ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Public Health Assessment for

OTTAWA RADIATION AREAS
OTTAWA, LASALLE COUNTY, ILLINOIS
EPA FACILITY ID: ILD980606750
JULY 25, 2006

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
Agency for Toxic Substances and Disease Registry

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment was prepared by ATSDR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6)), and in accordance with our implementing regulations (42 C.F.R. Part 90). In preparing this document, ATSDR has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate.

In addition, this document has previously been provided to EPA and the affected states in an initial release, as required by CERCLA section 104 (i)(6)(H) for their information and review. The revised document was released for a 30-day public comment period. Subsequent to the public comment period, ATSDR addressed all public comments and revised or appended the document as appropriate. The public health assessment has now been reissued. This concludes the public health assessment process for this site, unless additional information is obtained by ATSDR which, in the agency's opinion, indicates a need to revise or append the conclusions previously issued.

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PUBLIC HEALTH ASSESSMENT

OTTAWA RADIATION AREAS

OTTAWA, LASALLE COUNTY, ILLINOIS

EPA FACILITY ID: ILD980606750

Prepared by:

Illinois Department of Public Health
Under Cooperative Agreement with the
U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

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Summary

The Ottawa Radiation Areas (ORA) site consists of 14 areas of contamination located throughout the city of Ottawa in LaSalle County, Illinois (Figure 1). The majority of the sites are located in residential areas. Others are within the Ottawa business district or in light industrial areas. A few sites are outside the city limits in unincorporated locations.

Radium Dial, Inc. began operations in Ottawa, Illinois, in the late 1910s. Employees of both Radium Dial, and later Luminous Processes, used radium-containing, luminous (glow-in-the-dark) paints to coat the dials and faces of clocks, watches and other consumer products. During World War II, the company prepared luminous dials for military purposes.

During operation, the building and the surrounding area became contaminated with radium-226. Several remedial activities have occurred at the site. All identified areas of contamination have been cleaned up with the exception of NPL-8 Frontage Property and NPL-11.

Based on current site conditions, IDPH concludes that exposure to radium-226 in soil at NPL-11 and NPL-8 poses a public health hazard. Residents, workers, and trespassers have a low increased risk of cancer from exposure to contaminated soil. USEPA is planning to clean up these two remaining areas of contamination. The clean up should eliminate the exposure pathway and prevent future exposures.

Purpose

A Petitioned Public Health Assessment (PHA) was prepared for the Ottawa Radiation Areas in 1993 by the Agency for Toxic Substances and Disease Registry (ATSDR). To update activities that have occurred since 1993, the Illinois Department of Public Health (IDPH) has prepared an updated PHA to determine whether radiation exposure is currently a public health hazard at the Ottawa Radiation Areas site.

Background

Site Location

The Ottawa Radiation Areas (ORA) site consists of 14 areas of contamination (named NPL-1 through NPL-14) located throughout the city of Ottawa in LaSalle County, Illinois (Figure 1). The majority of the sites are located in residential areas. Others are within the Ottawa business district or in light industrial areas. A few sites are outside the city limits in unincorporated locations.

Site History

Radium Dial, Inc. began operation in Ottawa, Illinois, in the late 1910s. The company occupied the former Ottawa High School, located at Columbus and Washington Streets. The building was the Ottawa High School from 1880 until 1916, when the high school moved to its present location. Radium Dial, Inc. operated in this building until 1930, when it moved to the corner of Columbus and Washington Streets in Ottawa and changed the name of the company to Luminous Processes, Inc. Between 1930 and 1968, the original Radium Dial building was used as a meat packing plant and was later occupied by Farmers Co-op. This building was demolished in 1968.

Employees of both Radium Dial and Luminous Processes used radium-containing, luminous (glow-in-the-dark) paints to coat the dials and faces of clocks and watches. During World War II, the company prepared luminous dials for military purposes. Most of the employees were women, and in 1916, Radium Dial, Inc. employed 92 women and five men (USEPA 2003a).

After Luminous Processes ceased operations in 1978, the building remained empty, although residents and city officials reported that it was used as a meat locker for several years.

Until 1960, radium was the only radioactive material used at the facility. Radium was mixed with zinc sulfide as the base for the luminous paints. The exact amount of radium used at the facility between 1934 and 1957 is not known because no federal or state regulations existed at that time for the receipt, use and distribution of radium in consumer products. In 1957, the State of Illinois passed a radioactive materials law, which required users of radioactive material to register with the state, and to provide information about the types and quantities of radioactive materials used. When Luminous Processes registered with the state in December 1957, the company indicated an average annual radium usage of 700 milligrams. Tritium became available for use in luminous paints in the 1970s and replaced radium.

During operation, the building and the surrounding area became contaminated with radium-226. The building was demolished in 1985, and contaminated debris was transported for disposal at a commercial low-level waste disposal facility in Hanford, Washington. In 1986, a contractor for the Illinois Department of Nuclear Safety (IDNS) removed contaminated soils, foundations and sewer lines. However, local residents made several allegations about improper disposal of radioactive material. These allegations included improper disposal practices, the migration of dust particles during demolition, and contamination of water when wastewater from hosing down the foundation ran off into the sewer.

In 1986 at the request of IDNS, the U.S. Department of Energy conducted an aerial survey of the City of Ottawa to detect radium-contaminated areas. The survey identified approximately 11 areas that contained varying levels of below ground radium contamination. Because radium naturally decays to form radon gas, in August 1986, IDNS conducted radon screening of homes in the Ottawa area. Radon-detecting equipment was placed in basements or low areas in homes to measure radon levels. Two homes had radon levels greater than USEPA's standard of 4 picoCuries per liter (pCi/L) of air. IDNS removed approximately 800 cubic feet of soil from around one of the homes. Another home had a radon system installed to remove the radon.

In December 1986, IDNS requested USEPA's assistance to perform site inspections, evaluate possible movement of radium contamination, and supervise the clean-up plan (USEPA 2003a).

Removal Activities

Several activities have occurred at the site to clean up contaminated areas. In 1988, radon reduction systems were installed in two homes and one business by USEPA. In 1990, USEPA, working with IDNS, began removing radium-contaminated soil from the radiation areas. The material was transported to a low-level radioactive hazardous waste disposal facility in Utah.

Of the 14 areas, USEPA prioritized residential properties and properties near residential areas because they posed a greater risk to the public (USEPA 2000). Between 1993 and 1997, USEPA conducted removal activities on 12 of the 14 sites. As part of the removal actions, USEPA excavated contaminated soil greater than 6.2 picoCuries per gram (pCi/g) radium in these residential areas, including parts of NPL-11 (Figure 2). USEPA removed a total of 4,176 tons of radium-contaminated soil at NPL-11 in 1996. The NPL-11 excavation was terminated due to the difficulties of excavating material located below the water table.

