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

Public Health Consultation

Follow-Up J.H. Baxter Health Assessment Based on New Air Monitoring Data

Eugene, Oregon

FINAL VERSION

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

Table of Contents

TABLES

FIGURES

Acronyms and Abbreviations

ACZA	Ammoniated Copper Zinc Arsenate
AML	Acute Myelogenous Leukemia
ATSDR	Agency for Toxic Substances and Disease Registry
CREG	Cancer Risk Evaluation Guide (Comparison Value)
DEQ	Oregon Department of Environmental Quality
DHS	Oregon Department of Human Services
EMEG	Environmental Media Evaluation Guide (Comparison Value)
EPA	U.S. Environmental Protection Agency
LRAPA	Lane Regional Air Pollution Agency
MRL	Minimal Risk Level (used by ATSDR)
OPHD	Oregon Public Health Division (within DHS)
PAH	Polycyclic Aromatic Hydrocarbon
PCP	Pentachlorophenol
OSCaR	Oregon State Cancer Registry
RfC	Reference Concentration (used by EPA)
SHINE	Superfund Health Investigation and Education Program
SVOCs	Semi-volatile Organic Compounds
TEF	Toxicity Equivalency Factor
VOCs	Volatile Organic Compounds

Summary

The Superfund Health Investigation and Education (SHINE) program, part of Oregon Public Health Division (OPHD), developed this Public Health Consultation (PHC) to evaluate the public health risk of exposure to air emissions from the J.H. Baxter wood treating facility in Eugene, Oregon. The public health implications of exposure to creosote was evaluated for residents living near J.H. Baxter in neighborhoods directly north, northwest, and northeast of the site. The health consultation is based on air monitoring conducted by the Lane Regional Air Protection Agency (LRAPA). Air monitoring was targeted on days when emissions from J.H. Baxter were expected to be at maximum levels and meteorological conditions were most likely to carry emissions towards the neighborhoods to the north. This was designed to try and capture worst case exposure scenarios. SHINE has concluded that the current air monitoring data does not indicate people will become chronically ill from the PAHs from J.H. Baxter creosote emissions. Although naphthalene levels exceed health guidelines, these guidelines are designed to be health protective and air levels just above these guidelines are not likely to result in adverse health effects.

However, residents may be experiencing physical effects due to stresses from creosote-related odors. Odors from J.H. Baxter's creosote emissions are still being detected by residents living near the site. Based on residents' complaints, the odors are triggering eye, nose, and lung irritation. Although SHINE does not anticipate adverse health effects from the emissions based on the measured air concentration, physical responses to the stress from the odors could be a public health concern. SHINE recommends that J.H. Baxter take additional actions to reduce the creosote-related odors emitted by J.H. Baxter into nearby neighborhoods.

Purpose and Health Issues

The Superfund Health Investigation and Education (SHINE) program in the Oregon Public Health Division (OPHD) developed this follow-up health consultation to evaluate exposure to air contaminants released by the J.H. Baxter and Company's wood-processing facility in Eugene, Oregon, into neighborhoods near the site. SHINE is part of the Oregon Department of Human Services (DHS) Public Health Division and evaluates the human health risks of exposure to environmental contaminants in Oregon through a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR).

J.H. Baxter is located just south of the Bethel neighborhood in Eugene and uses wood preservatives to treat wood. Since the 1990s, the Lane Regional Air Protection Agency (LRAPA) has been receiving complaints about odors and health concerns related to air emissions from J.H. Baxter. In 2004, SHINE developed an initial public health consultation (PHC) which stated that chemicals released into the air by the facility posed an *indeterminate health hazard*. In this initial health consultation, SHINE recommended that LRAPA develop an air-monitoring program to better assess exposure to air emissions [1]. Between 2005 and 2006, LRAPA

conducted initial screening air sampling to characterize the impact of hazardous air pollutants emitted from the J.H. Baxter facility. The sampling effort was also conducted to provide information for designing more comprehensive air sampling studies in the future if necessary [2] (Appendix A). This updated health consultation focuses on the public health implications of inhaling chemicals released into the air by J.H. Baxter based on the results of recent air monitoring efforts. Concern about the inhalation of air emissions from J.H. Baxter has been the predominant complaint expressed by residents living in the area. Other pathways of exposure from soil or groundwater will not be evaluated because this document is only intended to evaluate exposure to air emissions from J.H. Baxter.

SHINE's initial J.H. Baxter PHC also recommended that SHINE and the Oregon State Cancer Registry (OSCaR) work with the community to investigate whether there are elevated levels of brain cancer and Acute Myelogenous Leukemia (AML) in three neighborhoods near J.H. Baxter. Several people in the area had expressed concerns about elevated cancer rates in the area. A cancer investigation was conducted at the census tract level in 2006 for the Bethel, Trainsong, and River Road neighborhoods and a report that describes the findings of the investigation can be found on the SHINE website at: http://egov.oregon.gov/DHS/ph/shine/bxsite.shtml. A discussion about this cancer investigation can be found in the section of this report titled *Cancer Investigation in Bethel, River Road, and Trainsong Neighborhoods.*

Background

Site History

In October of 2003, in response to an increasing number of requests from persons living near J.H. Baxter, LRAPA asked SHINE to evaluate whether persons living near the Baxter site were at risk of harmful health effects from exposure to emissions from the wood-processing operations. Since the mid 1990s, LRAPA received numerous community complaints about odors from the plant as well as health concerns related to J.H. Baxter's emissions. An initial health consultation report was prepared by SHINE and concluded that additional air monitoring information was needed to conduct the evaluation of health risks posed by emissions from the plant.

