Oregon Department of Human Services
Superfund Health Investigation and Education Program (SHINE)

HEALTH CONSULTATION

Cancer Investigation for Three Neighborhoods Surrounding J.H. Baxter & Co. Eugene, OR

Public Comment Release
September 1, 2006 to September 30, 2006

Prepared by the
Oregon Public Health Division
Superfund Health Investigation and Education Program

Under Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

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Public Comment Release

This document is being released for public comment. The public comment period is an opportunity for the public to comment on SHINE's findings or proposed activities contained in this draft document. The public comment period for this document is from September 1, 2006, through October 15, 2006. Comments are requested and should be directed to

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Or you can call 503-731-4025 to obtain an email address for submitting comments electronically.

Summary

The Superfund Health Investigation and Education (SHINE) program, part of Oregon Public Health Division (OPHD), developed this health consultation in response to a cancer investigation request in the neighborhoods of Bethel, River Road, and Trainsong located in Northwest Eugene, Oregon. These densely populated neighborhoods border the J.H. Baxter wood treatment plant, along with several other industrial sites. While collecting community concerns for the J.H. Baxter site in 2003, SHINE was petitioned by community members living in this area to investigate the incidence of acute myelogenous leukemia (AML) and brain cancer. Residents were concerned that there were excess rates of these two types of cancers, possibly caused by contaminants released from the wood treatment facility along with the other nearby industries. SHINE reviewed cancer rates in this area to determine if the number of cases of AML, brain, nasal, and lung cancers was higher than expected from 1996 to 2003, the years for which data are available from the state cancer registry. The cancer investigation focused on the rates of these cancers in the six census tracts that make up the Bethel, River Road, and Trainsong neighborhoods. Rates of AML and brain cancer were reviewed because these were the cancers residents thought might be occurring at higher rates. Rates of lung and nasal cancer were added to the review because of the close proximity of the wood treatment plant and the association between exposure the wood preservative creosote with these cancers. There were no statistically significant elevations for any of the cancers in the area investigated.

Purpose and Health Issues

The Superfund Health Investigation and Education (SHINE) program, part of Oregon Public Health Division, prepared this health consultation to address whether certain types of cancer are elevated in the neighborhoods of Bethel, River Road, and Trainsong located in northwest Eugene, Oregon. While collecting community concerns for the J.H. Baxter site in 2003, SHINE was petitioned by community members living in this area to investigate the incidence of acute myelogenous leukemia (AML) and brain cancer.

In 2003, SHINE completed a health consultation for J.H. Baxter , which concluded that there was not enough data to evaluate whether contaminants being released from J.H. Baxter posed a public health risk. The document stated that although the low-level concentrations of contaminants from J.H. Baxter were not likely to be associated with elevated cancer rates, the investigation should be conducted to address the resident's concerns [1]. SHINE recommended that the Oregon State Cancer Registry (OSCaR) and SHINE collaborate to complete this investigation. Excess brain cancer rates were brought up as a concern during a public meeting for J.H. Baxter so it was added to the investigation.

In 2004, OSCaR performed an initial investigation into the rates of AML and brain cancer in northwest Eugene near J.H. Baxter. That investigation used data reported at the zip code level, and produced no evidence of increased rates for the cancers of concern.

At that time, OSCaR was in the process of adding data to their database that allowed them to analyze the data for individual census tracts, which are smaller geographic areas than zip codes. OSCaR and SHINE concluded that when the complete data set became available, another review of the data would be performed. This health consultation summarizes the results of the census tract-level cancer investigation performed by OSCaR.

The follow-up census tract-level cancer investigation began in the winter of 2005. The focus was on census tracts 26.00, 27.00, 28.00, 41.00, 42.00, and 43.00 because they make up the majority of the area in the Bethel, River Road, and Trainsong neighborhoods. In addition to AML and brain cancer, SHINE requested that OSCaR expand the investigation to include lung and nasal cancer because these cancers have been linked to exposure to creosote which is used for wood treatment by J.H. Baxter.

This health consultation focuses on answering the specific question about cancer rates in these neighborhoods. SHINE is aware that, in addition to cancer rates, residents in the three neighborhoods have expressed concerns about other potential health effects from exposure to contaminants released by J.H. Baxter and the other industrial sites in the immediate area. Although there are many sources of contamination near the three neighborhoods, we are unable to draw conclusions about the public health impacts related to the individual or collective contaminant sources at this time. SHINE does plan to re-evaluate the public health impact posed by emissions from J.H. Baxter as air monitoring results become available.

