
**INVESTIGATION OF CANCER INCIDENCE
IN THE AREA SURROUNDING THE NIAGARA FALLS STORAGE SITE AND
THE FORMER LAKE ONTARIO ORDNANCE WORKS,
TOWNS OF LEWISTON AND PORTER,
NIAGARA COUNTY, NEW YORK, 1991-2000**

Prepared by the:

Cancer Surveillance Program
Bureau of Chronic Disease Epidemiology and Surveillance
Center for Community Health

with the assistance of
New York State Cancer Registry staff

and the

Center for Environmental Health
New York State Department of Health

For further information contact:
Aura L. Weinstein, M.P.H.
Director, Cancer Surveillance Program
(518) 474-2354

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Background

In January 2002, the Cancer Surveillance Program of the Bureau of Chronic Disease Epidemiology and Surveillance, New York State Department of Health, received a request from Congressman John LaFalce to conduct a cancer incidence investigation. Of interest was the area around the Niagara Falls Storage Site (NFSS), which is located within the developed portion of the former Lake Ontario Ordnance Works (LOOW) in the Towns of Lewiston and Porter, Niagara County. A short time later, in February 2002, a similar request was received from Dr. Walter Polka, superintendent of the Lewiston-Porter Central School District, for a study of current and former district students. The Lewiston-Porter Central School District campus is located on the undeveloped portion of the former LOOW, near the NFSS.

The LOOW and the NFSS The LOOW was created in 1942 when the U.S. War Department acquired approximately 7500 acres of land in the Towns of Lewiston and Porter, Niagara County, for an explosives manufacturing facility. Approximately 2500 acres were developed for use in munitions production, while the remaining 5000 acres remained undeveloped (see Map 1). Munitions production ended in 1943, and the undeveloped portion was released for sale in 1945. The undeveloped portion of the LOOW remains largely vacant, with more recent residential development occurring along its outer boundaries. The Lewiston Porter Central School District campus is located on the western edge of the undeveloped portion. The first school was built on this campus in 1952. After the war, some sections of the developed portion of the former LOOW were sold to private companies and municipal concerns, including municipal and hazardous waste landfills. The remainder is still owned by agencies of the federal government.

The NFSS is an approximately 191-acre parcel of land owned by the U.S. Department of Energy and located within the developed portion of the former LOOW. Starting in 1944, radioactive residues and wastes from uranium ore processing for the Manhattan Engineer District (Manhattan Project) and from other sources were brought to the LOOW. These wastes were later consolidated within the NFSS and are now stored in a 10-acre waste containment structure.

Environmental Investigations at the Sites Over the last several decades, government agencies have prepared reports documenting environmental contamination at the site. When viewed in their entirety, these reports present a general understanding of environmental conditions in the area. As the agency responsible for the chemical and radiological contamination resulting from federal activities at the site, the US Army Corps of Engineers (USACE) maintains the official administrative record, including detailed information on the history of the site and remediation efforts. The administrative record can be found

at several public libraries in the area. Documents that may be particularly useful in tracing the history of contamination and remediation efforts at the site are:

Aerial Radiological Survey of the Lake Ontario Ordinance Works and Vicinity in June 1972, EGG-1183-1554

Radiation Survey and Decontamination of the Lake Ontario Ordinance Works Site, USAEC ORO 1972

Background and Resurvey Recommendations for the Atomic Energy Commission Portion of the Lake Ontario Ordinance Works, November 1982, ATR-82(7963-04)-1

Certification Docket for the Remedial Action Performed at the Niagara Falls Storage Site Vicinity Properties in Lewiston New York from June 1983 through 1986, DOE ORO July 1992

Safety of the High-Level Uranium Ore Residues at the Niagara Falls Storage Site, National Research Council 1995

The Lewiston Porter Central School District campus has been the subject of numerous environmental investigations conducted by both government and private parties. In December 2001 the USACE and NYSDEC performed a background gamma radiation study at the Lewiston-Porter School in Youngstown. The purpose of the study was to help determine natural background radiation levels in the area. The results showed radiation levels to be consistent with background levels found in nature.

In 2005 the Niagara County Health Department began a project to assist in developing a comprehensive understanding of the LOOW site. The "Community LOOW Project" is a two-year project initiated to address a complex history of LOOW by consolidating relevant data from the entire LOOW site for all chemical and radiological investigations in combination with geological evaluations into a Geographic Information System (GIS) application available to the public. A comprehensive description of the project can be found at <http://niagaracounty.com/Health/loow.asp> and the GIS product can be found at <http://www.communityloowproject.com/>.

The reports described above have identified past practices and activities involving the production, use, handling, storage, and management of chemical and radiological compounds that occurred within the original limits of the LOOW area. The reports conclude that in general, chemical and radiological contamination is found in areas on properties controlled by either private companies or government agencies that restrict and control access to these properties.

Initiation of the Cancer Study Following receipt of the requests, input on the design of the cancer study was sought from local residents and other interested parties. During this process, people expressed concern over possible health effects resulting from current and past operations at the LOOW site as a whole as well as the NFSS. Based on this input, a final study plan was developed that includes three study areas. These study areas were chosen on the basis of the possibility of exposures to any site-

related contaminants by different pathways, independently of any knowledge of the presence of any actual contamination or contamination-related exposures. The first study area corresponds closely with the Lewiston-Porter school district. The second study area includes the entire developed and undeveloped portions of the LOOW and areas to the north, which are downstream. The third study area is to the northwest of the sites, in the direction of the prevailing winds. This area (Ransomville) was studied previously for a 5-year period in a ZIP-screening study, findings of which were released in October 2003. The present report describes the findings of the Cancer Surveillance Program's investigation of cancer incidence for the three areas defined in relation to the NFSS and the former LOOW.

Methods

Study Plan This investigation was designed to determine whether the number of cancers arising among people residing in any of the three study areas was unusual. To do this, the number of cancers actually diagnosed among all residents in each of the study areas was compared with the number of cancers one would expect to find, if cancer rates in the study areas were the same as in the state as a whole (exclusive of New York City). Due to the proximity of the school campus to the LOOW and NFSS sites, childhood cancers were also looked at separately for each study area.

Study Areas and Time Period The first study area consisted of Census Tracts 244.01, 244.04, 244.05, 245.01 and 245.02 ("study area #1", see Map 1) which closely corresponds to the Lewiston-Porter school district. The second study area consisted of ZIP Codes 14174 (Youngstown) and 14131 (Ransomville) ("study area #2", see Map 2). The third study area consisted of ZIP Code 14131 alone ("study area #3", see Map 3). The time period for the investigation of cancer incidence was 1991 through 2000, the most recent 10-year period for which cancer reporting was considered complete for analysis within small geographic areas at the time work on the study was initiated.

Identification of Observed Incident Cancers To proceed with the investigation, it was necessary to identify all cases of cancer diagnosed among people residing in each of the study areas during the time period of the study. 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. The computerized Cancer Registry files are continuously updated to reflect information gained from multiple reports on the same cancer. Cancer incidence data presented in this report represent cancer cases diagnosed from 1991 through 2000, with information on these cases updated as of December 2003.

Variation in cancer incidence among different geographic areas reflects not only true differences in cancer incidence, but also differences in how cancer is diagnosed, treated, and recorded in different areas of the state. The completeness and accuracy of the Cancer Registry depend upon reporting from hospitals. The Cancer Registry has been certified as more than 95% complete by the North American Association of Central Cancer Registries (1).