A Record of Decision was signed in September 2000 recommending complete removal of radium-contaminated soil from three of the sites where future residential use is likely and removal to 10 feet below ground surface at one site where future recreational use is planned. Remediation of the remaining properties is scheduled to take place beginning in 2007 and continuing through 2010.

Discussion

Chemicals of Interest

IDPH compared the maximum concentration of each contaminant detected during environmental sampling with appropriate screening values to select contaminants for further evaluation for carcinogenic and non-carcinogenic health endpoints (Attachment 1). Chemicals that exceeded comparison values were selected for further evaluation.

Comparison values are used only to screen for contaminants that should be evaluated further and do not represent thresholds of toxicity. Though some of these chemicals may exist at levels greater than comparison values, they can only affect someone who is exposed and receives a high enough dose for adverse health effects to occur. Whether exposure to a chemical will cause adverse health effects depends on how much has entered the body, the duration of the exposure, how the chemical entered the body, and how the body responds. The chemical of interest at this site is radium-226 (Tables 1 & 2).

Exposure Pathways

Adverse health effects may occur when a contaminant reaches a receptor population through an exposure pathway. These pathways are separated into completed and potential pathways. Completed exposure pathways consist of five elements: 1) a source of contamination, 2) transport through an environmental medium, 3) a point of exposure, 4) a route of human exposure, and 5) a receptor population. Potential exposure pathways have at least one element missing, but the missing element could exist. Potential exposure pathways suggest that exposure could have occurred in the past, could be occurring, or could occur in the future. An exposure pathway is eliminated if one or more of the elements are missing and will never be present.

Completed Exposure Pathways

As part of the Record of Decision, USEPA calculated exposure estimates for the two unremediated areas, NPL-8 Frontage Property and NPL-11 (Figures 2 and 3). Surface and subsurface soils have been contaminated with radioactive wastes. In addition, some buildings in the Ottawa area contain elevated levels of radon gas.

For NPL-11, a residential scenario was used to calculate exposure estimates. The risk at NPL-11 is primarily to residents, construction workers and people walking through the area. They could be exposed to contamination by inhaling radon gas escaping from the ground, by touching radium-contaminated soil, or from gamma radiation emitted by the contaminated soil. They also could get small particles of contaminated soil in their mouths by hand-to-mouth activity. The most contaminated soil is located several feet below the surface and would not be contacted unless digging or excavation activities were occurring.

USEPA estimated that there would be a low increased risk of cancer from exposure to radioactive contaminants at NPL-11 (Weston 1999). No noncancer health effects would be expected.

Currently, for the NPL-8 frontage property, people who walk through the area 60 days or more of the year could have a low increased risk of cancer (Weston 2003). No noncancer health effects would be expected. Proposed plans for this property are for a commercial or industrial site. The property will be remediated before any construction activities occur (USEPA 2003).

Toxicological Evaluation

Radium

Radium is naturally present in the environment at very low levels. Radium gives off gamma radiation that can cause adverse health effects at elevated levels. At the remaining two areas of contamination in Ottawa, people exposed to the low levels of radiation could have an increased risk of cancer. However, no studies exist to show what specific health effects may occur from being exposed to low levels of radium for a long period of time.

At higher levels, radium has been shown to cause effects on the blood (anemia) and eyes (cataracts). It also has been shown to affect the teeth, causing an increase in broken teeth and cavities. Patients who were injected with radium in Germany, from 1946 to 1950, for the treatment of certain diseases including tuberculosis were significantly shorter as adults than people who were not treated (ATSDR 1990).

Exposure to high levels of radium results in an increased incidence of bone, liver, and breast cancer. USEPA and the National Academy of Sciences, Committee on Biological Effects of Ionizing Radiation, have stated that radium is a known human carcinogen.

Health Outcome Data

The IDPH Division of Epidemiologic Studies reviewed the incidence of cancer for the Ottawa zip code 61350 from 1991 to 2000 (Attachment 2). In females, an increased risk of thyroid cancer was found with 2 cases expected and 7 cases observed. No other types of cancer were elevated for either males or females. The most common types of cancer caused by exposure to radium are bone, liver, and breast. The presence of an increase in thyroid cancer does not appear to be related to contaminants from this site.

Community Health Concerns

IDPH staff attended a public meeting held to discuss remediation activities. The meeting was held on July 30, 2003 at Ottawa City Hall. Representatives from USEPA, IDPH, city officials, and the contractor for USEPA performing sampling and remediation work were present at the meeting. The meeting was held to discuss cleanup of two properties and to propose different options for remediation. Community concerns included:

- Concern about children playing in contaminated soil
- Health risks from contaminated soil
- Cancer rates in the community

IDPH answered health-related questions and informed residents that the Division of Epidemiologic Studies would be evaluating cancer data to see if there was an increased rate of cancer in the Ottawa zip code.

This public health assessment was available for public comment from March 8, 2006 to April 22, 2006. No comments were received.

Child Health Considerations

IDPH and ATSDR recognize that children are especially sensitive to some contaminants. For this reason, IDPH includes children when evaluating exposures to contaminants. Children are the most sensitive population considered in this health assessment because of their frequent hand-to-mouth play habits. Children could have a low increased risk of cancer from exposure to radium in the soil at NPL-11 and NPL-8.

Conclusions

Elevated levels of radium-226 exist in soil and exposure may occur in the future if they are not removed. USEPA estimated that residents, workers, and trespassers have a low increased risk of cancer from exposure to contaminated soil. Based on current site conditions, IDPH concludes that exposure to radium-226 in soil at NPL-11 and NPL-8 poses a public health hazard. USEPA is planning to clean up these two remaining areas of contamination. This should eliminate the exposure pathway and prevent future exposures.

Recommendations

IDPH recommends that:

1. USEPA implement its plan to remediate NPL-8 Frontage Property and NPL-11.
2. Residents take steps to limit their exposure to contaminated soil until remediation is complete.

Public Health Action Plan

USEPA prioritized residential properties near residential areas because they posed a greater risk to the public. Between 1993 and 1997, USEPA conducted removal activities on 12 of the 14 sites.

On July 30, 2003, IDPH staff attended a public meeting held to discuss remediation activities. The meeting was held to discuss cleanup of two properties and to propose different options for remediation. IDPH also provided recommendations on how to reduce exposure to contaminants in soil to residents who had concerns.

In November 2004, the IDPH Division of Epidemiologic Studies reviewed the incidence of cancer for the Ottawa zip code 61350 from 1991 to 2000 (Attachment 2).