Background

In 2003, residents of the Bethel, River Road, and Trainsong neighborhoods expressed concern to SHINE staff about increased rates of AML and brain cancer due to chemicals released by industrial sites closely bordering the densely populated neighborhoods. A map of the area of interest can be seen in Figure 1. According to the U.S. 2000 Census (Table 1), approximately 36,000 people live in Bethel, River Road, and Trainsong neighborhoods. The primary census tracts that make up the three neighborhoods are 26.00, 27.00, 28.00, 41.00, 42.00, and 43.00 (Figure 1).

The concerns about cancer rates were raised while SHINE was evaluating the health risk posed by emissions from J.H. Baxter and Company, a wood treatment plant. The original complaint from community members was the unpleasant odor coming from wood creosoting plant. During a public meeting they described their frustration with the odors coming from the plant, and their concerns that exposure to the chemicals coming from this plant could be causing health effects, specifically cancer, in local residents. The chemical compounds used as preservatives at J.H. Baxter include pentachlorophenol, creosote, and ammonia copper zinc arsenate (ACZA). SHINE prepared an initial health consultation to evaluate public health risks related to emissions from the J.H. Baxter plant. Inhalation was identified as a completed exposure pathway for the site. The initial consultation concluded that there was an *indeterminate public health hazard* because of a lack of data. The health consultation recommended that more data on emissions from the

site be gathered to better assess chemicals released by the plant. The health consultation also concluded that an investigation be conducted to address the cancer concerns raised by community members although it was unlikely that the wood preservative emissions from the plant could be associated with increased cancer rates. It was suggested that the cancer investigation be conducted in coordination between the community, SHINE, and the Oregon State Cancer Registry (OSCaR). The Lane Regional Air Pollution Agency (LRAPA) is currently conducting air sampling, and a follow-up health consultation will be prepared after this sample collection is complete to re-assess public health risk from exposure to contaminants from J.H. Baxter.

Several other industrial sites also exist near residents' homes in or near the Bethel, River Road, and Trainsong neighborhoods (Figure 1), including Union Pacific Railroad (UPRR), many of which contain chemicals released in the area that are known or suspected carcinogens. Although there are many sources of contamination in these neighborhoods, we are unable to draw conclusions about the public health impacts from the individual or collective contaminant sources at this time.

Community Health Concerns

SHINE has had many opportunities to collect and listen to concerns expressed by residents in Trainsong, Bethel, and River Road neighborhoods over the past several years. Concerns have ranged from the immediate effects of breathing in air emissions from J.H. Baxter to long-range health effects, particularly cancer. Other long-term concerns include endocrine disruption, and damage to the respiratory and immune system. Residents have expressed concern regarding the contamination of air, soil, and water. Several residents have questions about how contaminants released from heavy automobile traffic and the numerous industrial sites may interact and impact the health of neighborhood residents.