To identify all cancer cases within the three study areas, a listing of all cancer cases diagnosed in any of the ZIP Codes serving the study areas was obtained from the Cancer Registry. For study area #1, each street address was then examined individually to determine whether that person lived in any of the census tracts of the study area at the time of diagnosis. For study areas #2 and #3, people with cancer were identified directly from Cancer Registry listings, which include the ZIP Code of residence at the time of diagnosis for all cases. As can be seen from the maps, the three study areas overlap to some extent, meaning, for example, that a person living in study area #1 could also be in study area #2 and possibly in study area #3. All cases with an address located within the study areas were then grouped by age, sex and type of cancer. These are referred to as "observed" cases.

Calculation of Expected Incident Cancers To determine whether the number of observed cases was unusual, it was necessary to calculate the numbers of cancer cases that would be expected in each of the study areas. This calculation takes into account the population size and the age and sex distribution of each area. The expected numbers of cancer cases were calculated by applying cancer incidence rates by age and sex for a reference area to the estimated populations of each of the study areas by age and sex. The reference area selected for this investigation was New York State, exclusive of New York City. The populations of the study areas by age and sex for each individual year between 1991 and 2000 were estimated using information from the 1990 and 2000 United States Censuses.

Types of Cancer (Anatomic Sites) Studied Seventeen of the most common types of cancer were examined among males, including lung, colorectal, prostate, and bladder cancers, and lymphomas and leukemias. Nineteen of the most common types were examined among females. In addition to the cancers examined for males (except prostate), cancers of the breast and female reproductive organs were examined for females. The examination of cancers among males and females included all persons, children and adults.

Twelve groups of cancers were examined among all children age 19 and under. Cancer groups were based on the International Classification of Childhood Cancer (ICCC), which is based on tumor cell type rather than location in the body. Groups of cancers examined include leukemias, lymphomas, brain and central nervous system tumors, neuroblastomas and other sympathetic nervous system tumors, retinoblastoma, kidney tumors including Wilms tumor, liver tumors, malignant bone tumors, soft-tissue sarcomas, gonadal and germ-cell tumors, carcinomas including malignant melanoma of the skin and thyroid cancers, and other malignant tumors.

Statistical Testing The probability that chance alone could explain an increase or decrease in the observed number of cancer cases compared to the expected number was evaluated based on the Poisson distribution (2). (In statistics, the Poisson distribution describes a process where a rare event occurs in a large population.) 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.

Interview Studies To follow up on selected findings of the cancer incidence study described above, two interview studies were conducted. The childhood interview study included all people who lived in any

of the study areas and were diagnosed with any type of cancer between the ages of 0 and 19 years. The male interview study included males of all ages living in study area # 1 who had been diagnosed with testicular cancer. These studies were intended to determine whether there were any similarities among the people diagnosed with these specific cancers, and to learn more about their medical and family histories, occupations and places of residence, and about the schools they attended.

Before attempting to contact any of the people identified, medical records were obtained from all hospitals that reported them to the Cancer Registry. Information from the medical records and the continually updated Cancer Registry listings was then consulted to determine whether any of the patients were deceased. For those not found to be deceased, physicians listed in the medical record were contacted to determine if they had any concerns with our contacting these patients. If the physicians did not express any objections to the interview, people who were age 18 or older at the time of the interview were contacted directly by letter and asked to participate. For children under 18 (for whom physicians did not express any concerns about being interviewed) and for patients known to be deceased, a letter was sent to the parents or next-of-kin, asking them to participate on behalf of the patient. Additionally, in the childhood interview study, individuals age 18 or over at the time of the interview were asked for permission to contact a parent to invite them to participate to provide information about the patient's early life and possible prenatal exposures. Letters were followed up by a telephone call during which an attempt was made to schedule an interview. If we were unable to obtain a telephone number or unable to reach a prospective participant by telephone after multiple attempts, a follow up letter was sent asking them to contact our office to set up a time to do the interview.

Interviews were conducted by telephone by a trained interviewer using a questionnaire developed for each study. Questions were asked regarding the patient's family medical history, personal medical history and the medical history of the patient's mother while she was pregnant with the patient, as well as about the schools the patient attended, his or her occupational history and his or her residence history from the time of conception to the time of cancer diagnosis. Questions were also included on specific exposures that have been associated with either the childhood cancers in question for the childhood cancer study, or with testicular cancer for the male interview study.

Results

Study Area #1 A total of 1292 cancers (702 males/590 females) were identified among all males and females residing in study area #1 between 1991 and 2000. For all anatomical sites combined, the total of 702 cases of cancer observed in males was statistically significantly greater than the 614 cases expected. Among females, the total of 590 cancer cases observed was not statistically significantly different from the total of 565 cases expected.

Table 1 shows results for the types of cancer examined for this study area. The most common types of cancer observed among males included prostate, with 238 cases observed (177 cases expected); lung, with 100 cases observed (104 cases expected); and colorectal, with 78 cases observed (76 cases expected). Fewer than six cases were observed for cancers of the liver/intrahepatic bile duct, thyroid and for multiple myeloma. (To protect patient confidentiality, for cancers with fewer than six

observed cases, the specific numbers of observed cases have not been indicated.) Among all cancers examined, a statistically significant excess was found in the numbers of males with prostate cancer and with testicular cancer. No other individual cancer among males showed a statistically significant excess.

The most common types of cancer observed among females included breast, with 193 cases observed (162 cases expected); colorectal, with 77 cases observed (73 cases expected); and lung, with 72 cases observed (78 cases expected). Fewer than six cases were observed for cancers of the esophagus, liver/intrahepatic bile duct, and larynx. Among all cancers examined, a statistically significant excess was found in the number of females with cancer of the breast and with cancer of the urinary bladder. No other individual cancer among females showed a statistically significant excess.

Interviews were conducted in an attempt to obtain more information on the males diagnosed with testicular cancer. Of the 12 males in study area #1 identified as having been diagnosed with cancer of the testis, interviews were completed with only three. All of these men were under the age of 40 at the time of their diagnosis, and all interviews were completed with the patient himself. For the remainder, we were unable to obtain the name of the attending physician to request permission to interview the patient for one, two individuals declined participation, and the rest did not respond to any of our telephone or mail contacts.

For those men who were interviewed, all were residents of Niagara County for 20 or more years prior to their diagnosis, and residents of the Lewiston-Porter area for over 10. Prenatal exposures were unknown. A small number reported having had testicular trauma or a vasectomy, and some reported a family history of various cancers among first and second degree relatives. Not all of the men interviewed had attended Lewiston Porter Schools. Occupations noted for these individuals from age 16 to the time of diagnosis included blue-collar, white-collar and service occupations. None had worked at the former LOOW prior to their diagnosis. Various occupational and residential exposures were noted, including exposures to pesticides, fertilizers, other chemicals and metals. All of the men interviewed reported drinking public water while living in the Lewiston-Porter area.

Study Area #2 A total of 611 cancers (334 males/277 females) were identified among all males and females residing in study area #2 between 1991 and 2000. For all anatomical sites combined, the total of 334 cases of cancer observed in males was not statistically significantly different from the 311 cases expected. Among females, the total of 277 cancer cases observed was not statistically significantly different from the total of 270 cases expected.

Table 2 shows results for the types of cancer examined for this study area. Certain cancers with small numbers of observed cases are combined with related cancers or not shown in the table, but statistical testing was done separately. The most common types of cancer observed among males included prostate, with 110 cases observed (88 cases expected); lung, with 55 cases observed (52 cases expected); and colorectal, with 48 cases observed (38 cases expected). Fewer than six cases were observed for several types of cancer including cancers of the stomach, liver/intrahepatic bile duct, pancreas, larynx, kidney and renal pelvis, brain and other parts of the nervous system, thyroid, and for multiple myeloma. Among all cancers examined, a statistically significant excess was found in the

number of males with prostate cancer. No other individual cancer among males showed a statistically significant excess.