The two remaining contaminated areas are scheduled to be cleaned up as soon as the final remedial design report is approved. Currently, it is estimated that the remaining contaminated properties will be cleaned up beginning in 2007 and continuing through 2010.

IDPH will continue to monitor USEPA activities at the Ottawa Radiation Areas site. An updated health consultation will be completed once remediation of NPL-11 and NPL-8 Frontage properties is complete.

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Certification

This Ottawa Radiation Areas Public Health Assessment was prepared by the Illinois Department of Public Health under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It was completed in accordance with approved methodologies and procedures existing at the time the health consultation was initiated. Editorial review was completed by the Cooperative Agreement partner.

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

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Weston Solutions, Inc. March 20, 2003. Screening Level Risk Assessment Report, Ottawa Radiation Areas, NPL-8 Frontage Property. Chicago: Publication No.: RFW105-2A-AMRZ.

Tables

Table 1. Radiological data summary of 0-2 feet below ground surface for NPL-8 Frontage Property in Pico Curies per gram (Weston 2003).

Chemical	Frequency of Detection	Range of Detected Concentrations	95% Upper Confidence Limit
Radium 226	32/32	0.6-28	8.159

Background level of radium 226 is reported to be 1.2 pCi/g in soil.

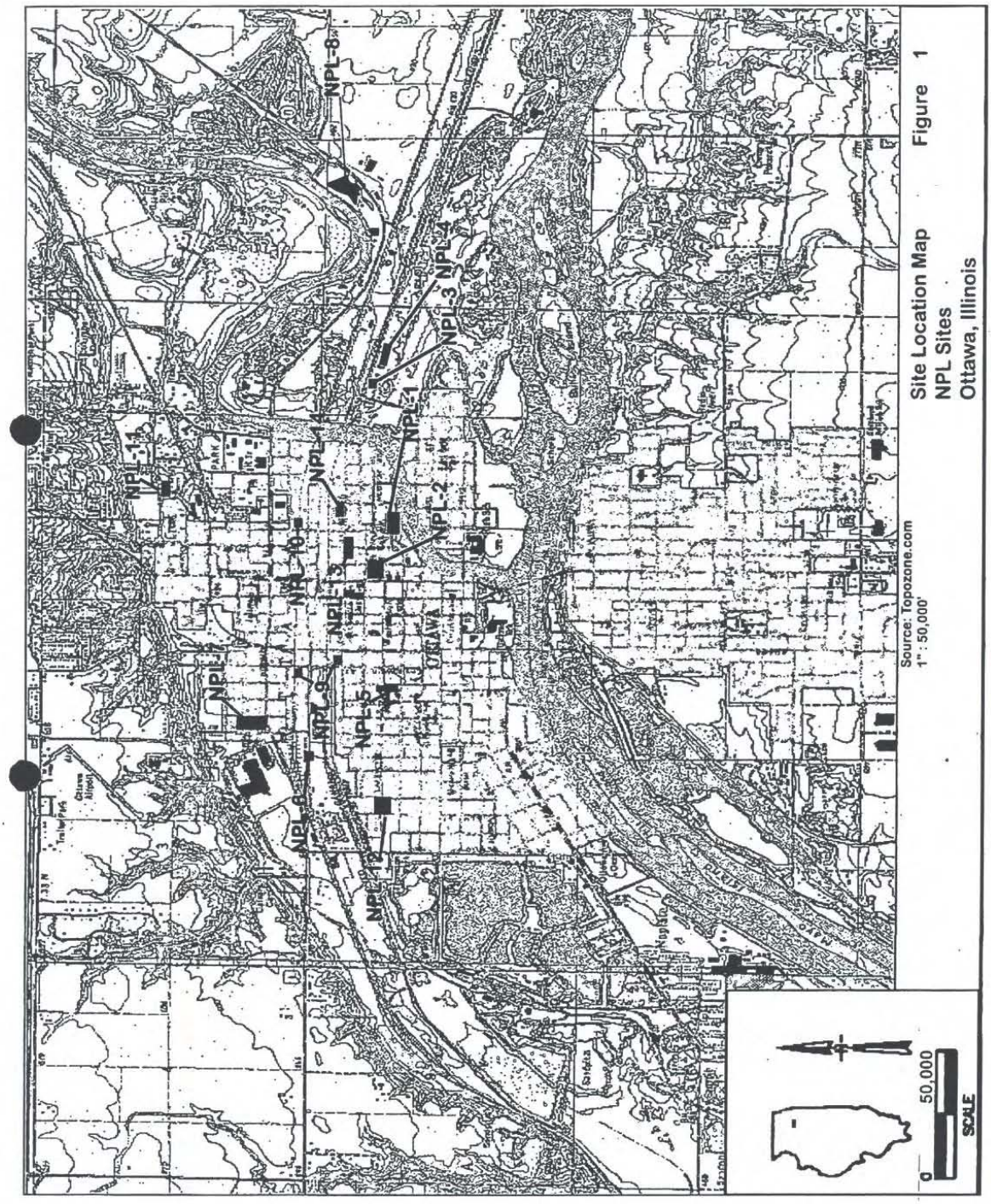
Table 2. Radiological data summary for NPL-11 in Pico Curies per gram (Weston 1999).

Chemical	Frequency of Detection	Range of Detected Concentrations	Area
Radium 226	7/7	0.95-2.66	A
Radium 226	3/3	28.63-6,016	B

Background level of radium 226 is reported to be 1.2 pCi/g in soil.

See Figure 2 for areas A and B.

Figures


NPL-8
NPL-3
NPL-4
NPL-1
NPL-11
NPL-14
NPL-2
NPL-10
NPL-13
NPL-7
NPL-9
NPL-5
NPL-12
NPL-6
OTTAWA
Source: Topozone.com
1" : 50,000'
Site Location Map
NPL Sites
Ottawa, Illinois
Figure 1
0
50,000
SCALE