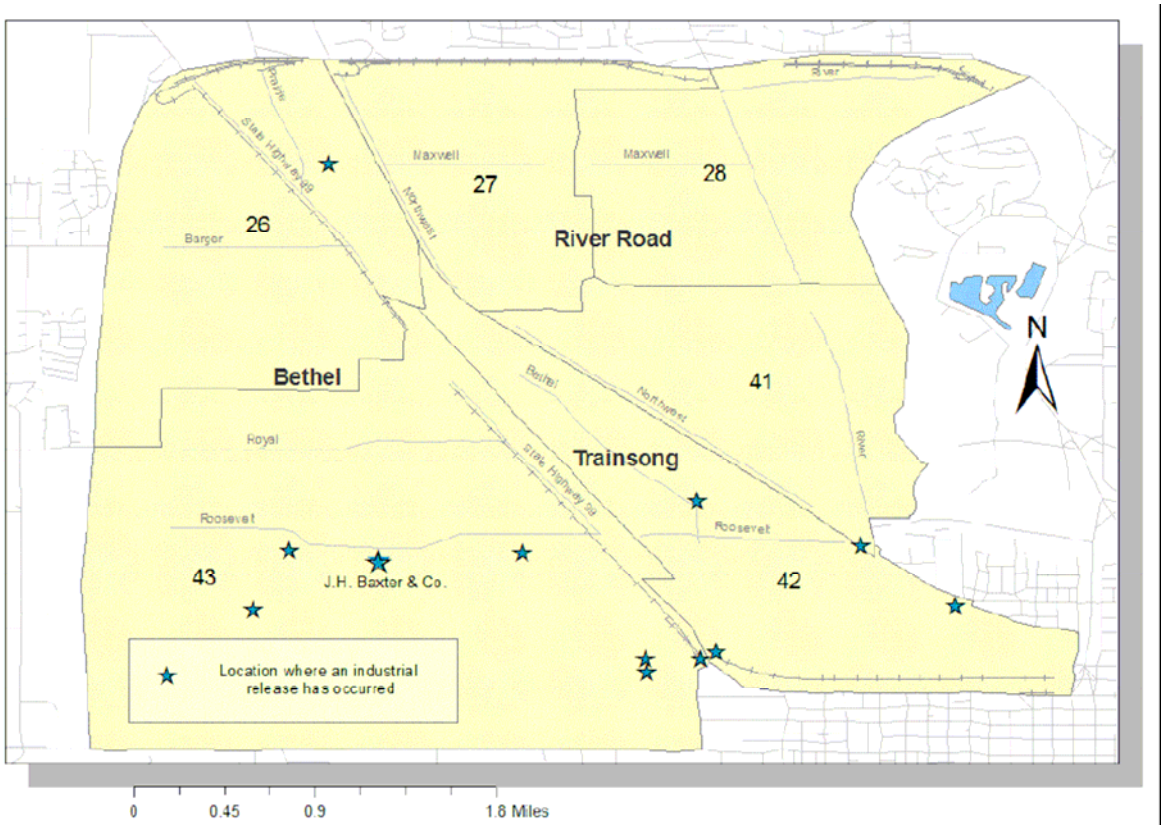
Residents' specific concerns related to a potential cancer cluster stemmed from a number of AML cases within a small area in the Bethel neighborhood. Residents also learned about what seemed to them an unusual number of brain cancer cases in the neighborhood. Because of the odors from J.H. Baxter and knowledge about chemicals released by the different industrial sites, residents came to believe that these cancer cases were related to environmental exposures. This document is intended to address some of those concerns.

Eugene Neighborhood Cancer Investigation History

In 2004, information on cancer rates was only available at the zip code level (for zip code 97402) at the time the initial Eugene cancer investigation was requested for AML and brain cancer [2]. Because of the data limitations, a more detailed look at cancer incidence at the neighborhood level was not possible in 2004. Residents felt there were an unusual number of AML cancer cases within the Bethel neighborhood, a much smaller area than what was reviewed at the zip code level. A community member consulted with

a local physician and he stated that he thought the number of AML cases in the small geographic area seemed elevated. The neighborhood associations also felt that they knew of an unusually large number of brain cancer cases in northwest Eugene but did not specify in which neighborhood. In 2004, an OSCaR staff member recommended that a more detailed cancer investigation be conducted at the census tract level once geocoded information was available to better address area residents' specific concerns.

Figure 1. Map of Census Tracts and Industrial Sites in Bethel, River Road, and Trainsong Neighborhoods, Eugene, OR.



Methods

After the data for census tracts became available for the years 1996 to 2003, the Oregon State Cancer Registry (OSCaR) reviewed cancer cases for the census tracts that make up the majority of the area in the Bethel River Road, and Trainsong neighborhoods. Information available from OSCaR about cancer in Oregon comes from a variety of sources including hospital cancer registries/medical records departments, ambulatory surgical centers, physician offices, pathology laboratories, other state cancer registries, and death certificates. Citizens can also report cases to OSCaR directly by means of the "Cancer Inquiry Report Form".

The number of cancer cases (the "observed" cases) in each identified census tract was compared with the number of "expected" cases for each census tract during the years

between 1996 and 2003 (See summary below). OSCaR used current cancer rates in the State of Oregon to calculate the number of cases of AML, brain, lung, and nasal cancers expected in these census tracts (background information on these four cancers can be found in Appendix A). They also did a comparison for all other cancers combined to determine whether cancer in general is elevated in those census tracts.