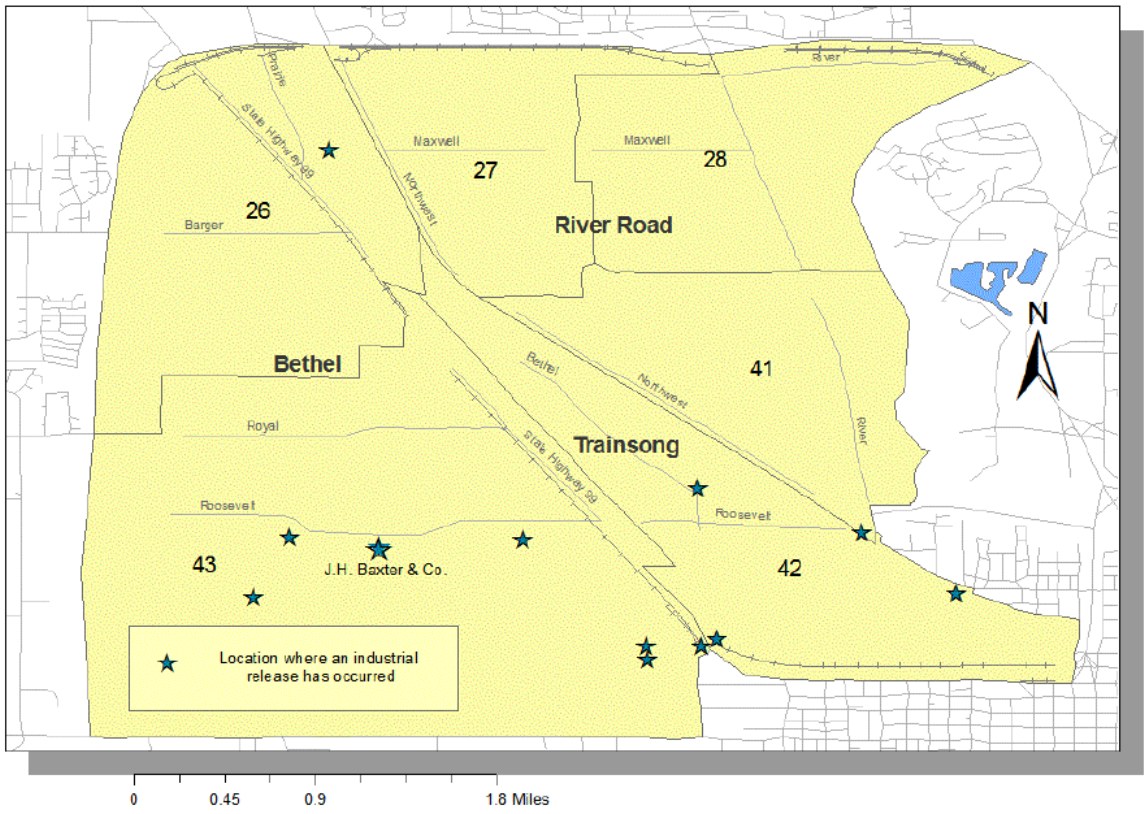
J.H. Baxter and Company is a wood-treatment facility in Eugene, Oregon that has been in operation since 1943. The company is located at 85 North Baxter Road on approximately 42 acres of land (Figure 1). Offices, wood storage and pressure-treatment facilities are located on the site. Among other wood products, utility poles, cross-arms, railroad ties, and posts are pressure treated at the plant. Substances used to treat the wood include creosote, pentachlorophenol (PCP), and ammoniated copper zinc arsenate (ACZA).

J.H. Baxter is located within the city limits of Eugene, Oregon, the second most populated city in Oregon. According to data from the 2000 U.S. Census, approximately 1,871 persons live within ½ mile of the site, and 6,852 people live within 1 mile. Wind direction is predominantly from the north or northeast during summer and from the southwest during winter. The areas to the

north, northwest, and west of J.H. Baxter are primarily residential. Industrial areas are located to the south, west, east, and northeast of the site.

Vapors are released from several locations around the J.H. Baxter facility. These sources include emissions released when: 1) doors to a retort (a steel cylinder in which the wood is treated) are opened after a treatment cycle, 2) from wood drying after treatment, and 3) from wood stored on the site. The air pathways that were identified as potential sources of exposure to nearby residents include direct exposure to airborne vapors and contaminated windblown dust [1]. Other facilities in the area are also potential sources of additional emissions. Among these facilities are a sewage treatment plant, a pulp mill, wood-products and recycling plants, coffee-processing plants, and the Union Pacific rail yard (UPRR).

Figure 1. The J.H. Baxter Site and Surrounding Neighborhoods



Steam injection of preservatives into retorts during wood pressure-treatment processes is a significant source of vapor emissions from the J.H. Baxter plant. LRAPA permits J.H. Baxter to emit air pollutants and volatile organic compounds from five retorts. LRAPA sets production limits of no more than 3,000,000 cubic feet of treated product per year, and requires that J.H. Baxter has no more than two retort door openings for creosote and PCP in any 60-minute period.

In the fall of 2002, J.H. Baxter initiated an odor-abatement project to reduce vapor and odor discharges during pressure-treatment operations. Large capacity vacuum pump systems were installed to condense vapor discharges and return the preservatives to the wood-treatment process. In addition to these measures, J.H. Baxter developed a method to cool the wood rapidly before opening the retort doors after treatment, which helps to reduce vapors emitted into the air when the doors are opened. Between 2003 and 2005, J.H. Baxter installed several different controls to reduce emissions and odor from their operations, including a carbon adsorption odor control system on their vacuum system and process tank vents [3]. J.H. Baxter estimates that this adsorption system results in a reduction of 3,512 pounds of creosote and fuel oil emissions per year. With the current odor control system, J.H. Baxter reported that their creosote and fuel oil emissions in 2005 were 5,578 pounds per year, and it was estimated that treated wood storage accounts for 64% of those emissions. The controls are listed in their *Engineering Effectiveness Report* released in November, 2005.

On and Off-site Soil, Groundwater, and Surface Water Investigations

The Oregon Department of Environmental Quality (DEQ) and J.H. Baxter have been investigating groundwater, surface water, and soil contamination at the site for nearly 20 years but there is limited off-site data [4]. The results of these investigations show that the level of contamination is highest near the wood treating-equipment. Offsite soil sampling on adjacent tax lots (non-residential) indicated that levels of arsenic were elevated. In 1999, J.H. Baxter removed soil that was contaminated with arsenic from four properties adjacent to the site. Sampling also showed that groundwater contamination extends off the site approximately 2,500 feet west and northwest of the facility. Between 1994 and 2001, 186 million gallons of groundwater, containing 774 pounds of pentachlorophenol and 3.8 pounds of PAHs, were extracted and treated [5].

