed cases have not been indicated in order to protect patient confidentiality.)

Common cancer sites among females included breast, with 105 cases observed (103
cases expected); lung, 46 cases observed (38 cases expected); and colon, 41 cases observed (32 cases expected). Fewer than six cases were observed for cancers of the liver and brain.

No specific anatomic cancer site among males or females was found to demonstrate a significant difference in observed numbers of cases from the numbers expected.

Among children (ages 0 to 14 years old) and young adults (ages 15 to 25 years old), there were 10 cases of cancer observed and 16 cases expected among males and females combined. No statistically significant differences were found for any specific anatomic sites of cancer among children and young adults.

Discussion

Significant findings: The present study did not find a statistically significant difference in numbers of cases of cancer among males or females for all sites of cancer or for any specific anatomic site of cancer.

Because parents had expressed concern about the children attending the Hampton Avenue School, the number of cancers among children (ages 0 to 14 years) and young adults (ages 15 to 24) was also examined. There was a slight deficit of cancer cases in both these age groups, and the total number of cases observed was small (10 cases in both age groups combined). The majority of cancers were those types which would be expected to occur in these age groups, including leukemia, lymphoma and brain cancer. There were also a few cases of less common types of cancer that are not known to be associated with each other. No statistically significant excesses were observed.

Additional information about the Brookhaven Landfill may be found in a Health Consultation prepared by the New York State Department of Health and the Agency for Toxic Substances and Disease Registry, released in 1996 for public comment (3). The Brookhaven Landfill Final Health Consultation, which evaluates the public health implications of the landfill in response to community concerns, is expected to be released in the summer of 2005 (4).

Study limitations: In drawing conclusions from these data, several aspects of the methodology need to be addressed. First, since there were 36 individual tests of significance, (16 among
males, 18 among females and 1 each among males and females overall), it was anticipated that one or two results might appear statistically significant even though the differences between observed and expected events were due entirely to random fluctuations in the data.

The second aspect is the power of the statistical test, that is, the probability that a true departure from the expected number can be detected by significance testing. The power of a significance test varies with the number of expected cases. For example, using the statistical test described above, the probability of detecting a true doubling in cancer incidence over the expected value will be 90 percent or higher when the expected number is at least 16. For this investigation, the power of detecting a doubling, if one were present, was high for the total number of cancer cases for each sex and for several of the most common cancer sites.

An additional limitation is the fact that cancer cases were identified among persons who both resided in the study area and were diagnosed with cancer during the period 1983-1992. Migration into and out of the study area could not be taken into account. As a secondary data source, U.S. Census information for 1990 was used to review patterns of migration in the study area, as well as in all of Suffolk County, based on residents' place of residence five years earlier. In the study area, about 67% of residents over the age of 5 had reported residing in the same house for at least five years. This compares to 67% of Suffolk County residents over the age of 5 who have resided in the same house for at least five years. This indicates that a sizable proportion of residents may have been recent arrivals in the community, indicating that migration may still be somewhat of an issue for this area.

General cancer information: Cancer may result from either genetic or environmental influences or an interaction of both genetics and environment (e.g. diet, social habits, occupation, air, water). Furthermore, it appears that for some cancers, the development of disease may depend upon two kinds of exposures. First, a cancer initiating agent must transform a previously normal cell into a cancerous cell. Subsequently, a cancer promoting agent must be present, allowing uncontrolled growth of this cell. For many cancers, it has been observed that exposures to cancer-causing agents only affect cancer incidence following a relatively long latency period. (In cancer, latency refers to the time between the initiation of the disease process and the onset of clinically recognizable symptoms.) Cancer-causing agents believed to act as initiators often exhibit latencies on the order of at least 10 and sometimes 20 or 30 years. Latency may be shorter, however, if the agent were to act as a cancer promoter.

Cancer, unfortunately, is a common disease. One of every three persons will develop cancer during his/her lifetime, and it eventually affects three of every four families (5). The
number of people with cancer is increasing in most communities because more people are living to the older ages, where cancer is more common.

Much more research is necessary before the causes of cancer are well understood. Current knowledge, however, suggests that the leading preventable cause of cancer is cigarette smoking. Dietary practices such as excessive alcohol consumption and the eating of high fat foods are also believed to be important. In fact, tobacco and diet may account for as many as two-thirds of all cancer deaths (6). Other avoidable risk factors include excessive exposure to sunlight, ionizing radiation, and various occupational exposures to cancer-causing agents.

It is important to realize that many cancers can be effectively treated if they are diagnosed at an early stage. Screening for cancers of the breast, cervix, rectum, colon, and prostate, for example, helps to identify these diseases before the onset of symptoms and at a time when they are usually the most curable. Many persons could reduce their chances of developing or dying from cancer by adopting a healthier lifestyle and by visiting their physician for a cancer-related checkup.
References


**Table 1**

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<td>Expected</td>
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^a Classification of site based on International Classification of Diseases, 9th revision.
^b Data obtained from the NYS Cancer Registry (database as of October 1996).
^c Expected numbers based on cancer incidence rates by age and sex for New York State, exclusive of New York City.
Rates for 1983-1988 for urban non city areas were applied to the estimated 1985 population of the study area.
Rates for 1988-1992 for urban non city areas were applied to the 1990 population of the study area. Individual sites may not sum due to rounding.
^d Number of cases not shown to protect patient confidentiality. The number of observed cases is added to the "All other sites-observed" cell.
^e Includes cases not shown above.
Brookhaven Landfill Study Area
Census Tracts 1591.03, 1591.06, 1592.03, 1592.04, and 1593.00
Town of Brookhaven, Suffolk County, New York
APPENDIX


Prior to the final release of this report, calculations of observed and expected numbers of cancer cases in the area surrounding the Brookhaven Landfill were updated through the year 1996. Methods used were essentially the same as those used in the original calculations, with the exception that the standard rates used to compute the expected numbers of cases were based on rates for all of New York State exclusive of New York City, rather than those for urbanized areas outside of central cities.