Table 1. Demographic Information for Bethel, River Road, and Trainsong Neighborhoods*

	Bethel	River Road	Trainsong
Total Population	22,689	11,731	1,775
Percent of Total Eugene Population	14.10%	7.30%	1.50%
Male	11,004	5,741	943
Female	11,685	5,990	832
Race or Ethnicity			
White	20,536	10,440	1,452
Black	216	123	13
American Indian Alaskan Native	246	180	22
Asian	298	98	13
Native Hawaiian, Pacific Islander	42	24	6
Hispanic or Latino	1,236	721	306
Other race	508	368	169
Two of more races	843	498	100
Number of Households	9,295	4,686	713
Renter Occupied	2,636	1,498	436
Owner Occupied	6,173	3,042	212
% Population below poverty level - 1999	11.70%	12.60%	38.40%

*Data is specifically for the 6 census tracts that make up the majority of Bethel, River Road and Trainsong Neighborhoods.

The method for calculating the expected number of cases in a small geographic area often produces some odd effects; specifically it is not uncommon that the number of expected cases at the census tract level could be expressed as a fraction of a person, (i.e 2.4 expected cases). This is because the number of expected cases is based on the number of cases in the larger population, and cancer at the population level is expressed in terms of the number of cases per 100,000 people. For example, if the rate for the number of bladder cancer cases in Oregon in 1996 was 24/100,000 and we were looking at a geographic area that only included 1,000 people we would say the number of expected cases of bladder cancer is .24 - or roughly ¼ of a case. This happens because there is a relatively low rate of bladder cancer at the population level (i.e. 0.24) and because the local population is small (1,000). This is important to understand because of the way that we express the excess number of observed cases. For instance, if we expect .24 cases, and

we observe 1 case, mathematically we would say we have four times thenumber of cancer cases than expected. This is misleading because it suggests that we have a much larger problem than we actually do, when what we actually have is a mathematical effect from a small numbers of cases.

One way to address this problem caused by small numbers is to test the numbers statistically. A statistical test, called a chi-square test, is run on the observed vs. expected numbers to determine if there is a "statistically significant" difference between the numbers we expect to see and number we actually see. This test helps us evaluate whether the difference between the expected and observed numbers is significant and not a result of chance or coincidence. It does not, however, tell us why there is a significant difference.

Results

After running statistical tests, we learned that there were no statistically significant elevations for any of the cancers investigated, in any of the census tracts during the period 1996-2003 in the three Eugene neighborhoods.

Table 2 is a summary of cancer cases for all six-census tracts from 1996 to 2003 and compares the actual number of cases (the "observed") to the number of cases we would expect to see, based on the rates of these cancers in Oregon. In one instance the number of cases of brain cancer was significantly greater than the number of cases we expected to find; in census tract 26 there were 6 cases of brain cancer when we expected to see 2.8. We examined the data for brain cancer more closely and could see the number of cases of brain cancer was higher than expected in the years 2001 and 2002, but there was no significant elevation in the observed number of cases in that census tract before 2001 or after 2002 (Table 3).

Table 2. Summary of Cancer Cases in Six Census Tracts in Northwest Eugene, OR between 1996-2003 (See Appendix A for Detailed Data Tables).

Census Tract	1996-2003									
	AML		**Lung****		**Brain**		**Nasal**		**All Cancers ****	
	Obs	*Exp*	*Obs*	*Exp*	*Obs*	*Exp*	*Obs*	*Exp*	*Obs*	*Exp*
26	1	2.2	33	24.2	6	2.8	1	0.3	155	150.0
27	0	1.6	24	19.0	0	2.1	0	0.2	109	114.6
28	2	1.5	11	18.2	4	2.1	0	0.2	102	114.5
41	1	1.4	19	15.3	3	2.0	0	0.2	90	101.6
42	0	1.1	21	8.5	2	1.6	1	0.1	55	67.0
43	6	3.0	31	37.1	4	3.7	0	0.4	184	220.2
Total	**10**	**10.8**	**139**	**122.3**	**19**	**14.3**	**2**	**1.4**	**695**	**767.9**

**Chi Square = 3.657, p<.05*
***Data not available for 2003*

While we are always concerned with possible evidence of higher than expected rates of cancer, it is difficult to draw conclusions from these findings because small increases in cancer rates in small geographic areas are not uncommon. In other words, this measurable increase in brain cancer may be due to chance; a possibility strengthened by the fact that we only see an increase over a two-year period, with very low numbers of cases in the years before the 2001 and no cases after 2002.

Sensitive Populations

Several factors put people at greater risk for developing cancer. Some people are more susceptible to developing cancer because they inherit altered genes, a weak immune system, or altered hormone levels [3]. Exposure to a cancer-causing chemical, behavioral choices, health, age, and gender can put people at greater risk for developing different types of cancer in addition to inherited conditions or genes. Occupational exposure to certain substances may also put workers at greater risk for developing cancer.