The most common types of cancer observed among females included breast, with 79 cases observed (80 cases expected); colorectal, with 38 cases observed (32 cases expected); and lung, with 37 cases observed (37 cases expected). Fewer than six cases were observed for several other types of cancer, including cancers of the oral cavity and pharynx, esophagus, stomach, liver/intrahepatic bile duct, larynx, cervix uteri, kidney and renal pelvis, brain and other parts of the nervous system, and for multiple myeloma. No individual cancer among females showed a statistically significant excess.

Study Area #3 A total of 278 cancers (160 males/118 females) were identified among all males and females residing in study area #3 between 1991 and 2000. For all anatomical sites combined, the total of 160 cases of cancer observed in males was not statistically significantly different from the 155 cases expected. Among females, the total of 118 cancer cases observed was not statistically significantly different from the total of 135 cases expected.

Table 3 shows results for the types of cancer examined for this study area. The most common types of cancer observed among males included prostate, with 51 cases observed (43 cases expected); lung, with 32 cases observed (26 cases expected); and colorectal, with 21 cases observed (19 cases expected). There were no cases of cancer observed for cancers of the larynx and for multiple myeloma. Fewer than six cases were observed for several types of cancer, including cancers of the oral cavity and pharynx, esophagus, stomach, liver/intrahepatic bile duct, pancreas, testis, kidney and renal pelvis, brain and other parts of the nervous system, thyroid, lymphomas, and for leukemia. No individual cancer among males showed a statistically significant excess. A statistically significant deficit (lower than expected number of cases) was found in the number of males with lymphoma.

The most common types of cancer observed among females included breast, with 31 cases observed (40 cases expected); lung, with 18 cases observed (18 cases expected); and colorectal, with 15 cases observed (16 cases expected). There were no cases observed for cancer of the stomach and cancer of the kidney and renal pelvis. Fewer than six cases were observed for several other types of cancer, including cancers of the oral cavity and pharynx, esophagus, liver/intrahepatic bile duct, pancreas, larynx, cervix uteri, ovary, urinary bladder, brain and other parts of the nervous system, and thyroid, and for lymphomas, multiple myeloma and leukemias. No individual cancer among females showed a statistically significant excess or deficit.

Childhood Cancers A total of 15 cases of cancer were diagnosed among children residing in study area #1. This number was statistically significantly greater than the eight cases of cancer expected. A majority of the children diagnosed were males. When individual types of cancer were examined, a statistically significant excess was found in the number of children diagnosed with cancers in the group germ cell, trophoblastic and other gonadal neoplasms. There were fewer than six children diagnosed with cancers in this group, while less than one (0.57) was expected (the exact number of observed cases of any single type of cancer cannot be disclosed for reasons of confidentiality). This group includes all cancers of the testis and ovary (with the exception of lymphomas), and cancers of germ cells

(cells eventually giving rise to sperm and eggs) in other parts of the body. The specific cancers in this category that were found included cancers at several locations in the body, although all were some type of germ cell cancer. Other types of cancer found in this study area included leukemias and lymphoma, as well as other types. No other single type of cancer showed a statistically significant excess.

In study area #2 there were six cases of cancer diagnosed among children. This number was not statistically significantly different from the five cases of cancer expected. When individual types of cancer were examined, no single cancer showed a statistically significant difference in the number of cancers actually diagnosed compared with the number expected. In study area #3 the total number of cases diagnosed was less than six and close to the number expected. No individual type of cancer showed a statistically significant difference in the number of cancers actually diagnosed compared with the number expected.

Interviews were conducted with the children and/or their parents in an attempt to learn more about individual exposures and risk factors. As noted above, the study identified 15 children from study area #1 who had been diagnosed with cancer during the time period of the study. There were additional children identified who lived in study area #3 but not in study area #1; for completeness, attempts were made to interview all of these children.

Completed interviews were obtained for seven children, all of whom lived in study area #1 at the time they were diagnosed. Four interviews were completed with a parent or parents alone, one with an individual over 18 alone, and two with both the individual and one or both parents. The remainder either declined the interview or did not respond to phone calls and/or follow-up letters.

The seven children for whom interviews were completed had a variety of cancers, including leukemias, lymphomas and other types. Interviews could not be completed with any of the children with cancers in the category germ cell, trophoblastic and other gonadal neoplasms. The majority of the children for whom interviews could be obtained had reached school age at the time of their diagnosis.

The interviews found no unusual exposures or commonalities among the children interviewed. Mothers' ages at the child's birth ranged from the early 20s to the mid-30s. There were no known prenatal exposures to radiation or other unusual prenatal exposures or pregnancy complications. A small number of the children had birth complications, otherwise there were no unusual medical conditions in childhood prior to the cancer diagnosis. All respondents reported at least one family member with a history of cancer. These were various types of cancer mostly among individuals over age 50.

The majority of the children interviewed were not born in the Lewiston-Porter area, but moved there some time between 5 and 14 years prior to their diagnosis. Most of the children attended day care at some time in their lives, however no two of them attended the same day care. Because of concern over the Lewiston-Porter school campus, questions regarding schools attended were asked of all children who had reached school age at the time of their diagnosis. It was found that while some students attended Lewiston-Porter schools for their entire school career up to the time of diagnosis,

some only attended in the later years and some, including children in the 10-14 year age group, never attended schools on the Lewiston-Porter campus at all.

A number of farms are located in the Lewiston-Porter area. Residence histories showed that some of the children, including children with lymphomas, lived on or next to a farm at some time in their lives, and/or worked on a farm. Some studies have shown associations between lymphomas in adults and farming or exposures to pesticides, although it is not known if this applies to children. Other occupations of those children who were age 16 or over at the time of their diagnosis included primarily short-term, part-time positions, such as maintenance work, with no unusual exposures noted. In particular, none of the children interviewed had worked at the former LOOW prior to their diagnosis.

Discussion

Significant Findings This study noted several statistically significant findings in the various study areas for people of all ages and for children considered separately. In study area #1, the excess in the total number of cancers diagnosed among males could be accounted for by statistically significant excesses in the numbers of prostate and testicular cancers, and non-significant excesses in several other cancer types. While the total number of females in this study area diagnosed with cancer was not statistically significantly different from the number expected, a statistically significant excess was found in the numbers of females with cancers of the breast and of the urinary bladder. In study area #2, while the total number of cancers diagnosed among males was similar to the number expected, a statistically significant excess was found in the number of males with prostate cancer. There were no statistically significant findings among females. In study area #3, the only significant finding was a statistically significant deficit in the number of cases of lymphoma among males; total numbers of males and females diagnosed with cancer were similar to the numbers expected and there were no significant excesses of any single type of cancer.

The total number of cancers diagnosed among children residing in study area #1 was statistically significantly greater than expected and there was a statistically significant excess in the number of children diagnosed with cancers falling into the category germ cell, trophoblastic and other gonadal neoplasms. The total numbers of cancers diagnosed among children residing in study areas #2 and #3 were similar to expected and no individual site showed a statistically significant excess or deficit, although the numbers of children diagnosed in these areas were small for statistical purposes.

The three study areas were chosen based on the possibility of exposure to site-related contaminants through different pathways, but it is important to realize that there is a great deal of overlap among the three areas. Both study areas #1 and #2 include the entire Town of Porter and the developed portion of the LOOW. Study area #1 extends south of the LOOW to include much of the Town of Lewiston, including the Village of Lewiston, while study area #2 extends east into the western portion of the Town of Wilson, including the entire Village of Ransomville. Study area #3 is the eastern portion of study area #2. Cancer incidence within the three study areas was looked at separately in view of the different potential exposure pathways, but since they cover much of the same areas, it is not surprising that many of the results in the different areas are similar.