Results for the later time period 1993-1996 are presented in Appendix Table 1. As can be seen from this table, the total number of cancer cases observed among males and females was not significantly different from the number expected. Among specific cancer sites, bladder cancer and malignant melanoma of the skin* in males and uterine cancer in females exhibited significant excesses in the numbers of cases observed compared with the numbers expected. No other individual cancer site among males or females showed a statistically significant difference from the expected number of cases.

Among the men identified as having bladder cancer, half were either current or former smokers. More than one-third of the male bladder cancer cases were age 75 or older at the time of diagnosis. While the incidence investigation showed a statistically significant elevation in uterine cancer, there was not an unusual pattern in terms of age. The incidence of uterine cancer is known to rise sharply between the ages of 45 and 65 and the uterine cancers seen in our investigation were generally among women aged 45 years and older. Locations of the residences of men diagnosed with bladder cancer and women diagnosed with uterine cancer were plotted on a map of the area. There was no obvious clustering of these residences around the Brookhaven Landfill.

Cancer cases among children (ages 0-14) and young adults (ages 15-24) were also examined separately in this time period. Fewer than six total cases were observed among all persons in both age groups combined. The number of cases observed was not significantly different from the number expected in any single age group among either males or females, or in all ages and both sexes combined. Approximately six cases of cancer were expected in all persons under the age of 25.
Results for the combined time period (1983-1996) are presented in Appendix Table 2. The overall number of cancer cases observed among males was not significantly different from the number expected. No specific cancer site among males exhibited a statistically significant excess or deficit in number of cases observed compared with number of cases expected. A statistically significant excess in total cancers was found among females. The excess in total number of female cancer cases is accounted for by a statistically significant excess in uterine cancer, as well as nonsignificant excesses in cancers of the lung and breast.

In both the later time period (1993-1996) and in the combined time period (1983-1996), the uterine cancers were generally diagnosed among women 45 years of age and older, as would be expected. Uterine cancer has no known environmental risk factors. All known risk factors for uterine cancer are related to individual characteristics and lifestyle choices, including never having given birth or having few children, late age at menopause, obesity, use of hormone replacement therapy without progesterone during and after menopause, and possibly dietary factors.

Cancer cases among children (ages 0-14) and young adults (ages 15-24) were also examined separately for the combined time period. The number of cases observed was not significantly different from the number expected in any single age group among either males or females, or in all ages and both sexes combined. Approximately 22 cases of cancer were expected in all persons under the age of 25.

This cancer incidence study and the updates provided in this Appendix were conducted in response to concerns about potential exposures related to living near Brookhaven Landfill in the Town of Brookhaven, Suffolk County. The Brookhaven Landfill Final Health Consultation, which evaluates the public health implications of the landfill in response to community concerns, is expected to be released in the summer of 2005.

*It should be noted that in recent years, statistics on the incidence of malignant melanoma from many state cancer registries, including New York’s, are believed to be unreliable due to the increasing tendency to treat certain of these patients on an outpatient basis. This would cause an underestimation in the number of melanoma cases expected. If a community happened to have a cancer reporting source, however, that was very diligent in reporting all its cases, this could lead to an apparent excess in observed numbers of cases.
### Table 1

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a Classification of site based on International Classification of Diseases, ninth revision.
b Data obtained from the New York State Cancer Registry (database as of July 1999).
c Expected numbers based on cancer incidence rates by age and sex for New York State, exclusive of New York City. Rates for 1993-1996 were applied to the 1990 and 2000 U.S. Census populations of the study area (average 10,300 males and 10,195 females). Individual sites may not sum to total due to rounding.
d Number of cases not shown to protect patient confidentiality. The number of observed cases is added to the "Other sites-observed" cell.
e Includes cases not shown above.

*Designates a statistically significant difference at the p=0.05 level.
### Table 2

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<td>30</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Ovary (183)</td>
<td>-</td>
<td>-</td>
<td>25</td>
<td>22</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Prostate (185)</td>
<td>112</td>
<td>102</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Bladder (188)</td>
<td>36</td>
<td>35</td>
<td>13</td>
<td>12</td>
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<tr>
<td>Lymphoma (200-202) and Leukemia (204-208)</td>
<td>37</td>
<td>42</td>
<td>35</td>
<td>34</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other(^e)</td>
<td>132</td>
<td>131</td>
<td>143</td>
<td>138</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^a\)Classification of site based on International Classification of Diseases, ninth revision.


\(^c\)Expected numbers based on cancer incidence rates by age and sex for New York State, exclusive of New York City. Rates for 1983-1988 for urban non city areas were applied to the estimated 1985 population of the study area. Rates for 1988-1992 for urban non city areas were applied to the 1990 population of the study area. Rates for 1993-1996 for New York State exclusive of New York City were applied to the 1990 and 2000 populations of the study area. Individual sites may not sum to total due to rounding.

\(^d\)Number of cases not shown to protect patient confidentiality. The number of observed cases is added to the "Other sites-observed" cell.

\(^e\)Includes cases not shown above.

\(^*\)Designates a statistically significant difference at the p=0.05 level.