Child Health Considerations

In general, SHINE and ATSDR recognize that infants and children may be more vulnerable than adults to exposures to contaminants in air, water, soil, or food. However, children in this area were no more likely to have increased rates of cancer than their adult counterparts.

Conclusions

There were no statistically significant elevations for any of the cancers in the area investigated. Observed cases of brain cancer were higher than expected in tract 26.00 during 2000 and 2001. However, over the period from 1996 to 2003, this elevation was not statistically significant, and no cases of brain cancer have occurred since 2001. AML, lung, nasal, and all other cancers combined are not statistically significantly elevated in the six census tracts that make up the majority of Bethel, River Road, and Trainsong neighborhoods in Northwest Eugene, Oregon. Observed elevation of malignant brain cancer cases in census tract 26.00 (northwest Bethel neighborhood) is also not statistically significant and appears to not be ongoing. This elevation occurred only for the years 2001 and 2002 and did not occur in the five years prior or two years after. Environmental contamination from J.H. Baxter or other industrial sites do not appear to be causing elevated rates of cancer in the Bethel, Trainsong, and River Road neighborhoods. This investigation was limited by a number of factors; specifically the limited availability of data for cancer incidence, the fact that there was no exposure information on any of the 6 identified cases, and finally that relied on population estimates to calculate expected rates of cancer in the census tracts. Despite these limitations we have concluded that there is no statistically significant increase in the number of cancers when compared with the expected number of cases in this area.

Recommendations/Public Health Action Plan

SHINE has arranged with OSCaR to monitor the cancer rate, and specifically the brain cancer rate, in census tract 26 as it becomes available for 2005 and 2006 to verify that elevations in brain cancer cases noted in that tract in 2000 and 2001 was due to chance and not ongoing.

SHINE will continue community involvement and outreach activities in the neighborhoods of Bethel, River Road, and Trainsong to address concern about environmental contaminants in the area and their impacts on public health.

A follow-up health consultation will be prepared for J.H. Baxter, a site of concern for neighbors in Bethel, River Road, and Trainsong neighborhoods, when air-monitoring data becomes available.

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Certification

The Superfund Health Investigation and Education Program of the Oregon Department of Human Services prepared this report of a cancer investigation for the Bethel, River Road, and Trainsong neighborhoods under a cooperative agreement with the Agency for Toxic Substances and Disease Registry. This document was completed in accordance with approved methodology and procedures existing at the time the health consultation was initiated. Editorial review was completed by the Cooperative Agreement partner.

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Robert Knowles
Technical Project Officer for Oregon, SSAB, DHAC

I have reviewed this health consultation, as the designated representative of the Agency for Toxic Substances and Disease Registry and concur with its findings.

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Alan Yarbrough, M.S.
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Appendix A - General Cancer Information

Note – The citations listed in this section can be found in the reference section at the end of the main body of this document

The American Cancer Society (ACS) estimates that approximately one in two men and one in three women will develop cancer in their lifetime [4]. Nearly eighty percent (77%) of all cancer cases occur in adults 55 years or older. It is a disease associated with increasing age. It is the leading cause of death for people under the age of 85 [5], and the second leading cause of all deaths in the United States.

Cancer, a group of over 200 diseases, develops inside the cell and disrupts the normal process of cell development [3]. Cancer causes cells to divide continuously when new cells are not needed.

It is estimated that smoking causes nearly two-thirds of cancers, and 25-30% of cancers are caused by obesity and physical inactivity. [3]. Other environmental factors linked to cancer include viruses, radiation, medications, and chemicals in the air and water. Identifying the factor or factors that act alone or in combination to cause cancer is difficult.

A cancer cluster is defined as a greater-than-expected number of cancer cases that occurs within a group of people in a geographic area over a period of time [6]. It is not uncommon to wonder about the cause of cancers when they are grouped in a geographic area and people often fear that pollution or environmental contamination is the cause. Cancer clusters can and do occur because of exposures from a common source but they are difficult to document [5]. There are some important considerations to take into account when trying to evaluate whether a cancer cluster exists.