SHINE is aware that there is some concern about offsite soil concentrations of arsenic due to dispersion of soils contaminated by ACZA treated wood. This exposure pathway will not be evaluated in this report but SHINE acknowledges it is a pathway that may need to be evaluated further in the future given there is adequate information to do so. The evaluation in this document will focus solely on exposure related to the inhalation of several air pollutants rather than exposure to contaminants in soil or water. SHINE may evaluate other pathways of exposure in a future document depending on the concern level and availability of necessary off-site data.

Creosote Emissions

Coal tar creosote is widely used as a wood preservative in the United States. Creosote is a general term that is used to describe a variety of products made from mixtures of chemicals. Some of the major components in creosote vapor include naphthalene, methylnaphthalene, indene, phenol, toluene, creosols, xylene, and xylenols [4]. Approximately 300 chemicals have been identified in coal tar creosote, but it is thought that as many as 10,000 may be present. It is estimated that naphthalene makes up 40% of gaseous emissions, by weight, from creosote [2, 6].

2-methylnaphthelene makes up 13%, dibenzofuran 5%, acenaphthene 5%, 1-methylnaphthalene 4%, fluorene 2%, and phenanthrene 1% of liquid creosote by weight [2]. Six of these seven compounds are polycyclic aromatic hydrocarbons (PAHs). PAHs are a group of chemicals that can be formed during the incomplete combustion or burning of coal, oil, gas, wood, garbage, or other organic substances, and they are known to be major components of creosote.

Community Concerns

LRAPA has received numerous complaints since the 1990s from people living near the Baxter site. Complaint logs and personal communications indicate that people living near the site experience a "creosote" or "tar-like" smell and "ammonia-like" odors emitted by J.H. Baxter. The number of complaints received by LRAPA increased significantly in 2003 from those received in previous years. Complaints have been reported from multiple locations, but more of the complaints come from areas immediately north and northeast of the site. Complaints occur more frequently during the months of July, August, and September. Not all of the complaints received have been solely linked to J.H. Baxter; however, the majority of complaints have been linked to the creosote/tar-like odor. Creosote is the wood preservative used by J.H. Baxter most likely to be associated with the kind of complaints received by LRAPA for residents living in the Bethel, River Road, and Trainsong neighborhoods.

Three neighborhoods in the area reported the largest number of complaints to LRAPA; specifically the Bethel, Trainsong, and River Road neighborhoods (Figure 1). The Bethel neighborhood spans many blocks, extending from Irving Road in the north to Roosevelt Boulevard in the south. The Baxter site is located along Baxter Street and Roosevelt Boulevard in the southeast corner of the Bethel neighborhood. The Trainsong neighborhood is northeast of the Baxter site and is between Highway 99 and the Union Pacific railyard. The River Road neighborhood is farther northeast of the Baxter site, past the Northwest Expressway and the rail yard.

On December 9, 2003, SHINE hosted a public meeting with a public availability session to meet with people from the three neighborhoods. SHINE received more than 50 comment sheets after the meeting, some at the meeting and some through the mail. SHINE also received comments from community members during another community meeting hosted by LRAPA on June 29, 2005. Because the smell and effects caused by these emissions are worse on hot days when the air is stagnant, residents report keeping their windows shut when they would normally want them open. Local residents have reported health concerns that include sore throat, eye irritation, headache, nausea, chronic pain, immune system impairment, difficulty in breathing, dizziness, arthritis, allergy and sinus problems, increased skin irritation and sensitivity, endocrine changes, obesity, depression, and elevated rates of acute myelogenous leukemia (AML), a malignant disease of bone marrow. The most common complaints were the presence of noxious odors, headaches, dizziness, nausea, eye irritation, and difficulty breathing.

Several community members reported to SHINE staff that the intensity and frequency of odors had increased since the late 1990s and they were most prevalent at night and during the summer.

Increased production could be a contributing factor to increased odors described by the neighbors in recent years. In 2002, 744,974 cubes of wood were treated at J.H. Baxter, approximately 25% more than the amount treated in 1998. J.H. Baxter indicated that products treated with creosote increased in 2003 as the number of suppliers had decreased without a lessening of the demand for treated wood (Gary Hunt, J.H. Baxter, personal communication, December 9, 2003). LRAPA has indicated that the frequency of complaints has declined since J.H. Baxter installed the carbon adsorption odor controls in the summer of 2005; however community members have said the odors and health concerns persist.

Environmental Sampling Methods and Approach

The initial PHC report released by SHINE in 2004 recommended that LRAPA conduct air sampling surrounding the J.H. Baxter facility to better characterize the impact of emissions from the plant on people living in adjacent and nearby neighborhoods. Since the release of that document, LRAPA collected 22 short-term samples (collection time ran one to three hours) and 31, 24-hour air samples. The short-term samples were collected on eight different days in 2005 and early 2006; the 24-hour samples were collected over 10 days from May through December 2006 for a total of 18 different sampling events. The samples were collected from 12 different locations surrounding the J.H. Baxter wood treatment facility (Figure 2). Eleven sampling locations were directly North, Northeast, or Northwest of J.H. Baxter in or near the Bethel neighborhood. This is the closest neighborhood to the facility. Sampling was also conducted at one site immediately south of J.H. Baxter in an industrial, non-residential area.

The air monitoring data collected by LRAPA provided SHINE with the information to evaluate potential health risks and impacts from odors and vapors emitted by the site on nearby residents. It also provided an opportunity to determine whether additional sampling is warranted in the future.