Cancer of the Prostate A statistically significant excess number of cases of prostate cancer was observed among males in study areas #1 and #2. The number of cases was higher than expected but not significantly so in study area #3, which is a part of study area #2. Prostate cancer is the most common cancer, other than skin cancer, diagnosed among men. It is estimated that one in six men will develop prostate cancer at some time in his life. Prostate cancer is more common in older men. Other risk factors for this cancer include race, with rates higher among African American men than among white men, and family history of the disease. The causes of prostate cancer are unknown, although dietary and hereditary factors are believed to be important. It is not known to be associated with radiation, or with any environmental contaminants.

Examination of the ages of the men diagnosed with prostate cancer in these two study areas showed that the majority of them were elderly at the time of their diagnosis. When individual 10-year age groups were examined separately, there was a statistically significant excess of prostate cancers for men in the 65-74 year age group in study area #1. Numbers of cases observed in all other age groups were similar to the numbers of cases expected. In study area #2, the numbers of cases observed were similar to the numbers expected for all individual age groups examined.

There are more men being diagnosed with prostate cancer in New York State now than there were in the 1980s. The number of men diagnosed with prostate cancer was highest in the early 1990s, but has since started to decline. It is believed that most of the increase early in the 1990s was due to more screening for prostate cancer. Screening is intended to detect disease at an earlier stage, when it is more treatable, and increased screening results in more cases of prostate cancer being found, at least initially. In the two study areas where a statistically significant excess number of cases of prostate cancer were found, approximately 89% of the cancer cases were diagnosed at an early stage (local or regional spread). This is higher than in New York State, exclusive of New York City for the same time period, where 77% of prostate cancer cases were diagnosed at an early stage. There was, however, a lower percentage of cases with an unknown stage of diagnosis in either of the study areas compared to New York State, excluding New York City (7% compared with 16%, respectively). This may indicate a greater level of prostate cancer screening and/or contact with the medical care system among men in this area.

The Cancer Surveillance Improvement Initiative (CSII) is a multi-part project designed to enhance the Health Department's cancer education and surveillance activities. The CSII has produced maps of cancer incidence by county and ZIP Code, as well as information to increase public awareness of cancer rates and risk factors. Prostate cancer maps by ZIP Code were produced for all of New York State for the time period 1994 through 1998. These showed a 50 to 100% increased incidence in a group of ZIP Codes in northwestern Niagara County, including the area covered by this study. CSII also mapped separately the incidence of prostate cancers diagnosed at a late stage, which is not as sensitive to the level of screening in a community since by this stage symptoms of the disease are usually apparent. Northwestern Niagara County did not show an increased incidence of late stage prostate cancer, which suggests that the underlying occurrence of the disease (as opposed to the rate at which it is being diagnosed) may not be elevated.

Cancer of the Testis A statistically significant excess number of cases of testicular cancer was observed among males in study area #1. Incidence of this cancer has doubled in the past twenty years, with most of the increase being among young men aged 15 to 44 years. In the U.S., the incidence of testicular cancer is six times higher among white males than African-American males. It is the most common cancer among white males aged 20 to 34 years and the second most common cancer among white males aged 15 to 19 and 35 to 39 years.

It is not known exactly what causes testicular cancer. We do know that testicular cancer occurs more often in men with certain medical conditions, including undescended testis. Research also indicates that men in white-collar or professional occupations are at a higher risk, suggesting that socioeconomic status or lifestyle may be linked to risk factors for this cancer. Employment in the military, aviation equipment support, crude petroleum and natural gas extraction, printing and leather finishing industries has been associated with cancer of the testis.

Individual age groups of males diagnosed with testicular cancer were examined separately for this study area. A statistically significant excess was found in males age 15 to 24 years, which accounted for the largest number of cases. For all other age groups, the observed number of cases was close to expected.

The cell types of the cancers in this study area included seminomas, non-seminomas, and mixed cell types, all of which are germ cell cancers. Non-seminoma and mixed cell types were found among the younger men and seminomas were found in most of the older men. This is what is usually seen in testicular cancer cases.

The residence at the time of diagnosis was also examined to determine whether there was any apparent geographic clustering of cases. The residence of each male diagnosed with testicular cancer was marked on a street map of the study area. The cases were located throughout the study area. There was no obvious concentration in the area around the LOOW and NFSS sites, or any other section of the study area. Many of the men lived in or near the Village of Lewiston or in areas of Town of Lewiston, south of the sites.

Cancer of the Breast A statistically significant excess number of females with breast cancer was observed in study area #1. Breast cancer is the most frequently diagnosed cancer (other than skin) among women in New York State. It is estimated that one in eight women will develop this cancer at some time in her life. The risk for getting breast cancer increases with age. More than three-quarters of the women who get breast cancer are over the age of 50.

Individual age groups were examined separately for this study area. There was a statistically significant excess number of cases among women in the 75-84 year age group. Numbers of cases among women in the 55-64 and 65-74 year age groups were slightly higher than expected but these differences were not statistically significant. The numbers of cases observed in the remaining age groups were similar to the numbers expected.

In study area #1, as well as all other comparison areas, the majority of breast cancers diagnosed were infiltrating ductal carcinomas. These make up 67% of total invasive breast cancers in New York State, exclusive of New York City, and 66% of breast cancers in study area #1. The second most frequently occurring type of breast cancer is lobular carcinoma, accounting for 9% of cases in New York State, exclusive of New York City and 16% of cases in study area #1. The third most frequently occurring type is mixed infiltrating ductal and lobular carcinomas. The percentage of cases in study area #1 with unspecified type was comparable to New York State, exclusive of New York City.

Improved early detection also contributes to the number of new breast cancer cases. In the study area, approximately 70% of the cancer cases were diagnosed at a local stage. This is comparable to the 66% of breast cancer cases that were diagnosed at a local stage in New York State, exclusive of New York City, during this time period.

White women are more likely to get breast cancer than African-American women, as are women of high socioeconomic status. Other risk factors for breast cancer include a family history of breast cancer, breast cancer genes, a personal history of breast cancer, alcohol consumption, obesity, and hormonal and reproductive factors (first period at young age, menopause at a late age, first child later in life or no full-term pregnancies). The only confirmed environmental risk factor is exposure to ionizing radiation, although much research on possible environmental risk factors for breast cancer is currently under way.

Cancer of the Urinary Bladder (including in situ) A statistically significant excess number of cases of cancer of the urinary bladder was observed among females in study area #1. The number of males diagnosed with bladder cancer was close to expected. Bladder cancer is more common among men than women and occurs more frequently among whites than African-Americans. It is more common among older people. When the age groups were examined separately, there was a statistically significant excess number of cases among women in the 65-74 year age group. The numbers of cases in the other age groups were similar to numbers of cases expected.

Although it is not known exactly what causes cancer of the bladder, cigarette smoking is the most important known risk factor. People who smoke have more than twice the risk of developing bladder cancer as non-smokers. Among females in study area #1 who developed bladder cancer between 1991 and 2000, for whom smoking status could be ascertained, 74% were identified as either current or former smokers at the time of diagnosis. According to the New York State Cancer Registry, about 58% of females diagnosed with bladder cancer between 1991 and 2000 in New York State, exclusive of New York City, were current or former smokers at the time of diagnosis. Therefore, smoking prevalence may have been higher among females with bladder cancer in this study area than among women with bladder cancer in the state as a whole.