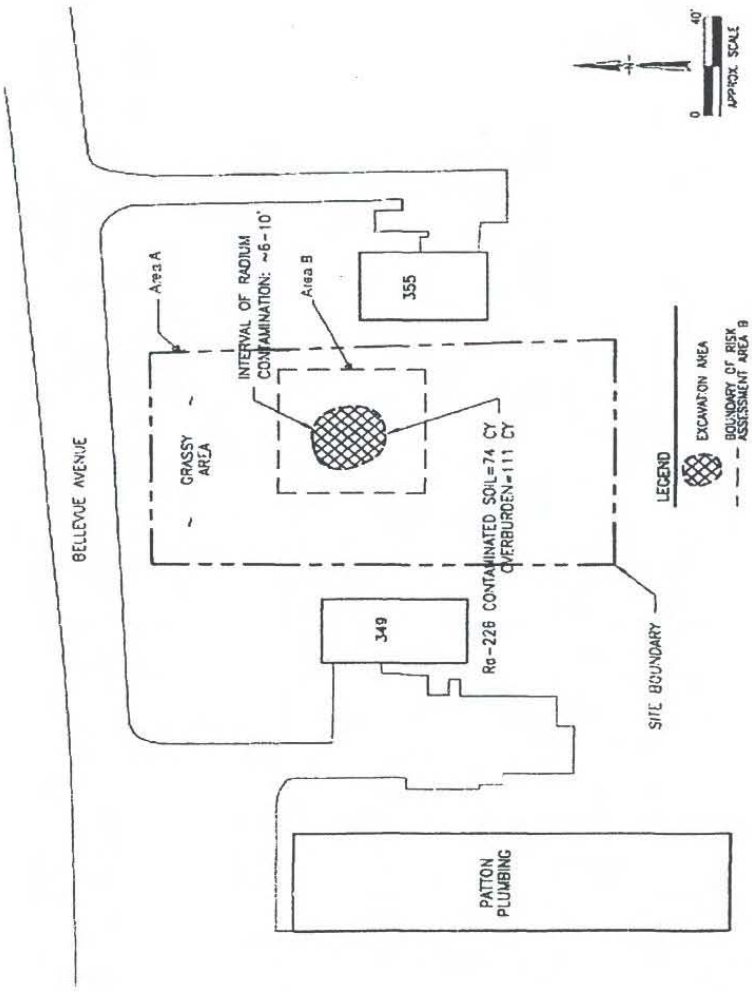


Figure 2

NPL-11 Site Layout

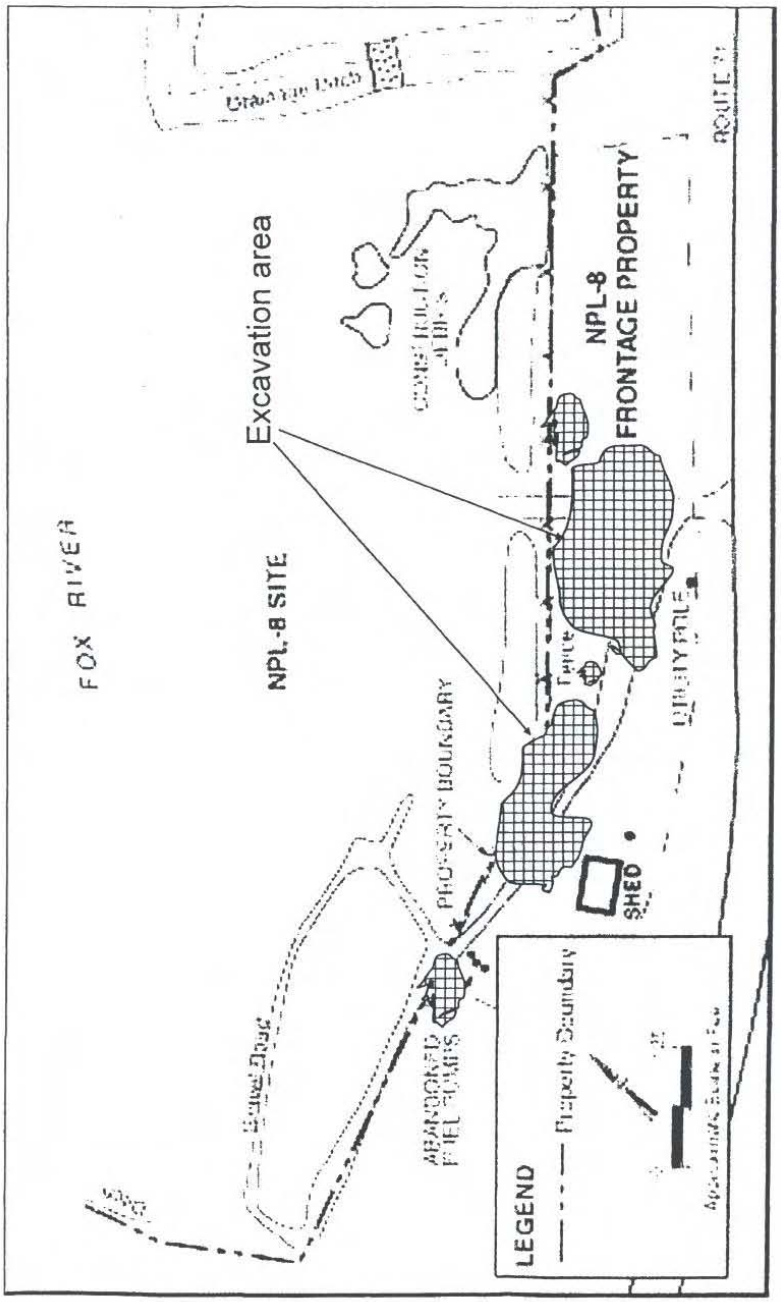


Figure 3

NPL-8 Site Layout

Attachments

Attachment 1

Comparison Values Used in Screening Contaminants for Further Evaluation

Environmental Media Evaluation Guides (EMEGs) are developed for chemicals based on their toxicity, frequency of occurrence at National Priorities List (NPL) sites, and potential for human exposure. They are comparison values used only to select chemicals for further evaluation. They are developed without consideration for carcinogenic effects, chemical interactions, multiple routes of exposure, or other media-specific routes of exposure. They are very conservative concentration values designed to protect sensitive members of the populations.

Reference Dose Media Evaluation Guides (RMEGs) are another type of comparison value derived to protect the most sensitive populations. They are developed without consideration for carcinogenic effects, chemical interactions, multiple routes of exposure, or other media specific routes of exposure. They are conservative concentrations.

Cancer Risk Evaluation Guides (CREGs) are estimated contaminant concentrations based on one excess cancer in a million persons exposed to a chemical over a lifetime. These are also conservative values designed to protect sensitive members of the population.

Maximum Contaminant Levels (MCLs) have been established by USEPA for public water supplies to reduce the chances of adverse health effects from use of contaminated drinking water. These standards are well below levels for which health effects have been observed and take into account the financial feasibility of achieving specific contaminant levels. These are enforceable limits that public water supplies must meet.

Lifetime Health Advisories (LTHAs) have been established by USEPA for drinking water and are the concentration of a chemical in drinking water that is not expected to cause any adverse, non-carcinogenic effects over a lifetime of exposure. These are conservative values that incorporate a margin of safety.