1.) Cancer is the second leading cause of death in the U.S., and consists of about 200 different types and may not share a common cause.
2.) It is difficult to track the cause of most cancers. For some, the cause is unknown and for others there may be a long period of time between one more exposures that trigger the disease and the diagnosis of cancer.
3.) A person may change residence between exposure and development of cancer, often making it difficult draw the connection between exposure and disease.
4.) Occupation and individual behavior (smoking, nutrition, exercise) play significant roles in the risk of developing cancer.

Possible cancer clusters can initially be evaluated by defining a population (i.e., neighborhood or workplace) and calculating the expected number of cases in that group over a period of time, based on a comparison population. The observed number of cases is then compared to the expected number of cancer cases in that population.

AML

Acute myelogenous leukemia (AML) is the most common type of leukemia, a cancer of the blood and bone marrow [7]. It causes the production of abnormal cells including

blasts that normally develop into white blood cells, red blood cells, and platelets. The abnormal leukemia cells crowd out normal red and white blood cells and platelets. It is a disease that usually affects older adults (average age at diagnosis is 65 years) and nearly 12,000 new cases are diagnosed in the U.S. each year.

Occupational exposures to certain hazardous substances and specific occupations are associated with an increased risk of developing leukemia [8]. A strong association exists between exposure to benzene, ethylene oxide, and ionizing radiation along with working in boot and shoe manufacturing and repair. An association means there is evidence of a link between an environmental exposure and a disease [9] but it does not assume that exposure to that substance will automatically result in that disease. An association between exposure and disease does not automatically mean that exposure to a hazardous substance will automatically result in a disease. Other substances or industries that may also be linked to an increased risk of developing leukemia are formaldehyde, non-arsenical (non-arsenic containing) pesticides and the rubber industry or petroleum refining [8].

Brain

Brain cancers are categorized according to the type of cell affected. There are several types of brain cancers since tumors can form in any of the brain tissues, cells, or a mixture of cell types [4]. Only primary malignant brain tumors were included in this investigation – not benign tumors or tumors that had spread from other sites.

There is strong evidence linking brain cancer with pesticide exposure and ionizing radiation [5]. There is some evidence of a link between brain cancer and solvents such as benzene and toluene and metals such as lead, arsenic and mercury.

Lung

Lung cancer is the second most common type of cancer[5]. It is estimated that nearly 175,000 people will develop lung cancer in the U.S. in 2006 [10]. There are two main types of lung cancer small cell and non-small cell.

Several environmental contaminants are associated with lung cancer in addition to the well-known link between lung cancer and tobacco smoke. Natural fibers such as silica, wood dust, and asbestos are strongly linked with lung cancer as well as exposure to arsenic, beryllium, cadmium, and chromium [5]. Exposure to polycyclic aromatic hydrocarbons (PAHs), ionizing radiation, benzene, toluene, mustard agent, and coal tar pitch is also linked with lung cancer.

Nasal

Nasal cancer is a rare cancer that affects approximately 2,000 people each year in the U.S. [11]. Several different cells make up the nasal cavity resulting in several different potential types of nasal cancer [4]. The most common type of nasal cancer is squamous cell carcinoma.

Occupational exposures have been linked to nasal cancer including exposure to dusts from wood, textiles, and leather, glues, formaldehyde, solvents used in furniture and shoe production, nickel and chromium dust, mustard agent, isopropyl ("rubbing") alcohol, and radium [4]. Inhalation of napthalene, a PAH that is a major constituent of coal tar and petroleum, has also been shown to cause nasal cancer in an animal study [12].

Appendix B. ATSDR Plain Language Glossary of Environmental Health Terms.

Absorption	How a chemical enters a person's blood after the chemical has been swallowed, has come into contact with the skin, or has been breathed in.
Acute Exposure	Contact with a chemical that happens once or only for a limited period of time. ATSDR defines acute exposures as those that might last up to 14 days.
Additive Effect	A response to a chemical mixture, or combination of substances, that might be expected if the known effects of individual chemicals, seen at specific doses, were added together.
Adverse Health Effect	A change in body function or the structures of cells that can lead to disease or health problems.
ATSDR	The **A**gency for **T**oxic **S**ubstances and **D**isease **R**egistry. ATSDR is a federal health agency in Atlanta, Georgia that deals with hazardous substance and waste site issues. ATSDR gives people information about harmful chemicals in their environment and tells people how to protect themselves from coming into contact with chemicals.
Background Level	An average or expected amount of a chemical in a specific environment. Or, amounts of chemicals that occur naturally in a specific environment.
Bioavailability	See **Relative Bioavailability**.
Cancer	See **C**ommunity **A**ssistance **P**anel.
Carcinogen	A group of diseases which occur when cells in the body become abnormal and grow, or multiply, out of control
CERCLA	Any substance shown to cause tumors or cancer in experimental studies.
Chronic Exposure	See **C**omprehensive **E**nvironmental **R**esponse, **C**ompensation, and **L**iability **A**ct.
Completed Exposure Pathway	A contact with a substance or chemical that happens over a long period of time. ATSDR considers exposures of more than one year to be *chronic*.