The details for the sampling method used by LRAPA can be found in Appendix A. LRAPA aimed to collect samples on days when the wind blew from a southerly direction. A meteorological station was set up by LRAPA at the northwest corner of the J.H. Baxter site to aid in the identification of ideal meteorological conditions. Southerly winds are most likely to carry contaminants from the site into the dense neighborhoods situated north of the site. Sampling dates were also selected based on days when creosote emissions were expected to be at maximum rates. Monitoring on days when the wind was blowing directly from the south and when emissions rates were at their maximum was considered to be a worst-case human exposure scenario. It is common to evaluate health risks posed during worst-case exposure conditions to ensure that public health recommendations are health protective for the most vulnerable individuals. LRAPA did not specifically target sampling for days when weather conditions resulted in very stable air known as an inversion but theoretically these conditions could lead to worst-case exposure scenarios. The stable air, or stagnant air, traps pollutants and is less likely to carry them away from the pollution source.

LRAPA monitored for hazardous air pollutants most likely to be found in the wood preservatives creosote and PCP. The chemicals in these preservatives can vaporize and migrate off site into

nearby neighborhoods. The monitoring plan was designed to detect volatile organic compounds (VOCs) such as benzene, toluene, acetone, and xylene, and semi-volatile compounds (SVOCs) known as polycyclic aromatic compounds (PAHs), in addition to PCP. VOC monitoring was eventually suspended because the method to measure them was not cost effective and it became apparent that SVOCs make up the majority of emissions from J.H. Baxter so sampling became targeted to SVOCs [2]. PAHs, primarily a specific compound called naphthalene, are a major component of creosote.

Figure 2. Environmental Sampling Locations

Figure provided by LRAPA.

Environmental Sampling Results

The list of compounds LRAPA detected and the percentage detections for each compound are listed in Table 1 (127 different compounds were included in the analysis but not all of these were detected). Not all of the compounds that were analyzed for were detected during each monitoring event, but all were detected at least once. The detections are shown in the columns labeled "Percent of Samples with Detections." Compounds detected in more than 25% of the

samples are highlighted in bold in Table 1. If compounds were detected in less than 25% of the samples, it was assumed that they are not consistently present in ambient air around J.H. Baxter and therefore not frequently found in the air local residents are breathing. The maximum levels of the compounds that were not frequently detected were also compared to health guidelines and all of them were well below the guidelines; therefore, these compounds did not warrant further analysis. The detailed sampling results for both short and long-term samples can be found in Appendix B.

Although PCP was on the list of compounds measured during sampling, it was not detected in ay of the samples. 50% of the short-term samples were collected during PCP treatment, and 50% of the samples were collected during creosote treatment. 75% of the 24-hour sample were collected during PCP treatment, and 25% were collected during creosote treatment. Since PCP was not detected in any of the samples, it will not be evaluated further.

Table 1. Percentage of Detections for Compounds Analyzed During LRAPA's Air Sampling Effort*

Note: If compound is bolded, it was detected 25% or more of the samples, evaluated further, and either 1. compared to health guidelines and/or (Table 4), 2. compared to odor thresholds (Table 5).

Compound	Percent of Samples with Detections	
	1 to 3-hour Samples (n=22)	24-hour Samples (n=31)
	[%]	[%]
1,2,4-Trimethyl Benzene	18	Not analyzed
1-Methylnaphthalene	**36**	**94**
2-Methylnaphthalene	**73**	**100**
4-Ethyltoluene	23	Not analyzed
Acenaphthene	**45**	**71**
Acetone	**45**	Not analyzed
Benzene	**27**	Not analyzed
Bis(2-ethylhexyl)phthalate	5	ND
Butylbenzylphthalate	ND	3
Butylphthalate	ND	3
Dibenzofuran	**27**	**65**
Ethanol	14	Not analyzed
Ethyl Benzene	9	Not analyzed
Fluorene	**27**	**58**
m,p - Xylene	**36**	Not analyzed
Methyl Ethyl Ketone	14	Not analyzed
Methylene Chloride	**41**	Not analyzed
Naphthalene	**73**	**100**
n-Hexane	9	Not analyzed
o, Xylene	9	Not analyzed
Pentachlorophenol (PCP)	ND	ND
Phenanthrene	18	**39**
Toluene	**50**	Not analyazed

*ND = Non-Detect (method TO-15 VOC compounds were not analyzed for the 24-hour samples)

24-hour Sampling Results

The compounds detected in more than 25% of the 24-hour samples as well of the range of measured concentrations are listed in Table 2. Twenty-four hour samples represent the average exposure people may experience over an entire day. These concentrations will serve as a surrogate in this report for daily human exposure over an extended period of time. The exposure period represented by the 24-hour samples will be referred to as the chronic, or long-term, exposure scenario. These chronic exposure concentrations were evaluated by comparing them to health guidelines, or acceptable exposure limits, that represent an allowable exposure concentration over a period of time (months to years for chronic exposure) that is not expected to result in adverse health effects. If a concentration exceeds a health guideline it does not necessarily mean that a health effect will occur. These guidelines provide information to determine whether the public health risks for a particular chemical or group of chemicals from a site need further evaluation.

Twenty-four hour sample concentrations were also compared to background air concentrations measured at the Amazon Park air monitor. This air monitor is located south of downtown Eugene, a few miles away from J.H. Baxter. Amazon data were not available for the compounds of interest during 2006, but most compounds were available for the years 2001 to 2005. These background concentrations provide a reference to determine if the J.H. Baxter area contains elevated concentrations above those measured in areas that are not adjacent to industrial sites.

The seven compounds that were detected in more than 25% of the 24-hour samples are listed in Table 2. The concentrations of these compounds are reported in micrograms per cubic meter, expressed as $\mu g/m^3$. Six out of the seven compounds detected in the 24-hour air samples fall within the chemical class referred to as polycyclic aromatic hydrocarbons (PAHs). The other compound detected was dibenzofuran which is also a component of coal tar [7]. All of the seven compounds were found at levels well above the background concentrations measured at Amazon Park (Table 2).

Naphthalene was detected in 100% of the samples (n=31) gathered near J.H. Baxter and had a range of 0.4 to 12.9 $\mu g/m^3$. 1-methylnaphthalene and 2-methylnaphthalene were also detected frequently in 94% and 100% of the samples respectively. The highest concentrations for each compound were detected at sampling sites next to J.H. Baxter. Six PAHs were detected in the samples, which was expected, and the maximum concentrations detected for five out of the six compounds occurred on December 12th, 2006 at location I.