Attachment 2

INCIDENCE OF CANCER IN ZIP CODE 61350 OF OTTAWA (LASALLE COUNTY), ILLINOIS

1991-2000

Prepared by the

Division of Epidemiologic Studies
Illinois Department of Public Health

November 2004

Background

The Illinois Department of Public Health, Division of Environmental Health (DEH), contacted the Division of Epidemiologic Studies (DES), with a request to evaluate the cancer incidence in Ottawa (LaSalle County). The U. S. Environmental Protection Agency is moving forward with clean up plans at the remaining radium contaminated sites in Ottawa. DEH will be writing a Public Health Assessment to update activities since 1993. DES collaborated with Center for Governmental Studies at Northern Illinois University on a previous study of this area which was completed in January 1998 and assessed cancer cases diagnosed between 1986 and 1992.[1] Since several more years of data are now available, Dr. Tiefu Shen, Chief of the Division of Epidemiologic Studies, initiated a second evaluation to update the previous investigation.

Methods

Analyzing data for areas smaller than a ZIP code is difficult, not only because of small numbers but also the insufficient collection of address information for health data and the lack of population counts from the Census, which are necessary to calculate and compare rates. The previous report mentioned above defined the study area as eight census tracts specific to the areas of Ottawa where radium contamination sites were located (9626, 9627, 9628, 9636, and parts of 9622, 9623, 9640, and 9637). In that study, however, about 20 percent of the cancer incidence cases were omitted from the analysis because they would not have been assigned to census tracts according to exact street level addresses. Cases that were assigned to census tracks 9622, 9623, 9640 and 9637 were also omitted in the previous study because the radium sites were only partially in these tracks.[1]

Recognizing severe limitations faced by conducting cancer cluster evaluations at any geographic areas smaller than a ZIP code, the Division current cluster assessment protocol calls for the study area to be defined by ZIP code area. Often, the ZIP code information is available for all cases[2] and its reporting accuracy is 99.9 percent.[3] In the present study, the study area for this evaluation was defined as ZIP code area 61350. Census tracks 9626, 9627, 9628, and 9636 used in the previous study account for 61 percent of the population for ZIP code area 61350.

All cases of cancer diagnosed among residents of the study area for the most recent ten years of complete data at the time of the study, 1991-2000, were identified. The source for these data was the Illinois State Cancer Registry (ISCR). Identification of cancer cases in ISCR is dependent upon reporting by diagnostic and therapeutic facilities as mandated by state law.

In addition, ISCR has agreements with other central cancer registries to send back Illinois cancer data which are identified outside the state. These registries include Arkansas, California, Florida, Indiana, Iowa, Kentucky, Michigan, Mississippi, Missouri, North Carolina, Washington, Wisconsin, Wyoming, Barnes-Jewish Hospital in St. Louis, and the Mayo clinic in Minnesota. Completeness of out-of-state reporting depends upon the years of operation of these other central registries, the extent of their identification of out-of-state residents, and their standards of quality.

Out-of-state diagnoses among residents of ZIP code area 61350 accounted for less than 3 percent of the total number of cases reported and were included in the study. Completeness of reporting from all reporting sources, assessed using the North American Association of Central Cancer Registries (NAACCR) Standard,[4] is considered to be 96 percent complete for the period 1991 through 2000.

To benchmark and foster best practices among population-based registries, NAACCR has developed a certification process that reviews registry data for completeness, accuracy, and timeliness of reporting beginning with diagnosis year 1995. The criteria for silver and gold certification can be found on the NAACCR web site http://www.naaccr.org/Certification/index.html . As of February 2003, ISCR data met the criteria for gold certification for cancer diagnosis years 1995, 1996, 1997, 1998, 1999, and 2000.

All cancer cases from the study area were grouped by tumor site, sex, race, and age. These are referred to as the *observed* cases. Age-, sex-, and race-specific rates from a comparable population in Illinois were applied to each age group of the study population and to each tumor site to obtain an *expected* number of cases for the study area[5]. The tumor site groups included oral cavity, esophagus, stomach, colon and rectum, liver, pancreas, lung and bronchus, bone, melanoma, breast, cervix, uterus, ovary, prostate, testis, bladder, kidney, Hodgkin's lymphoma, non-Hodgkin's lymphoma, multiple myeloma, leukemia, and all other cancers. The comparable population was defined as an area with a similar population density and race distribution as the study area (83 rural counties in Illinois).

Age-, sex-, and race-specific population counts for the study area for each year (1991-1999) were interpolatively estimated using an exponential method with population counts derived from the 1990 and 2000 U.S. Census, the most reliable sources for population counts and estimates for small areas. Age-, sex-, and race-specific population estimates for each year (1991-2000) for the reference group were obtained from the U.S. Census Bureau.

The observed number of cases was compared with the expected number of cases. Based on the Poisson model, a probability of 0.01 or less for an observed number of cancer cases that

was higher or lower than the expected number was considered to be a statistically significant difference.[6]

When a significant excess was identified, and when appropriate for the site in question, other data elements and risk factor data, as reported to ISCR, were reviewed. These may include stage of disease at diagnosis, tobacco and alcohol use, occupational information, morphologic type of tumor, and location of residence within the study area.

When the observed number is less than six cases for a specific tumor site, the number is not mentioned in this report to protect the privacy of individuals. If possible, the cases are grouped with other sites within body organ systems, or when not possible, they are included in the *All Other Sites* category.

In addition, although race-specific rates were calculated and showed similar outcomes to all races combined, due to small numbers of cases among blacks and persons of other races in the study area, data are only presented for all races combined.

Results and Discussion

For all cancer sites combined, the incidence of cancer among males in the study area was 677 cases observed with 676 cases expected. In females, 697 cases were observed while 693 cases were expected. These differences were not statistically significant for either sex. In addition, in males, none of the differences between observed and expected numbers of cases for each site group was statistically significant. The sites are grouped in the table to protect the privacy of individuals.

Although the total number of female cases was not statistically different from the expected numbers, a significant excess of thyroid cancer (included in the *All Other Sites* category in the table) was noted for among females aged 15-34 with 7 cases observed and 2 cases expected. The difference was not significant for thyroid cases among females of all ages with 16 cases observed and 10 expected. None of the other specific sites of cancer in females had observed numbers of cases significantly different from the expected numbers.