Bladder cancer has also been associated with occupational exposures. In particular, exposures to aromatic amines and aniline dyes have been shown to be related to the risk of bladder cancer. These types of exposure may occur to individuals who work with dyes, rubber, textiles and leather.

The residence at the time of diagnosis was also examined to determine whether there was any apparent geographic clustering of cases. The residence of each female diagnosed with bladder cancer was marked on a street map of the study area. The cases were located throughout the study area with more cases in the more populated areas including the Village of Youngstown and in and around the Village of Lewiston. There was no obvious concentration in the area around the LOOW and NFSS sites, or any other section of the study area.

Childhood Cancers The types of cancers that occur in children differ from those seen in adults. The most frequently diagnosed childhood cancers include leukemia, particularly acute lymphocytic leukemia (ALL), cancers of the brain and central nervous system, and lymphomas, including Hodgkin's disease and the non-Hodgkin's lymphomas. Cancer incidence among children is usually highest in the 0-4 and 15-19 year age groups.

The types of cancers that were found among children in the study areas included leukemia and lymphomas, as well as other types. A statistically significant excess was found in the number of children living in study area #1 who were diagnosed with cancers in the category germ cell, trophoblastic and other gonadal neoplasms. These types of tumors are rare, representing only 7% of cancer diagnoses among children younger than 20 years of age (3). The category includes a diverse group of cancers, including cancers of the gonads (ovaries and testes) as well as cancers of germ cells (cells giving rise to sperm or eggs) in parts of the body other than the gonads. These may include inside the skull, pelvis, abdomen, and chest. Incidence rates for tumors in this category are relatively high in the first year of life, then decline to low levels before beginning to rise again at around the age of 8 for females and 11 for males. Little is known about the causation of these tumors, with undescended testes the only established risk factor for testicular germ cell tumors (3). Other factors that have been suggested to increase risk for malignant germ cell tumors include the mother's use of hormones or naturally high hormone levels during pregnancy, pre-term birth, hernia, trauma, and a family history of germ cell tumors (3). Childhood malignant germ cell tumors have not been confirmed to be associated with exposure to ionizing radiation or with personal or parental chemical exposures.

This investigation was requested partly because of the proximity of the LOOW and NFSS sites to the Lewiston-Porter schools. We therefore looked at the ages of the children with cancer to see if they could have attended Lewiston-Porter schools. In study area #1, we found a small number of children who had not reached school age at the time they were diagnosed. The majority of the children, however, were age 5 and over, with the greatest number of children in the 10-14 year age group at the time they were diagnosed. The children in this age group had a variety of cancers. When expected numbers of cancers were calculated for individual five-year age groups, the number of cancers diagnosed in children ages 10-14 was statistically significantly greater than the number expected. The numbers of children in younger age groups who were diagnosed were similar to the numbers expected, while the number of children in the 15-19 year age group was slightly, although not significantly, greater than expected.

The less common types of childhood cancers may not often be seen by some hospitals, and errors in disease coding can occur. The medical records for all of the cases of childhood cancer were

obtained to confirm the listed diagnoses and to gain additional information on the cancers. The diagnoses reported here are the ones that have been confirmed by medical records.

The residence at the time of diagnosis was examined to determine whether there was any apparent geographic clustering of cases. The residence of each child age 19 years and younger who was diagnosed with cancer was marked on a street map of the study area. The study areas were looked at as a whole, instead of as three separate study areas, with all childhood cases of cancer marked on one map. The maps showed that the cases were located throughout the study areas with most of them located in and around the Village of Lewiston, the most populated area in the study. There was no obvious concentration in the area around the LOOW and NFSS sites, or any other section of the study areas.

Comparison with Ransomville Study Results The Ransomville area (study area #3) was studied previously in a ZIP Code screening study for a 5-year period (1995-1999). In that study, a statistically significant excess was found in the total number of males diagnosed with cancer, while the total number of females diagnosed with cancer was close to expected. The excess in males could be accounted for by excesses in several types of cancer, including cancers of the prostate, lung, and urinary bladder. None of these excesses, however, was statistically significant, meaning that they were not greater than what would frequently occur by chance.

In the present study, the total numbers of both males and females in study area #3 who were diagnosed with cancer over a 10-year period were close to what was expected. Looking at individual types of cancer, numbers of cancer cases actually diagnosed were not statistically significantly different from the numbers expected in either males or females for any type of cancer. For bladder cancer in males in particular, for which the 10 cases observed in the screening study was about twice the number expected, the 13 cases observed in the 10-year study was much closer to the 11 expected.

Environmental Considerations This study was conducted in response to concerns over the NFSS and the former LOOW independently of any knowledge of any actual contamination or contamination-related exposures from the sites. The three study areas were selected on the basis of the most likely *possibility* of exposures through the air, water or soil, regardless of whether there had been any documented or *actual* human exposures. It is important to remember that without exposure, that is, human contact with a substance either through breathing it in, consuming it in food or water, or getting it on the skin, a substance can have no health effects. It is also important to realize that this was a study of persons living (or likely attending school) in the vicinity of the NFSS and the former LOOW; it did not include workers at the sites (who might be expected to be exposed to higher levels of any contaminants), unless they lived in the vicinity as well.

Study area #1 was chosen to examine cancer patterns in children who might be attending Lewiston-Porter schools, which are located on the undeveloped portion of the former LOOW near the NFSS, and in former students who might still be living in the area. Study area boundaries correspond closely with those of the school district. Although many former students would have moved away from the area, this area is the single area that would include the largest number of former students as well.

Since much of the population of study area #1 is located in or near the Village of Lewiston, which is upwind, upstream and at a higher elevation than the sites, the only exposures, if any, many current or former students may have received would have occurred while attending school, or in connection with other activities that brought them to the area, such as employment.

In this study, we found a significant excess number of cancers in children living in study area #1, with 15 cancers observed and 8 expected. This excess was accounted for by many different types of cancer, including many of the cancers most frequently diagnosed in children as well as cancers in the group germ cell, trophoblastic and other gonadal neoplasms. When the ages of the children diagnosed with cancer were examined, it was found that the number of children under school age who had been diagnosed with cancer was not unusual, while there was an unusual number of older children diagnosed with cancer, particularly those in the age group 10-14 years. We attempted to interview the children and/or their parents to obtain additional information, including information on whether the children had ever attended Lewiston-Porter schools. Interviews obtained for about half of these children showed that some did not attend Lewiston-Porter schools, including children in the 10-14 year age group, where there was a statistical excess of children with cancer. The children who did attend Lewiston-Porter schools attended them for varying amounts of time.

This area also showed a statistically significant excess number of total cancer cases in males of all ages, accounted for largely by significant excesses in numbers of cases of prostate and testicular cancers. There were also significantly elevated numbers of breast and bladder cancer cases in females. Prostate cancer is a cancer primarily found in elderly men, and much of the observed excess was in men in the 65-74 year age group. Men in this age range and older would have completed high school before the Lewiston-Porter schools were built, although they may have spent significant time in the area in connection with other activities such as employment. Similarly, much of the excess in female breast cancer was accounted for by women in the 65-74 and 75-84 year age groups, and much of the excess in female bladder cancer by women in the 65-74 year age group, who also would not have attended Lewiston-Porter schools.

The excess in testicular cancer, on the other hand, was accounted for mainly by young men in the 15-24 year age group, who would have been young enough to have attended the Lewiston-Porter schools. Of the small number of men under the age of 40 who could be interviewed, not all attended Lewiston-Porter schools. Plotting of the residences of the males with testicular cancer shows many of them to live in or near the Village of Lewiston. This area is relatively distant from the LOOW and NFSS sites and not in a direction likely to have experienced a high level of exposure to site-related contaminants.