Dispersion modeling that estimated air concentrations of naphthalene in air surrounding J.H. Baxter based on creosote emissions was conducted in 2005 by Premier Environmental Services, a contractor for J.H. Baxter [3]. The estimated 24-hour average concentration was 5.9 $\mu g/m^3$ for the area just outside the J.H. Baxter property boundary, along Roosevelt Boulevard and extending a few blocks north into the Bethel neighborhood. The modeled 24-hour average concentration near Elmira Boulevard was estimated to be 1.15 $\mu g/m^3$. These levels are fairly consistent with the 24-hour naphthalene concentrations measured by LRAPA. Annual average concentrations were also measured and they were estimated to be 0.38 $\mu g/m^3$ along Roosevelt

Boulevard and a few blocks into the Bethel neighborhood and 0.054 μg/m^3 near Elmira Boulevard directly north of J.H. Baxter.

Table 2. 24-hour Sampling Results Compared with Background Levels
Note: Blank spaces indicate values were unavailable

Compounds	May '06 (n=8) [μg/m^3]	June '06 (n=3) [μg/m^3]	Sept '06 (n=3) [μg/m^3]	Nov '06 (n=7) [μg/m^3]	Dec '06 (n=10) [μg/m^3]	Maximum All Dates (n=31) ‡ [μg/m^3]	Background Dec '01 to Dec '05 § [μg/m^3]
1-Methylnaphthalene	0.2 -0.7	0.1-0.7	0.5-1.2	0.2-1.2	0.2-2.3	2.3	-
2-Methylnaphthalene	0.2-1.3	0.3-1.4	1.1-2.6	0.3-2.8	0.5-5.7	5.7	-
Acenaphthene†	0.3-0.3	0.2-0.3	0.2-0.4	0.2-0.6	0.2-1.0	1.0	<0.001-0.003
Dibenzofuran	0.2	0.2	0.2	0.2-0.4	0.1-0.7	0.7	<0.001-0.013
Fluorene†	0.1-0.2	0.2	0.2	0.1-0.3	0.1-0.5	0.5	<0.001-0.022
Naphthalene†	0.4-3.3	0.4-3.4	2.4-5.8	0.7-6.9	1.0-12.9	12.9	<0.001-0.019
Phenanthrene†	ND*	0.1	0.1-0.2	0.1-0.3	0.2-0.3	0.3	0.001-0.024

*ND = Non-detect
†Polycyclic aromatic hydrocarbon (PAH)
‡The maximum concentrations for each compound for 24-hour sampling were detected at location I (Figure 1) on 12/12/06
§Amazon Park Monitoring Station located south of J.H. Baxter in Eugene

Table 3. One to Three-Hour Sampling Results
Note: Blank spaces indicate values were unavailable

Compounds	2005 (n=16) [μg/m^3]	2006 (n=6) [μg/m^3]	Maximum 2005 & 2006 [μg/m^3]
1-Methylnaphthalene	1.3-7.1	1.1-7.2	7.2
2-Methylnaphthalene	2.3-19.4	2.4-12.1	19.4
Acenaphthene †	0.6-4.6	0.9-1.9	4.6
Acetone	8.6-69	7.1-8.1	69
Benzene	2.4-7.6	ND*	7.6
Dibenzofuran	0.8-2.7	0.9	2.7
Fluorene †	0.6-2.3	0.9	2.3
Methylene Chloride	3.5-29	ND*	29
Naphthalene †	1.7-24.5	2.4-25.6	25.6
Phenanthrene †	0.8-1.6	ND*	1.6
Toluene	3.6-17	4.3	17
m,p - Xylene	3.4-11	ND	11

*ND = Non-detect
†Polycyclic aromatic hydrocarbon (PAH)

Short-term (1- to 3-Hour) Sampling Results

The compounds detected in more than 25% of the short-term samples (one to three-hours) along with the range of measured concentrations are listed in Table 3. Naphthalene and 2-methylnaphthalene were detected in 73% of all the samples which was the most frequent out of all the chemicals measured (Table 1). Acenaphthene and acetone were detected in 45% of the samples which was the second most frequent level of detection. The other compounds detected in 25% of more the samples were: 1-methylnaphtalene, benzene, dibenzofuran, fluorene, methylene chloride, phenanthrene, toluene, and m- and p-xylene (expressed as one concentration).

Acetone had a concentration range of 7.1 to 69 $\mu g/m^3$ (Table 3). The maximum measured methylene chloride, toluene, and xylene concentrations were 29, 17, and 11 $\mu g/m^3$ respectively. The range of naphthalene concentrations were 1.7 to 25.6 $\mu g/m^3$. 2-methynaphthalene had a range of 2.3 to 19.4 $\mu g/m^3$. All of the other chemicals were measured at concentrations of 10 $\mu g/m^3$ or less.

The short-term sample results were not compared to background levels because no short-term monitoring was conducted at the Amazon site. It is most appropriate to compare concentrations of samples that are collected over equivalent time periods.

Premier Environmental Services also modeled 1-hour air maximum naphthalene concentrations for ambient air surrounding J.H Baxter based on creosote emissions. The estimated air concentrations were 22.8 $\mu g/m^3$ along Roosevelt Boulevard just across the street from the site and 6.37 $\mu g/m^3$ long Elmira Boulevard directly north of J.H. Baxter [3].

Discussion

Contaminants of Concern

Identifying contaminants of concern is a screening process used to determine which chemicals are present at levels above which they need to be evaluated further for their potential public health impacts at a site. Contaminants of concern, or pollutants of concern, are identified using health guidelines, known as comparison values (explained in Appendix C and also defined in Appendix D). It should be noted that health assessments evaluate cancer and non-cancer risks separately which is why there are separate non-cancer and cancer-based comparison values. A summary of the criteria used to determine contaminants of concern for J.H. Baxter were:

- Contaminant concentrations and frequency of detection in air samples,
- Comparison of maximum contaminant concentrations with background levels (Amazon Park),
- And comparison of maximum contaminant concentrations with chronic and acute reference health guidelines, also referred to as comparison values, and/or odor thresholds.