Comparison Value (CVs)	A group of people from the community and health and environmental agencies who work together on issues and problems at hazardous waste sites.
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)	Concentrations of substances in air, water, food, and soil that are unlikely, upon exposure, to cause adverse health effects. Comparison values are used by health assessors to select which substances and environmental media (air, water, food and soil) need additional evaluation while health concerns or effects are investigated.
Concern	**CERCLA** was put into place in 1980. It is also known as **Superfund**. This act concerns releases of hazardous substances into the environment, and the cleanup of these substances and hazardous waste sites. This act created ATSDR and gave it the responsibility to look into health issues related to hazardous waste sites.
Concentration	A belief or worry that chemicals in the environment might cause harm to people.
Contaminant	How much or the amount of a substance present in a certain amount of soil, water, air, or food.
Delayed Health Effect	See **Environmental Contaminant**.
Dermal Contact	A disease or injury that happens as a result of exposures that may have occurred far in the past.
Dose	A chemical getting onto your skin. (see **Route of Exposure**).
Dose / Response	The amount of a substance to which a person may be exposed, usually on a daily basis. Dose is often explained as “amount of substance(s) per body weight per day”.
Duration	The relationship between the amount of exposure (dose) and the change in body function or health that result.
Environmental Contaminant	The amount of time (days, months, years) that a person is exposed to a chemical.
Environmental Media	A substance (chemical) that gets into a system (person, animal, or the environment) in amounts higher than the **Background Level**, or what would be expected.

U.S. Environmental Protection Agency (EPA)	Usually refers to the air, water, and soil in which chemicals of interest are found. Sometimes refers to the plants and animals that are eaten by humans. **Environmental Media** is the second part of an **Exposure Pathway**.
Epidemiology	The federal agency that develops and enforces environmental laws to protect the environment and the public's health.
Exposure	The study of the different factors that determine how often, in how many people, and in which people will disease occur.
Exposure Assessment	Coming into contact with a chemical substance.(For the three ways people can come in contact with substances, see **Route of Exposure**.)
Exposure Pathway	The process of finding the ways people come in contact with chemicals, how often and how long they come in contact with chemicals, and the amounts of chemicals with which they come in contact.
Frequency	A description of the way that a chemical moves from its source (where it began) to where and how people can come into contact with (or get exposed to) the chemical. ATSDR defines an exposure pathway as having 5 parts 1. Source of Contamination, 2. Environmental Media and Transport Mechanism, 3. Point of Exposure, 4. Route of Exposure, and 5. Receptor Population. When all 5 parts of an exposure pathway are present, it is called a **Completed Exposure Pathway**. Each of these 5 terms is defined in this Glossary.
Hazardous Waste	How often a person is exposed to a chemical over time; for example, every day, once a week, twice a month.
Health Effect	Substances that have been released or thrown away into the environment and, under certain conditions, could be harmful to people who come into contact with them.
Indeterminate Public Health Hazard	ATSDR deals only with **Adverse Health Effects** (see definition in this Glossary).