Study area #2 includes all of the former LOOW and areas downstream in the event that there were any exposures to site-related contaminants in the soil or in surface water such as streams. Aside from prostate cancer, which was also found to be in excess in study area #1, there were no excesses found in total cancers among males or females, or at any other specific cancer site. There were also no excesses in cancers found when children were looked at separately.

Study area #3 is downwind of the sites and is the area that might have been most impacted by any airborne releases. There were no statistically significant excesses in total cancers or any individual cancer type for either males or females in this area, and no significant excesses found when children were looked at separately.

Study Limitations In drawing conclusions from these data, several aspects of the methodology need to be addressed. First, since there were 38 individual tests of significance for people of all ages in each study area (17 among males, 19 among females and one each among males and females overall) and 12 tests of significance for children, it was anticipated that one or two results for each study area or age group 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 80% or higher when the expected number is at least 12. 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 in each study area and for many individual cancer sites, especially in study area #1, the largest study area. The power to detect a doubling in the number of total cancers in children was not high in any study area. These considerations imply that, while a lack of statistical significance may rule out a strong effect, a small effect on cancer incidence may not be detectable by statistical methods.

An additional limitation is that migration, that is, movement of people in or out of the study area, could not be taken into account. Cancer cases were identified among persons who both resided in the study area and were diagnosed with cancer during the period 1991 through 2000. Former residents of the study area who moved away prior to being diagnosed with cancer could not be included, while persons who developed cancer shortly after moving into the area were included.

General Cancer Information Cancer may result from either genetic or environmental influences or an interaction of both genetics and environment. Examples of possible environmental influences include diet, smoking, and other lifestyle factors and occupation, as well as natural and man-made cancer-causing substances in the air, food or water. The development of cancer is usually a lengthy process. For many types of cancer, symptoms do not occur until 10 to 30 years after exposure to cancer-causing agents. An agent that promotes the uncontrolled growth of cancer cells may cause cancer symptoms to be recognized in less time.

Cancer, unfortunately, is a common disease. One of every two men and one of every three women will develop cancer during his/her lifetime (4). Cancer occurs at all ages, but most often in middle-aged and older people. The number of people diagnosed with cancer is increasing in most communities. Most of this is 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, as well as physical inactivity are also believed to be important. In fact, tobacco use has been estimated to account for about 30% of all cancer deaths (5) and recent evidence suggests that one third of cancer deaths may be due to unhealthy diet and insufficient physical activity (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.

Interpretation

A statistically significant excess was found in the total number of males diagnosed with cancer in study area #1, which was chosen due to concerns over cancer among current and former students of Lewiston Porter schools. This excess can be accounted for by statistically significant excesses in prostate and in testicular cancers and by non-significant excesses in several other types of cancer. Since cancer is not a single disease, but a collection of many different diseases, each with its own risk factors, the source of the overall cancer excess in males may best be understood by examining the individual cancers contributing to the excess.

The statistically significant excess in prostate cancer in study area #1, which was also found in study area #2, is part of a pattern involving northwestern Niagara County. The higher proportion of early stage cancers in this area and the lack of an elevation in late stage cancers suggest that this finding could be due to increased screening for the disease or to another factor associated with medical care practices such as increased awareness of early symptoms.

The addresses of the men with testicular cancer do not suggest an association with any residential exposures. The greatest number of cases of this cancer was found among young adults, among whom testicular cancer rates are known to be increasing rapidly. Young men in this age range could have attended Lewiston-Porter schools, although available interviews indicate that not all of the men under 40 with testicular cancer did so. The small number of interviews obtained, however, does not allow further evaluation of the possible association with school attendance.

Statistically significant excesses were also found in study area #1 in the numbers of females diagnosed with cancers of the breast and of the urinary bladder, although the number of women with all types of cancer combined was not significantly different from the number expected. The excesses in breast and bladder cancers were concentrated in older persons, who would have been past high

school age at the time the Lewiston-Porter schools opened and so could not have attended school there.

The excess in childhood cancers diagnosed in study area #1 was accounted for in part by a statistically significant excess in the number of children diagnosed with cancers grouped as germ cell, trophoblastic and other gonadal neoplasms. This is a fairly heterogeneous group and the cancers occurred at several different locations in the body, although all were germ cell tumors. With the exception of testicular cancer, for which some risk factors have been identified, little is known about possible causes of cancers in this group. There is no strong evidence that childhood germ cell cancers are associated with ionizing radiation or chemical exposures. Since no interviews were obtained for any of the children with these cancers, we do not have any information on school attendance or potential childhood or parental exposures by which to evaluate further the possibility of environmental exposures contributing to the development of cancer.

The excess in childhood cancers was seen primarily among older children. Children ages 10 and over would have had the opportunity to have attended Lewiston-Porter schools prior to their diagnosis, although the interviews showed that some did not actually attend schools there. In addition, the cancers in children in this age group represented a variety of different types, including those most frequently diagnosed in children; even in children, different cancers can be considered to be different diseases, with different causes. It is possible that excesses in different cancers arose in different ways.

Aside from the statistically significant excess in numbers of prostate cancer cases diagnosed among men living in study area #2, discussed above, there were no statistically significant excesses in any individual cancer type or in all cancers combined among males or females living in study areas #2 or #3, or among children examined separately. These study areas were chosen due to community concerns over possible contaminant exposures in the soil and water (study area #2) and in the air (study area #3). Considerations of statistical power do not rule out the possibility that one or more cancers are being diagnosed at a *slightly* elevated rate in these areas due to reasons other than chance. It is, however, likely that none are being diagnosed at a *greatly* elevated rate.

Results of the present study indicate unusual patterns of testicular cancer in young men, and malignant germ cell tumors in children. It is not possible to conclude, however, that any of the patterns is necessarily a result of any site-related contamination. Most cancers have many possible causes, including genetic, lifestyle and occupational factors in addition to possible environmental exposures, and little information was available to evaluate the possible contributions of these factors. It is also not possible to exclude chance as a source of the excesses.

Additional follow-up

Since the case identification phase of this study was completed, additional years of data have become available from the New York State Cancer Registry. Cancer Registry files were therefore searched to identify any additional children with cancers diagnosed in the years after 2000. At the time

of this follow-up search (August 2008), Cancer Registry data were official through 2005 and nearly complete for cancers diagnosed in 2006, although these data were still subject to edits.

The search identified five additional children living in study area #1 who were diagnosed with cancer between 2001 and 2006. This number was not statistically different from the approximately five children expected to develop cancer in a six-year time period in this area (based on the average number of cases expected per year for 1991-2000). The types of cancer identified included the types of cancer most frequently found in children. In particular, there were no additional cases of malignant germ cell tumors.

References

1. Ellison JH, Wu XC, Howe HL, et al., (eds). *Cancer in North America, 1998-2002. Volume One: Incidence*. Springfield, IL: North American Association of Central Cancer Registries, Inc. April 2005 (Appendix C).
2. Molina EC. *Poisson's Exponential Binomial Limit*, Huntington, NY: Robert E. Krieger Co., 1973.
3. Bernstein L, Smith MA, Liu L, et al. Chapter X Germ Cell, Trophoblastic and Other Gonadal Neoplasms, in Ries LAG, Smith MA, Gurney JG, et al. (eds). *Cancer Incidence and Survival among Children and Adolescents: United States SEER Program 1975-1995*, National Cancer Institute, SEER Program. NIH Pub. No. 99-4649. Bethesda, MD, 1999.
4. American Cancer Society. *Cancer Facts and Figures - 2002*, New York: American Cancer Society, 2002.
5. Doll R and Peto R. *The Causes of Cancer*, Oxford: Oxford University Press, 1981.
6. Byers T, Nestle M, McTiernan A, et al. American Cancer Society Guidelines on Nutrition and Physical Activity for Cancer Prevention: Reducing Risk of Cancer with Healthy Food Choices and Physical Activity. *CA Cancer J Clin.* 52(2):92-119, 2002.