Twenty-four hour samples were evaluated against chronic comparison values and evaluated for health effects related to long-term, chronic exposure (exposure lasting months to years). Short-

term samples were evaluated separately from 24-hour samples and compared to acute comparison values (threshold limit values (TLVs)) and odor thresholds. A one to three-hour sample captures more acute, or short-term, exposure concentrations that are often higher than those for the 24-hour period; however, the elevated exposures generally do not persist for extended periods of time (hours, possibly days).

Long-term, Chronic Exposure

The primary contaminant of concern for chronic exposure based on LRAPA's 24-hour air monitoring results is naphthalene. Its levels are well above background and they exceeded the comparison values for chronic exposure when considering both cancer (cancer risk evaluation guide, CREG) and non-cancer health (minimal risk level, MRL) guidelines (Table 4). Acenaphthene was detected at a concentration slightly above the CREG. Fluorene and phenanthrene were detected at levels just below the CREG. The health risks associated with chronic exposure to naphthalene, acenaphthene, fluorene, and phenanthrene, will be evaluated further for in the sections below titled: *Exposure Evaluation – Chronic Exposure* and *Public Health Implications – Chronic Exposure*.

One- and 2-methylnaphthalene are related to naphthalene and were detected in most of the 24-hour samples (Table 1); however, they will not be evaluated further because of the absence of inhalation health guidelines and lack of toxicological information for these two compounds. Dibenzofuran will also not be evaluated further due to lack of toxicological information [7] (dibenzofuran should not be confused with polychlorinated dibenzofurans which are likely to have a very different toxicity). Dibenzofuran is commonly detected near all roadways and the levels detected during LRAPA's sampling are not expected to present a health concern.

Short-Term, Acute Exposure & Odor Thresholds

A one-hour sample can capture a peak exposure for short time periods (1 or 2 hours) on a specific day when emission rates are at a maximum and meteorological conditions are likely to transport pollutants towards residential areas. These instances occur periodically but generally not for an entire day, on a daily basis. These short-term maximum exposures that do not occur daily for long time periods are referred to as acute exposures. Specific health guidelines for acute exposures, which are different from chronic or long-term exposure guidelines, provide the most appropriate comparison values for short-term exposures.

In this report short-term results are compared to odor thresholds and acute, non-cancer comparison values when available (Table 5). None of the chemicals measured during the short-term sampling periods exceed the short-term, acute health guidelines. The maximum naphthalene concentration of 25 ug/m^3 was less than the lowest reported odor threshold of 50 ug/m^3 but evidence suggests this threshold is set higher than what many people are able to detect (discussed further in the section: *Exposure Evaluation- Odor Thresholds*). Two other chemicals, 2-methylnaphthalene and toluene, were also not detected above the odor threshold but were within the same order of magnitude as the odor threshold (See the glossary in Appendix D for a definition of an order of magnitude). Measuring a chemical within the same order of magnitude of a guideline gives scientists an indication that the chemical concentration is not substantially

different from the guideline. Naphthalene, toluene, and 2-methylnaphthalene will be evaluated further for the public health impacts related to their odors in the section titled *Odor Impacts* because the maximum short-term concentrations were within the same order of magnitude of their odor threshold. Therefore, the maximum measured air concentrations are assumed to not be substantially different from their thresholds.

Exposure Evaluation & Public Health Implications

Exposure Evaluation – Chronic Exposure

A completed exposure pathway exists for the inhalation, or breathing in, of creosote vapors released by J.H. Baxter. There is a densely populated neighborhood across the street from the site, people living around the site regularly detect a "creosote-like" odor, and the chemicals known to make up a large portion of creosote were measured in air surrounding J.H. Baxter. The primary purpose of this section is to evaluate the human health risks and impacts from inhalation of the chemicals from J.H. Baxter emissions that were identified as contaminants of concern – acenaphthene, fluorene, naphthalene, and phenanthrene. These are related because they are all PAHs.

In health assessments, chemicals are evaluated for cancer and non-cancer health effects separately as is discussed in Appendix C. Because they are evaluated separately, there are cancer-based and non-cancer-based health guidelines. Exposure and risk estimates were calculated based on the median and maximum concentrations measured in air during 24-hour sample surrounding J.H. Baxter. Evaluating for maximum concentrations in these calculations provides health protective exposure estimates. Median concentrations provide estimates that are more likely to represent ongoing, more frequent, exposure levels.

Non-Cancer Risk

Naphthalene is the only individual PAH that has an established non-cancer comparison value, referred to as a reference concentration (RfC), which is 3 $\mu g/m^3$ [8]. 17 of 31 samples gathered by LRAPA contained naphthalene at concentrations above the RfC (Table 6). The median naphthalene air concentration was 3.1 $\mu g/m^3$. This value is equivalent to the RfC of 3 $\mu g/m^3$. The maximum concentration of naphthalene measured during the entire sampling project was 12.9 $\mu g/m^3$ and occurred on December 12, 2006 at location I. This maximum value exceeded the RfC by 4 times. As mentioned, there are no non-cancer comparison values for three other PAHs – acenaphthene, fluorene, and phenanthrene – so non-cancer risk was not evaluated.

Table 4. Comparison of Median and Maximum Long-term (24-hour) Sampling Concentrations with Chronic Non-Cancer-Based and Cancer-Based Comparison Values
Note: Blank spaces indicate values were unavailable

	Concentration		Health Guidelines - Chronic	
	Median	Maximum	Comparison Value, Non-Cancer (EMEG)	Comparison Value, Cancer (CREG)
Compounds	[µg/m^3]	[µg/m^3]	[µg/m^3]	[µg/m^3]
Acenaphthene	**0.33**	**1.0**	**Unavailable**	**0.91**[2]
Fluorene	**0.18**	**0.5**	**Unavailable**	**0.91**[2]
Naphthalene	**3.06**	**12.9**	**4**[1]	**0.03**[3]
Phenanthrene	**0.17**	**0.3**	**Unavailable**	**0.91**[2]
Total PAHs (BaP Equivalent) *	**0.00068**	**0.0018**	**Unavailable**	**0.0009**[3]