Ingestion	The category is used in Public Health Assessment documents for sites where important information is lacking (missing or has not yet been gathered) about site-related chemical exposures.
Inhalation	Swallowing something, as in eating or drinking. It is a way a chemical can enter your body (See **Route of Exposure**).
LOAEL	Breathing. It is a way a chemical can enter your body (See **Route of Exposure**).
Malignancy	**L**owest **O**bserved **A**dverse **E**ffect **L**evel. The lowest dose of a chemical in a study, or group of studies, that has caused harmful health effects in people or animals.
MRL	See **Cancer**.
NPL	**M**inimal **R**isk **L**evel. An estimate of daily human exposure – by a specified route and length of time -- to a dose of chemical that is likely to be without a measurable risk of adverse, noncancerous effects. An MRL should not be used as a predictor of adverse health effects.
NOAEL	The **N**ational **P**riorities **L**ist. (Which is part of **Superfund**.) A list kept by the U.S. Environmental Protection Agency (EPA) of the most serious uncontrolled or abandoned hazardous waste sites in the country. An NPL site needs to be cleaned up or is being looked at to see if people can be exposed to chemicals from the site.
No Apparent Public Health Hazard	**N**o **O**bserved **A**dverse **E**ffect **L**evel. The highest dose of a chemical in a study, or group of studies, that did not cause harmful health effects in people or animals.
No Public Health Hazard	The category is used in ATSDR's Public Health Assessment documents for sites where exposure to site-related chemicals may have occurred in the past or is still occurring but the exposures are not at levels expected to cause adverse health effects.
PHA	The category is used in ATSDR's Public Health Assessment documents for sites where there is evidence of an absence of exposure to site-related chemicals.
Plume	**P**ublic **H**ealth **A**ssessment. A report or document that looks at chemicals at a hazardous waste site and tells if people could be harmed from coming into contact with those chemicals. The PHA also tells if possible further public health actions are needed.

Point of Exposure	A line or column of air or water containing chemicals moving from the source to areas further away. A plume can be a column or clouds of smoke from a chimney or contaminated underground water sources or contaminated surface water (such as lakes, ponds and streams).
Population	The place where someone can come into contact with a contaminated environmental medium (air, water, food or soil). Some examples include the area of a playground that has contaminated dirt, a contaminated spring used for drinking water, or the backyard area where someone might breathe contaminated air.
Public Health Assessment(s)	**P**otentially **R**esponsible **P**arty. A company, government or person that is responsible for causing the pollution at a hazardous waste site. PRP's are expected to help pay for the clean up of a site.
Public Health Hazard	See **PHA**.
Public Health Hazard Criteria	The category is used in PHAs for sites that have certain physical features or evidence of chronic, site-related chemical exposure that could result in adverse health effects.
Reference Dose (RfD)	People who live or work in the path of one or more chemicals, and who could come into contact with them (See **Exposure Pathway**).
Relative Bioavailability	An estimate, with safety factors (see **safety factor**) built in, of the daily, life-time exposure of human populations to a possible hazard that is <u>not</u> likely to cause harm to the person.
Route of Exposure	The amount of a compound that can be absorbed from a particular medium (such as soil) compared to the amount absorbed from a reference material (such as water). Expressed in percentage form.
Safety Factor	The way a chemical can get into a person's body. There are three exposure routes – breathing (also called inhalation), – eating or drinking (also called ingestion), and – getting something on the skin (also called dermal contact).
SARA	Also called **Uncertainty Factor**. When scientists don't have enough information to decide if an exposure will cause harm to people, they use "safety factors" and formulas in place of the information that is not known. These factors and formulas can help determine the amount of a chemical that is <u>not</u> likely to cause harm to people.

Sample Size	The **S**uperfund **A**mendments and **R**eauthorization **A**ct in 1986 amended CERCLA and expanded the health-related responsibilities of ATSDR. CERCLA and SARA direct ATSDR to look into the health effects resulting from chemical exposures at hazardous waste sites.
Sample	The number of people that are needed for a health study.
Source (of Contamination)	A small number of people chosen from a larger population (See Population).
Special Populations	The place where a chemical comes from, such as a landfill, pond, creek, incinerator, tank, or drum. Contaminant source is the first part of an **Exposure Pathway**.
Statistics	People who may be more sensitive to chemical exposures because of certain factors such as age, a disease they already have, occupation, sex, or certain behaviors (like cigarette smoking). Children, pregnant women, and older people are often considered special populations.
Superfund Site	A branch of the math process of collecting, looking at, and summarizing data or information.
Synergistic effect	A way to collect information or data from a group of people (**population**). Surveys can be done by phone, mail, or in person. ATSDR cannot do surveys of more than nine people without approval from the U.S. Department of Health and Human Services.
Toxic	A health effect from an exposure to more than one chemical, where one of the chemicals worsens the effect of another chemical. The combined effect of the chemicals acting together are greater than the effects of the chemicals acting by themselves.
Toxicology	Harmful. Any substance or chemical can be toxic at a certain dose (amount). The dose is what determines the potential harm of a chemical and whether it would cause someone to get sick.
Tumor	The study of the harmful effects of chemicals on humans or animals.
Uncertainty Factor	Abnormal growth of tissue or cells that have formed a lump or mass.
Urgent Public Health Hazard	See **Safety Factor**.