**BUREAU OF CHRONIC DISEASE EPIDEMIOLOGY AND SURVEILLANCE
NEW YORK STATE DEPARTMENT OF HEALTH**

TABLE 1

Observed and Expected Numbers of Incident Cancer Cases, Study Area #1
Census Tracts: 244.01, 244.04, 244.05, 245.01 and 245.02
Niagara County, New York, 1991-2000
New York State exclusive of New York City Standard 1991-2000

| SITES (ICD-O-2) ^a | MALES | | FEMALES | |
|-------------------------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| | Observed ^b | Expected ^c | Observed ^b | Expected ^c |
| All Sites ^d | 702* | 614 | 590 | 565 |
| Oral Cavity / Pharynx | 17 | 16 | 7 | 8 |
| Esophagus | 13 | 9 | – ^e | – ^e |
| Stomach | 9 | 14 | 7 | 8 |
| Colorectal | 78 | 76 | 77 | 73 |
| Pancreas | 15 | 15 | 17 | 16 |
| Larynx | 9 | 10 | – ^e | – ^e |
| Lung / Bronchus | 100 | 104 | 72 | 78 |
| Female Breast | | | 193* | 162 |
| Cervix uteri | | | 6 | 11 |
| Corpus Uterus / Uterus NOS | | | 28 | 35 |
| Ovary | | | 26 | 24 |
| Prostate | 238* | 177 | | |
| Testis | 12* | 5 | | |
| Urinary Bladder (including in situ) | 52 | 46 | 29* | 17 |
| Kidney / Renal Pelvis | 24 | 18 | 9 | 11 |
| Brain / Other Nervous System | 7 | 9 | 7 | 8 |
| Thyroid | – ^e | – ^e | 12 | 10 |
| Lymphomas | 32 | 27 | 16 | 24 |
| Multiple Myeloma | – ^e | – ^e | 6 | 7 |
| Leukemias | 23 | 18 | 17 | 13 |

^aClassification of site is based on ICD for Oncology, 2nd Edition.

^bData were obtained from the New York State Cancer Registry (database as of December 2003).

^cExpected numbers are based on standard cancer incidence rates by age and sex for New York State, exclusive of New York City. Standard rates are applied to the total 1991-2000 study population (94,088 males, 99,721 females) to obtain expected numbers of cases.

^dIncludes observed and expected numbers of cases at sites of cancer not listed below.

^eThe number of cases is not shown to protect patient confidentiality.

*Denotes a statistically significant difference from expected. The probability that this difference is due to chance is less than 5%.

**BUREAU OF CHRONIC DISEASE EPIDEMIOLOGY AND SURVEILLANCE
NEW YORK STATE DEPARTMENT OF HEALTH**

TABLE 2
Observed and Expected Numbers of Incident Cancer Cases, Study Area #2
ZIP Codes: 14174 and 14131
Niagara County, New York, 1991-2000
New York State exclusive of New York City Standard 1991-2000

| SITES (ICD-O-2) ^a | MALES | | FEMALES | |
|--|-----------------------|-----------------------|-----------------------|-----------------------|
| | Observed ^b | Expected ^c | Observed ^b | Expected ^c |
| All Sites ^d | 334 | 311 | 277 | 270 |
| Colorectal | 48 | 38 | 38 | 32 |
| <u>Other Digestive:</u> Esophagus, Stomach, Liver/Intrahepatic Bile Duct, Pancreas | 16 | 23 | 12 | 14 |
| Lung / Bronchus | 55 | 52 | 37 | 37 |
| Female Breast | | | 79 | 80 |
| <u>Female Genital System:</u> Cervix Uteri, Corpus Uterus / Uterus NOS, Ovary | | | 33 | 34 |
| Prostate | 110* | 88 | | |
| Urinary Bladder (including in situ) | 30 | 23 | 10 | 8 |
| <u>Blood and Blood-forming System:</u> Lymphomas, Multiple Myeloma, Leukemias | 18 | 27 | 24 | 21 |

^aClassification of site is based on ICD for Oncology, 2nd Edition.

^bData were obtained from the New York State Cancer Registry (database as of December 2003).

^cExpected numbers are based on standard cancer incidence rates by age and sex for New York State, exclusive of New York City. Standard rates are applied to the total 1991-2000 study population (56,719 males, 56,670 females) to obtain expected numbers of cases.

^dIncludes observed and expected numbers of cases at sites of cancer not listed below.

^eThe number of cases is not shown to protect patient confidentiality.

*Denotes a statistically significant difference from expected. The probability that this difference is due to chance is less than 5%.

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NEW YORK STATE DEPARTMENT OF HEALTH**

TABLE 3

Observed and Expected Numbers of Incident Cancer Cases, Study Area #3

ZIP Code: 14131

Niagara County, New York, 1991-2000

New York State exclusive of New York City Standard 1991-2000

| SITES (ICD-O-2) ^a | MALES | | FEMALES | |
|--|-----------------------|-----------------------|-----------------------|-----------------------|
| | Observed ^b | Expected ^c | Observed ^b | Expected ^c |
| All Sites ^d | 160 | 155 | 118 | 135 |
| Colorectal | 21 | 19 | 15 | 16 |
| <u>Other Digestive:</u> Esophagus, Stomach, Liver/Intrahepatic Bile Duct, Pancreas | 10 | 12 | – ^e | – ^e |
| Lung / Bronchus | 32 | 26 | 18 | 18 |
| Female Breast | | | 31 | 40 |
| <u>Female Genital System:</u> Cervix Uteri, Corpus Uterus / Uterus NOS, Ovary | | | 19 | 17 |
| Prostate | 51 | 43 | | |
| Urinary Bladder (including in situ) | 13 | 11 | – ^e | – ^e |
| <u>Blood and Blood-forming System:</u> Lymphomas, Multiple Myeloma, Leukemias | – ^e | – ^e | 8 | 10 |

^aClassification of site is based on ICD for Oncology, 2nd Edition.

^bData were obtained from the New York State Cancer Registry (database as of December 2003).