[1]Agency for Toxic Substances and Disease Registry (ATSDR) Comparison Value Guidance and Naphthalene Toxicological Profile [9]
[2] Nisbet et al., Toxic Equivalency Factors (TEFs) for Polycyclic Aromatic Hydrocarbons (PAHs) [10]
[3]Oregon Department of Environmental Quality (DEQ) Air Toxic Benchmark for Naphthalene and Total Polycyclic Aromatic Hydrocarbons (PAHs) [11]
*Sum of individual Benzo[a]Pyrene equivalent concentrations for acenaphthene, fluorene, and phenanthrene, excludes naphthalene , Total PAH Concentration = Equivalency Factor$_{acenaph}$ * Concentration$_{acenaph}$+ Equivalency Factor$_{fluorene}$ * Concentration$_{fluorene}$ + Equivalency Factor$_{phenanthrene}$ * Concentration$_{phenanthrene}$

Cancer Risk

One excess cancer case per 1,000,000 people over a lifetime of exposure is a risk level used by SHINE and ATSDR for an individual chemical that represents a negligible excess cancer risk above the general population in the U.S. A cancer risk greater than 1 excess case per 10,000 people can be interpreted as a low risk. These risks from chemical exposures are risk estimates that account for cancer cases that exceed expected cancer rate within United States. The American Cancer Society (ACS) estimates that approximately one in two men and one in three women will develop cancer in their lifetime [12].

Cancer Risk

Cancer risk estimates do not reach zero no matter how low the level of exposure to a carcinogen. Terms used to describe this risk are defined below as the number of excess cancers expected in a lifetime of exposure:

Moderate risk ~ 1 in 1,000
Low risk ~ 1 in 10,000
Very low risk ~ 1 in 100,000
Slight or negligible risk ~ 1 in 1,000,000

Thirty-one (31) out of 31 total samples collected contained naphthalene at concentrations above the cancer-based comparison value, known as the cancer risk evaluation guide (CREG) (See Appendix C), of 0.03 µg/m^3 (Oregon DEQ Air Toxics Benchmarks) as seen in Table 4. At the maximum naphthalene concentration measured near J.H. Baxter, the cancer risk equals 4 excess

cases per 10,000 people over a lifetime which exceeds the 1 in a 1,000,000 negligible risk (Table 6). The cancer risk based on median concentrations was 1 excess case per 10,000 people over a lifetime of exposure.

The cancer risk for acenaphthene, fluorene, and phenanthrene individually is less than the negligible risk of one excess case in a million people over a lifetime (Table 6). When calculating risk based on maximum concentrations for the three PAHs combined, the cancer risk was 2 excess cases per 1,000,000 people over a lifetime. This is just slightly above the negligible risk of 1 excess case per 1,000,000 people over a lifetime. It is unlikely that someone would be exposed to the maximum concentration for all these compounds on a daily basis for a period of months to years.

Table 5. Comparison of Maximum Short-Term (1- to 3-hour) Sampling Concentrations with Acute Comparison Values and Odor Thresholds

Compounds	Maximum Concentration 2005 & 2006 [µg/m^3]	Acute Comparison Value [µg/m^3]	Odor Threshold [µg/m^3]	Characteristic Smell
1-Methylnaphthalene	7.2	-	-	Not described
2-Methylnaphthalene	19.4	-	36.7[4]	Not described
Acenaphthene †	4.6	-	-	Not described
Acetone	69	60,000[1]	8,600[5]	Sweet/Fruity
Benzene	7.6	30[1]	2,800[6]	Sweet/Solvent
Dibenzofuran	2.7	-	-	Not described
Fluorene †	2.3	-	-	Not described
Methylene Chloride	29	2,000[1]	550,000[5]	Sweet
Naphthalene †	25.6	78,644[2]	50[5,7]	Tar/Creosote/Moth balls
Phenanthrene †	1.6	-	-	Not described
Toluene	17	4,000[1]	80[5]	Sour/burnt
m,p - Xylene	11	9000[1,3]	1,500[5]	Not described

[1]ATSDR Comparison Value
[2]ACGIH Threshold Limit Value (TLV), Short-term exposure limit (STEL) = 15 minutes
[3]Based on total xylene exposure
[4]ATSDR = Toxicological profile summary for naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene
[5]AIHAa = American Industrial Hygiene Association, Odor Threshold Guidance, A = accepted value based on critique
[6]AIHAb = American Industrial Hygiene Association, Odor Threshold Guidance, B2 = rejected value - minimal perceptible value
[7]AIHAc = American Industrial Hygiene Association, Odor Threshold Guidance, E1 = rejected value - source located but not reviewed

Public Health Implications – Chronic Exposure

The frequent detection of acenaphthene, fluorene, naphthalene, and phenanthrene in air surrounding J.H. Baxter is consistent with the mixture of PAHs measured by the U.S. Environmental Protection Agency (EPA) in emissions from a pressure treating facility on Bainbridge Island in Washington State [6]. Breathing in creosote vapors for a long period of time can result in irritation of the respiratory tract and eyes. A number of studies have reported associations between occupational exposure to coal tar creosote and cancer in humans, and the International Agency for Research on Cancer considers creosote to be a probable human

carcinogen [13]. Cancer was observed in a number of tissues from animals exposed to creosote including the respiratory tract, lips and skin, lung, pancreas, kidney, scrotum, prostate, rectum, bladder, and central nervous system [6]. The chronic exposure levels at which no health effects were observed in these studies, referred to as the No Observed Adverse Effect Level (NOAEL), ranged from 10,000 $\mu g/m^3$ to 660,000 $\mu g/m^3$ [6]. These levels are many times higher than the those of any of the compounds measured in air surrounding J.H. Baxter. Many of these studies had numerous limitations, including the absence of smoking data and the absence of data on exposures to mixtures of chemicals, such as PAHs.

PAHs make up the largest portion of creosote by weight, especially naphthalene which makes up 40% of creosote by weight. For this reason, this assessment focuses on PAHs as surrogates to evaluate the health effects related to creosote. There are more than 100 different PAHs. Typically, a person is not exposed to an individual PAH, but to a mixture [14].