Thyroid cancer is one of the rarer and less virulent neoplasms, however, the incidence has been rising in the past few decades. Thyroid cancer is as least three times more frequent among females than among males and two times greater among whites than among blacks. The incidence of thyroid cancer is relatively high between the ages of 15 and 39 years, when thyroid cancer accounts for about 9 percent of all newly diagnosed cancers. Persons of Jewish ethnicity have been reported to have a greater susceptibility to thyroid cancer than other ethnic groups. Other than ionizing radiation, the causes of thyroid cancer are unknown. From recent epidemiologic studies, factors suspected to be associated with thyroid cancer include benign thyroid nodules and goiter, hormonal and reproductive variables, dietary intake, and genetic factors. [7]

Analytical Considerations

In drawing conclusions from these data, two aspects of the statistical method need to be addressed. First, random fluctuations in disease occurrence cannot be completely ruled out in explaining differences between the observed and expected numbers, even when the difference is statistically significant. The problem of random fluctuations is expected to be more prominent as the study areas become smaller.

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. A non-significant difference sometimes reflects the low statistical power rather than the absence of differences. The power of a test varies with the number of cases expected.[8] In this study, the power of detecting a doubling was low in both sexes for myelomas and cancers of the nervous system. Among the sex-specific sites, it was also low for females with cancers of the oral cavity, esophagus, stomach, cervix, kidney and melanomas.

In addition, the latency between the time of exposure and the onset of clinically-recognizable disease for most adult cancers is between 10 and 20 years. Specific cancers may vary somewhat in the length of the latent period, but generally speaking, recent exposure, that is exposures in the last 10 years cannot be expected to be associated with current cancer incidence. The history of residency for cases included in the present study could not be assessed because this information is not collected by the cancer registry, nor is such information available for the general population in the area.

Additional Comments

Cancer is a common disease, sometimes more common than many people believe. In the U.S., one in two men have a lifetime risk of developing cancer. For women, the lifetime risk is one in three.[9] The number of people with cancer is increasing in most communities because more people are living to the ages of greatest cancer occurrence.

Many people could reduce their chances of developing or dying from cancer by adopting a healthier lifestyle and by visiting their physician regularly for a cancer-related checkup. Screening examinations, conducted regularly by a health care professional, can result in the detection of

cancers of the breast, tongue, mouth, colon, rectum, cervix, prostate, testis, and melanomas at earlier stages, when treatment is more likely to be successful. More than half of all new cancer cases occur in the nine screening-accessible cancer sites listed above.[9]

Current knowledge suggests that the leading preventable cause of cancer is cigarette smoking.[10] Exposures to carcinogenic chemicals, ionizing radiation, and other agents produced by humans is responsible for less than five percent of human cancers.[10] Generally speaking, any possible risk associated with the environment would most likely only have a small effect on cancer incidence relative to that of tobacco.[9] The following table shows the best current estimates for the causes of cancer.

Causes of Cancer in the United States	**Percent**
smoking	30
adult diet and obesity	30
sedentary lifestyle	5
alcohol	3
reproductive factors	3
prenatal factors and growth	5
occupational factors	5
environmental pollution	2
ionizing and UV radiation	2
viruses and other biologic agents	5
prescription drugs and medical procedures	1
food additives and contaminates	1
family history of cancer	5
socioeconomic status	3

Source: Harvard School of Public Health. Harvard Report on Cancer Prevention Volume 1: Causes of Human Cancer. *Cancer Causes and Control*. London: Rapid Science Publishers; 1996:*Vol 7.*

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Illinois State Cancer Registry
Division of Epidemiologic Studies
Illinois Department of Public Health

Observed and Expected Numbers of Cancer Cases by Site and Sex
Residents of ZIP Code 61350 of Ottawa, Illinois
1991-2000

	Males		Females	
Cancer Site Group	Obs.	Exp.[a]	Obs.	Exp.[a]
Oral Cavity	20	19	15	9
Esophagus and Stomach	25	21	14	10
Colorectal	95	87	95	101
Liver and Pancreas	21	18	19	20
Lung and Bronchus	122	133	100	83
Melanomas	15	17	9	15
Breast invasive	-	-	187	191
Breast *in situ*	-	-	23	25
Cervix	-	-	11	15
Uterus	-	-	46	41
Ovary	-	-	17	26
Prostate	179	188	-	-
Bladder	52	46	15	17
Kidney	22	18	9	15
Nervous System	7	9	10	8
Lymphomas	33	28	21	29
Myelomas	6	8	7	8
Leukemias	12	19	16	16
All Other Sites	68	65	83	64
All Sites	677	676	697	693

SOURCE: Illinois State Cancer Registry, January 2003.

[a] Expected numbers are based on the age- and sex-specific incidence rates in an area of Illinois with a similar population density and race distribution as the study area.

ATSDR Glossary of Terms

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal public health agency with headquarters in Atlanta, Georgia, and 10 regional offices in the United States. ATSDR's mission is to serve the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and diseases related to toxic substances. ATSDR is not a regulatory agency, unlike the U.S. Environmental Protection Agency (EPA), which is the federal agency that develops and enforces environmental laws to protect the environment and human health. This glossary defines words used by ATSDR in communications with the public. It is not a complete dictionary of environmental health terms. If you have questions or comments, call ATSDR's toll-free telephone number, 1-888-42-ATSDR (1-888-422-8737).

General Terms

Absorption
The process of taking in. For a person or an animal, absorption is the process of a substance getting into the body through the eyes, skin, stomach, intestines, or lungs.

Acute
Occurring over a short time [compare with chronic].

Acute exposure
Contact with a substance that occurs once or for only a short time (up to 14 days) [compare with intermediate duration exposure and chronic exposure].

Adverse health effect
A change in body function or cell structure that might lead to disease or health problems

Ambient
Surrounding (for example, ambient air).

Background level
An average or expected amount of a substance or radioactive material in a specific environment, or typical amounts of substances that occur naturally in an environment.

Biota
Plants and animals in an environment. Some of these plants and animals might be sources of food, clothing, or medicines for people.

Body burden
The total amount of a substance in the body. Some substances build up in the body because they are stored in fat or bone or because they leave the body very slowly.

Cancer
Any one of a group of diseases that occur when cells in the body become abnormal and grow or multiply out of control.

Cancer risk
A theoretical risk for getting cancer if exposed to a substance every day for 70 years (a lifetime exposure). The true risk might be lower.

Carcinogen
A substance that causes cancer.

Central nervous system
The part of the nervous system that consists of the brain and the spinal cord.

CERCLA [see Comprehensive Environmental Response, Compensation, and Liability Act of 1980]

Chronic
Occurring over a long time [compare with acute].

Chronic exposure
Contact with a substance that occurs over a long time (more than 1 year) [compare with acute exposure and intermediate duration exposure]

Cluster investigation
A review of an unusual number, real or perceived, of health events (for example, reports of cancer) grouped together in time and location. Cluster investigations are designed to confirm case reports; determine whether they represent an unusual disease occurrence; and, if possible, explore possible causes and contributing environmental factors.