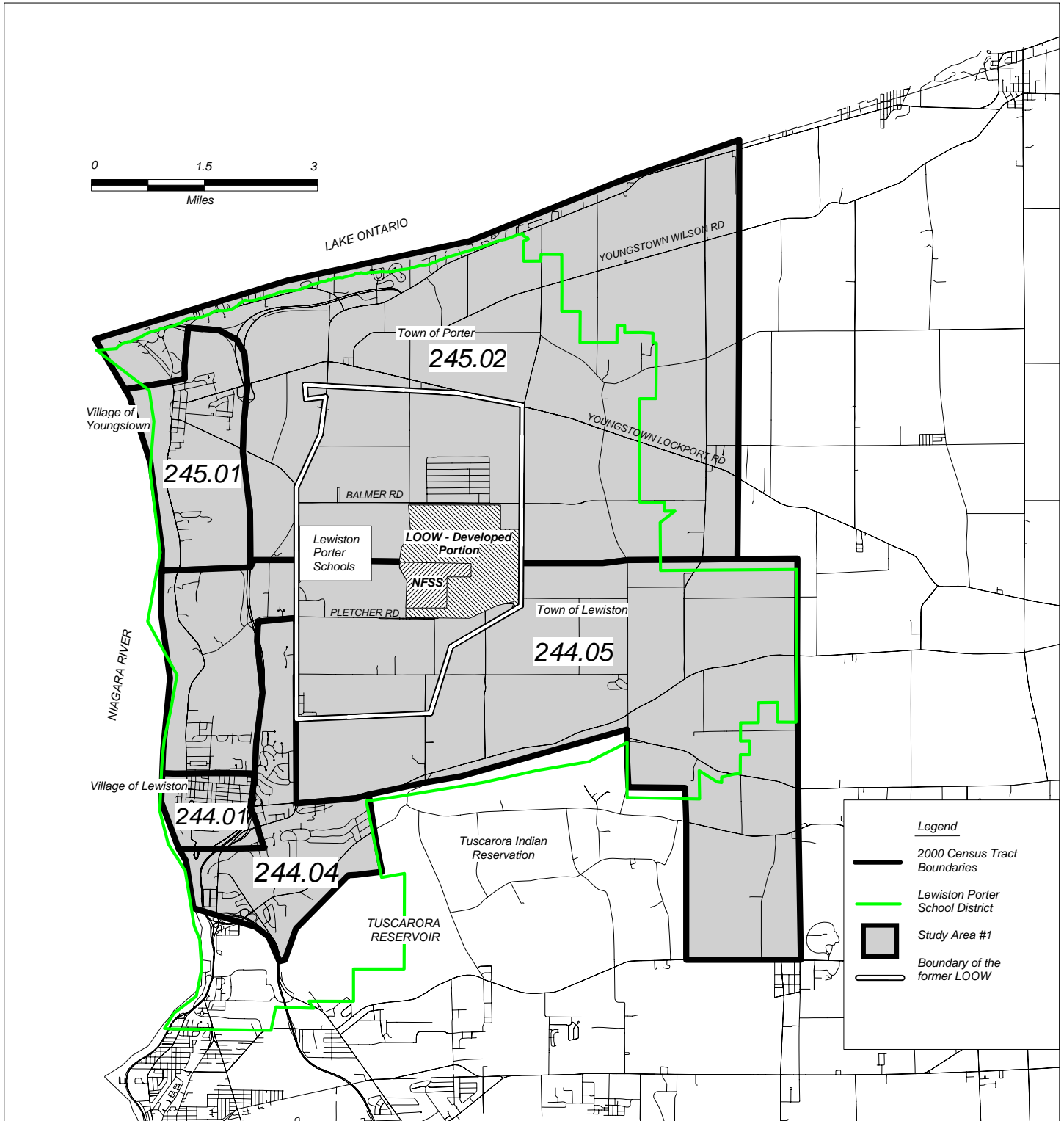
^cExpected numbers are based on standard cancer incidence rates by age and sex for New York State, exclusive of New York City. Standard rates are applied to the total 1991-2000 study population (28,350 males, 27,893 females) to obtain expected numbers of cases.

^dIncludes observed and expected numbers of cases at sites of cancer not listed below.

^eThe number of cases is not shown to protect patient confidentiality.

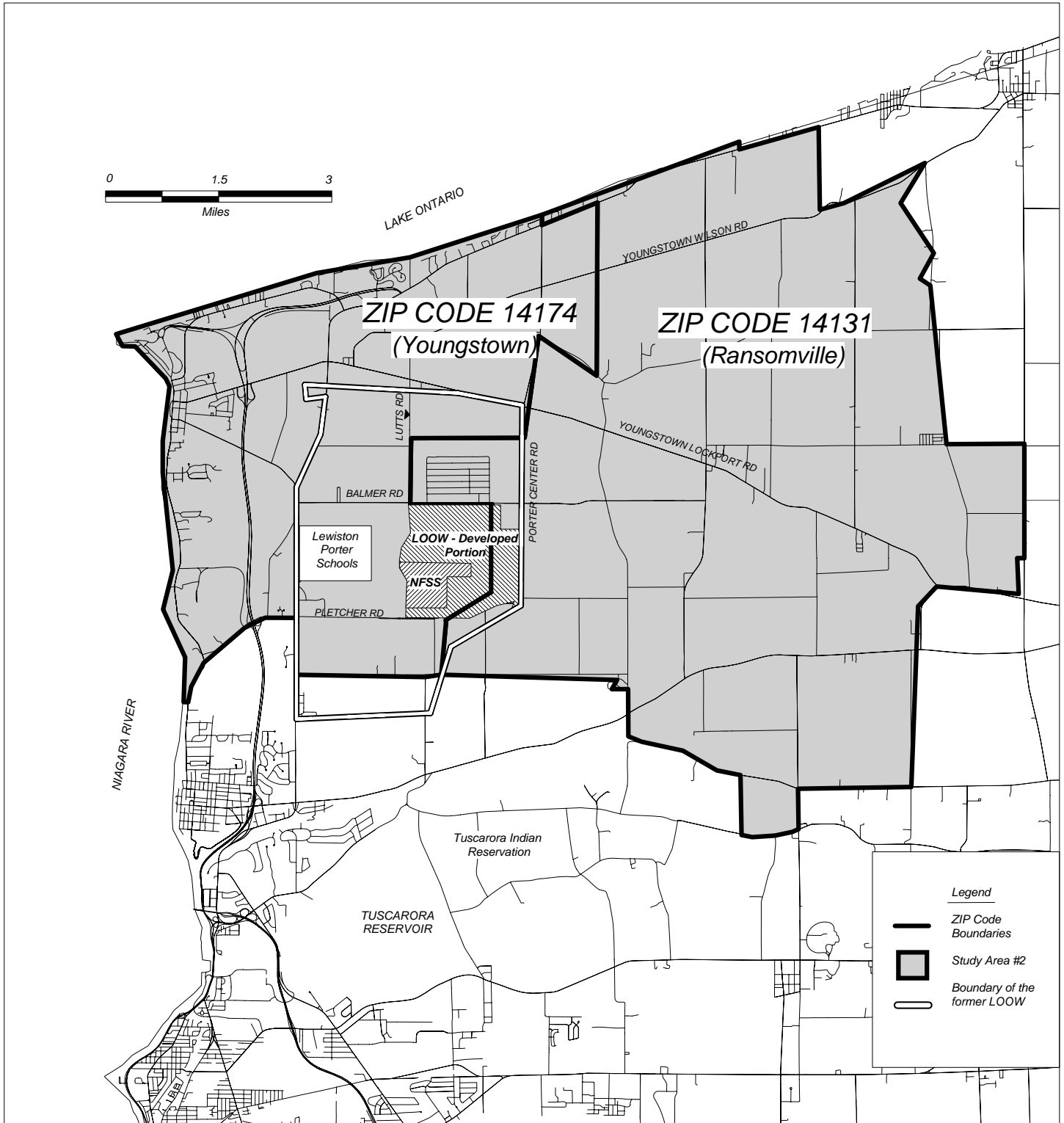
Map 1.

**STUDY AREA #1:
AREA SURROUNDING THE
NIAGARA FALLS STORAGE SITE,
TOWNS OF LEWISTON AND PORTER,
NIAGARA COUNTY, NEW YORK
(2000 CENSUS BOUNDARIES)**



Map 2.

**STUDY AREA #2:
ZIP CODES 14174 AND 14131
YOUNGSTOWN AND RANSOMVILLE
NIAGARA COUNTY, NEW YORK**



Map 3.

STUDY AREA #3:
ZIP CODE 14131
RANSOMVILLE, NIAGARA COUNTY, NEW YORK