Comparison value (CV)
Calculated concentration of a substance in air, water, food, or soil that is unlikely to cause harmful (adverse) health effects in exposed people. The CV is used as a screening level during the public health assessment process. Substances found in amounts greater than their CVs might be selected for further evaluation in the public health assessment process.

Completed exposure pathway [see exposure pathway].

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)
CERCLA, also known as Superfund, is the federal law that concerns the removal or cleanup of hazardous substances in the environment and at hazardous waste sites. ATSDR, which was created by CERCLA, is responsible for assessing health issues and supporting public health activities related to hazardous waste sites or other environmental releases of hazardous substances. This law was later amended by the Superfund Amendments and Reauthorization Act (SARA).

Concentration
The amount of a substance present in a certain amount of soil, water, air, food, blood, hair, urine, breath, or any other media.

Contaminant
A substance that is either present in an environment where it does not belong or is present at levels that might cause harmful (adverse) health effects.

Dermal
Referring to the skin. For example, dermal absorption means passing through the skin.

Dermal contact
Contact with (touching) the skin [see route of exposure].

Detection limit
The lowest concentration of a chemical that can reliably be distinguished from a zero concentration.

Disease registry
A system of ongoing registration of all cases of a particular disease or health condition in a defined population.

Dose (for chemicals that are not radioactive)
The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An "exposure dose" is how much of a substance is encountered in the environment. An "absorbed dose" is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.

Dose (for radioactive chemicals)
The radiation dose is the amount of energy from radiation that is actually absorbed by the body. This is not the same as measurements of the amount of radiation in the environment.

Dose-response relationship
The relationship between the amount of exposure [dose] to a substance and the resulting changes in body function or health (response).

Environmental media
Soil, water, air, biota (plants and animals), or any other parts of the environment that can contain contaminants.

Environmental media and transport mechanism
Environmental media include water, air, soil, and biota (plants and animals). Transport mechanisms move contaminants from the source to points where human exposure can occur. The environmental media and transport mechanism is the second part of an exposure pathway.

Epidemiology
The study of the distribution and determinants of disease or health status in a population; the study of the occurrence and causes of health effects in humans.

Exposure
Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term [acute exposure], of intermediate duration, or long-term [chronic exposure].

Exposure assessment
The process of finding out how people come into contact with a hazardous substance, how often and for how long they are in contact with the substance, and how much of the substance they are in contact with.

Exposure investigation
The collection and analysis of site-specific information and biologic tests (when appropriate) to determine whether people have been exposed to hazardous substances.

Exposure pathway
The route a substance takes from its source (where it began) to its end point (where it ends), and how people can come into contact with (or get exposed to) it. An exposure pathway has five parts: a source of contamination (such as an abandoned business); an environmental media and transport mechanism (such as movement through groundwater); a point of exposure (such as a private well); a route of exposure (eating, drinking, breathing, or touching), and a receptor population (people potentially or actually exposed). When all five parts are present, the exposure pathway is termed a completed exposure pathway.

Feasibility study
A study by EPA to determine the best way to clean up environmental contamination. A number of factors are considered, including health risk, costs, and what methods will work well.

Geographic information system (GIS)
A mapping system that uses computers to collect, store, manipulate, analyze, and display data. For example, GIS can show the concentration of a contaminant within a community in relation to points of reference such as streets and homes.

Groundwater
Water beneath the earth's surface in the spaces between soil particles and between rock surfaces [compare with surface water].

Half-life (t½)
The time it takes for half the original amount of a substance to disappear. In the environment, the half-life is the time it takes for half the original amount of a substance to disappear when it is changed to another chemical by bacteria, fungi, sunlight, or other chemical processes. In the human body, the half-life is the time it takes for half the original amount of the substance to disappear, either by being changed to another substance or by leaving the body. In the case of radioactive material, the half life is the amount of time necessary for one half the initial number of radioactive atoms to change or transform into another atom (that is normally not radioactive). After two half lives, 25% of the original number of radioactive atoms remain.

Hazard
A source of potential harm from past, current, or future exposures.

Hazardous waste
Potentially harmful substances that have been released or discarded into the environment.

Health consultation
A review of available information or collection of new data to respond to a specific health question or request for information about a potential environmental hazard. Health consultations are focused on a specific exposure issue. Health consultations are therefore more limited than a public health assessment, which reviews the exposure potential of each pathway and chemical [compare with public health assessment].

Health education
Programs designed with a community to help it know about health risks and how to reduce these risks.

Health investigation
The collection and evaluation of information about the health of community residents. This information is used to describe or count the occurrence of a disease, symptom, or clinical measure and to evaluate the possible association between the occurrence and exposure to hazardous substances.

Health statistics review
The analysis of existing health information (i.e., from death certificates, birth defects registries, and cancer registries) to determine if there is excess disease in a specific population, geographic area, and time period. A health statistics review is a descriptive epidemiologic study.

Indeterminate public health hazard
The category used in ATSDR's public health assessment documents when a professional judgment about the level of health hazard cannot be made because information critical to such a decision is lacking.

Incidence

The number of new cases of disease in a defined population over a specific time period [contrast with prevalence].

Ingestion
The act of swallowing something through eating, drinking, or mouthing objects. A hazardous substance can enter the body this way [see route of exposure].

Inhalation
The act of breathing. A hazardous substance can enter the body this way [see route of exposure].

Intermediate duration exposure
Contact with a substance that occurs for more than 14 days and less than a year [compare with acute exposure and chronic exposure].

Lowest-observed-adverse-effect level (LOAEL)
The lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals.

Medical monitoring
A set of medical tests and physical exams specifically designed to evaluate whether an individual's exposure could negatively affect that person's health.

Metabolism
The conversion or breakdown of a substance from one form to another by a living organism.

Metabolite
Any product of metabolism.

mg/kg
Milligram per kilogram.

mg/cm2
Milligram per square centimeter (of a surface).

mg/m3
Milligram per cubic meter; a measure of the concentration of a chemical in a known volume (a cubic meter) of air, soil, or water.

Migration
Moving from one location to another.

Minimal risk level (MRL)
An ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects. MRLs are calculated for a route of exposure (inhalation or oral) over a specified time period

(acute, intermediate, or chronic). MRLs should not be used as predictors of harmful (adverse) health effects [see reference dose].

National Priorities List (NPL)
EPA's list of the most serious uncontrolled or abandoned hazardous waste sites in the United States. The NPL is updated on a regular basis.

No apparent public health hazard
A category used in ATSDR's public health assessments for sites where human exposure to contaminated media might be occurring, might have occurred in the past, or might occur in the future, but where the exposure is not expected to cause any harmful health effects.

No-observed-adverse-effect level (NOAEL)
The highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals.

No public health hazard
A category used in ATSDR's public health assessment documents for sites where people have never and will never come into contact with harmful amounts of site-related substances.

NPL [see National Priorities List]

Pica
A craving to eat nonfood items, such as dirt, paint chips, and clay. Some children exhibit pica-related behavior.

Plume
A volume of a substance that moves from its source to places farther away from the source. Plumes can be described by the volume of air or water they occupy and the direction they move. For example, a plume can be a column of smoke from a chimney or a substance moving with groundwater.

Point of exposure
The place where someone can come into contact with a substance present in the environment [see exposure pathway].

Population
A group or number of people living within a specified area or sharing similar characteristics (such as occupation or age).

Potentially responsible party (PRP)
A company, government, or person legally responsible for cleaning up the pollution at a hazardous waste site under Superfund. There may be more than one PRP for a particular site.

ppb
Parts per billion.

ppm
Parts per million.

Prevalence
The number of existing disease cases in a defined population during a specific time period [contrast with incidence].

Prevention
Actions that reduce exposure or other risks, keep people from getting sick, or keep disease from getting worse.

Public availability session
An informal, drop-by meeting at which community members can meet one-on-one with ATSDR staff members to discuss health and site-related concerns.

Public comment period
An opportunity for the public to comment on agency findings or proposed activities contained in draft reports or documents. The public comment period is a limited time period during which comments will be accepted.

Public health action
A list of steps to protect public health.

Public health advisory
A statement made by ATSDR to EPA or a state regulatory agency that a release of hazardous substances poses an immediate threat to human health. The advisory includes recommended measures to reduce exposure and reduce the threat to human health.

Public health assessment (PHA)
An ATSDR document that examines hazardous substances, health outcomes, and community concerns at a hazardous waste site to determine whether people could be harmed from coming into contact with those substances. The PHA also lists actions that need to be taken to protect public health [compare with health consultation].

Public health hazard
A category used in ATSDR's public health assessments for sites that pose a public health hazard because of long-term exposures (greater than 1 year) to sufficiently high levels of hazardous substances or radionuclides that could result in harmful health effects.

Public health hazard categories
Public health hazard categories are statements about whether people could be harmed by conditions present at the site in the past, present, or future. One or more hazard categories might be appropriate for each site. The five public health hazard categories are no public health hazard, no apparent public health hazard, indeterminate public health hazard, public health hazard, and urgent public health hazard.

Public meeting
A public forum with community members for communication about a site.

Radioisotope
An unstable or radioactive isotope (form) of an element that can change into another element by giving off radiation.

Radionuclide
Any radioactive isotope (form) of any element.

RCRA [see Resource Conservation and Recovery Act (1976, 1984)]

Receptor population
People who could come into contact with hazardous substances [see exposure pathway].

Reference dose (RfD)
An EPA estimate, with uncertainty or safety factors built in, of the daily lifetime dose of a substance that is unlikely to cause harm in humans.

Remedial investigation
The CERCLA process of determining the type and extent of hazardous material contamination at a site.

Resource Conservation and Recovery Act (1976, 1984) (RCRA)
This Act regulates management and disposal of hazardous wastes currently generated, treated, stored, disposed of, or distributed.

RfD [see reference dose]

Risk
The probability that something will cause injury or harm.

Risk reduction
Actions that can decrease the likelihood that individuals, groups, or communities will experience disease or other health conditions.

Risk communication
The exchange of information to increase understanding of health risks.

Route of exposure
The way people come into contact with a hazardous substance. Three routes of exposure are breathing [inhalation], eating or drinking [ingestion], or contact with the skin [dermal contact].

Safety factor [see uncertainty factor]

Sample
A portion or piece of a whole. A selected subset of a population or subset of whatever is being studied. For example, in a study of people the sample is a number of people chosen from a larger population [see population]. An environmental sample (for example, a small amount of soil or water) might be collected to measure contamination in the environment at a specific location.

Sample size
The number of units chosen from a population or an environment.

Solvent
A liquid capable of dissolving or dispersing another substance (for example, acetone or mineral spirits).

Source of contamination
The place where a hazardous substance comes from, such as a landfill, waste pond, incinerator, storage tank, or drum. A source of contamination is the first part of an exposure pathway.

Substance
A chemical.

Superfund [see Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and Superfund Amendments and Reauthorization Act (SARA)

Surface water
Water on the surface of the earth, such as in lakes, rivers, streams, ponds, and springs [compare with groundwater].

Survey
A systematic collection of information or data. A survey can be conducted to collect information from a group of people or from the environment. Surveys of a group of people can be conducted by telephone, by mail, or in person. Some surveys are done by interviewing a group of people [see prevalence survey].

Toxicological profile
An ATSDR document that examines, summarizes, and interprets information about a hazardous substance to determine harmful levels of exposure and associated health effects. A toxicological profile also identifies significant gaps in knowledge on the substance and describes areas where further research is needed.

Toxicology
The study of the harmful effects of substances on humans or animals.

Tumor
An abnormal mass of tissue that results from excessive cell division that is uncontrolled and progressive. Tumors perform no useful body function. Tumors can be either benign (not cancer) or malignant (cancer).

Uncertainty factor
Mathematical adjustments for reasons of safety when knowledge is incomplete. For example, factors used in the calculation of doses that are not harmful (adverse) to people. These factors are applied to the lowest-observed-adverse-effect-level (LOAEL) or the no-observed-adverse-effect-level (NOAEL) to derive a minimal risk level (MRL). Uncertainty factors are used to account for variations in people's sensitivity, for differences between animals and humans, and for differences between a LOAEL and a NOAEL. Scientists use uncertainty factors when they have some, but not all, the information from animal or human studies to decide whether an exposure will cause harm to people [also sometimes called a safety factor].

Urgent public health hazard
A category used in ATSDR's public health assessments for sites where short-term exposures (less than 1 year) to hazardous substances or conditions could result in harmful health effects that require rapid intervention.

Volatile organic compounds (VOCs)
Organic compounds that evaporate readily into the air. VOCs include substances such as benzene, toluene, methylene chloride, and methyl chloroform.

Other glossaries and dictionaries:
Environmental Protection Agency (http://www.epa.gov/OCEPAterms/)

National Center for Environmental Health (CDC)
(http://www.cdc.gov/nceh/dls/report/glossary.htm)

National Library of Medicine (NIH)
(http://www.nlm.nih.gov/medlineplus/mplusdictionary.html)

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