Several PAHs are considered probable or possible human carcinogens by the EPA. Known carcinogenic PAHs, such as benzo[a]pyrene, are present at much lower concentrations in creosote, compared with naphthalene [15]. When evaluating the effects of carcinogenicity of acenaphthene, fluorene, and phenanthrene, it was assumed they had a cancer potency that is 1000 times less than benzo[a]pyrene which is considered a "probable human carcinogen" [16]. Naphthalene is evaluated individually and separate from the other PAHs. The International Agency for Research on Cancer (IARC) has listed naphthalene as "possibly carcinogenic to humans" but most cancer data for the chemical is based on animal studies and have not been confirmed in human studies [17]. The National Toxicology Program reported clear evidence that naphthalene is carcinogenic in rats [18]. Acenaphthene, fluorene, and phenanthrene are not classifiable as a carcinogen (See glossary for definition) due to a lack of scientific information [14].

One human study that evaluated the long-term effects of PAHs (a mixture made up primarily of benzo[a]pyrene) and particulate exposures in rubber factory workers found that a PAH concentration of 0.1 $\mu g/m^3$ (primarily made up of benzo[a]pyrene) resulted in a variety of respiratory effects - reduced lung function, abnormal chest x-rays, cough, bloody vomit, and throat and chest irritation [14]. The researchers did not attempt to separate the effects related to PAH exposure versus particulate exposure.

Because naphthalene makes up the largest component of creosote vapor, and because there is a considerable amount of scientific information about naphthalene, the health effects related to the chemical are considered separately from those related to PAH mixtures. It is very difficult to draw conclusions about actual health effects from naphthalene in this assessment because, while it is significant because of its known health effects, it is only one part of the complex chemical mixture that makes up creosote. The variability of the mixture could play an important role in and affect the toxicity of naphthalene, other PAHs, or other types of chemicals measured in small amounts.

ATSDR's chronic naphthalene minimal risk level (MRL) of 4 $\mu g/m^3$ for inhalation is based on the lowest-observed-adverse-effect level (LOAEL) for rats exposed to approximately 52,000 $\mu g/m^3$ daily, 6 hours/day, for 2 years [9]. At this level, both male and female rats developed abnormal cell growth in the form of both non-carcinogenic and carcinogenic lesions and tumors in the nose cavity and respiratory tract. This LOAEL is nearly 5000 times greater than the maximum 24-hour naphthalene concentration measured surrounding J.H. Baxter. The exposure levels in animal or occupational studies are often much higher than what is experienced by the general population. In addition, a high amount of uncertainty exists concerning the significance of low-level, long-term exposures to contaminants compared with the known health effects found in occupational or high dose animal studies.

Estimated exposure levels for resident's living around J.H. Baxter based on LRAPA's monitoring results indicate that naphthalene exposures along the road near J.H. Baxter slightly exceed the RfC of 3 $\mu g/m^3$, but these levels are not far above these health protective guidelines. Also, chronic health guidelines such as the RfC represent acceptable exposure levels where health effects are not expected at, or slightly above, those levels. Naphthalene cancer risk estimates for this assessment show that there is a risk of 4 excess cancers per 10,000 people at the maximum naphthalene concentrations of 12.9 $\mu g/m^3$. This is still considered a relatively low cancer risk. The likelihood of developing cancer in a lifetime is relatively high (one in two men and one in three women in the U.S. will develop cancer in their lifetime) and naphthalene is not considered to be as potent a carcinogen in comparison to other PAHs, such as benzo[a]pyrene. At the concentrations measured in air around J.H. Baxter, naphthalene and the other three PAHs are not expected to result in chronic non-cancer or cancer health effects.

Exposure Evaluation – Odor Thresholds

Naphthalene, 2-methylnaphthalene, and toluene were the three chemicals measured in the short-term LRAPA air sampling that had concentrations near the commonly reported odor thresholds (Table 7) [19]. An odor threshold is the concentration at which the odor of a chemical can be detected. A measured level that does not exceed the documented odor threshold does not signify that they are not smelled by local residents. Based on the information from the community about odors, documented odor detections by LRAPA staff during the air sampling effort [2], and personal observations by the SHINE team, the evidence indicates that creosote odors from J.H. Baxter can be detected along Roosevelt Boulevard and the neighborhood directly north of the facility. The odors may vary in intensity but based on LRAPA's sampling, they are being detected at levels below the thresholds reported in the literature (Table 7).

According to J.H. Baxter, the intensity of odors and complaints about odors from residents decreased since they installed the carbon adsorption odor control system in July, 2005. Their summary report states that the system has reduced creosote and fuel emissions by 39% of the facility-wide creosote and fuel oil emissions [3].

Often, the health complaints expressed by a community, including odor complaints, defy classic toxicological explanation. This may occur when contaminants are detected below levels associated with known adverse health effects [20]. Additionally, odor thresholds and health

guidelines are usually established for individual chemicals, rather than for complex mixtures such as creosote. There is the possibility that complex chemical mixtures can lower or raise odor thresholds for individual chemicals that are part of that mixture.

Evidence suggests that people can experience physical symptoms as a result of exposure to odors [21]. Odors are perceived as smell (olfaction) and pungency (sensory irritation). Odor-related mechanisms that may result in symptoms include innate odor aversion, stress-induced illness, and aggravation of existing medical conditions, such as bronchial asthma. After exposure to noxious odors, these processes may occur in some individuals and not in others. Smokers and the elderly may be less susceptible to odors. In general, women are more sensitive to smells than men. Odor-related aversive conditioning may occur when a person experiences low-level odors after an initial traumatic exposure. A common response is the panic or hyperventilation cluster of symptoms such as fast heart rates, dizziness, nausea, sweating, and anxiety. Stress, which can result in health effects, may to some extent be related to the degree to which an individual believes an odor is causing risk. Many contaminants have odor thresholds that are lower than the levels thought to be hazardous, but at those lower levels, the odor-related symptoms described above are provoked.

It is possible that residents living near J.H. Baxter experience physical symptoms due to physiological reactions that can occur in response to breathing in odors released by creosote compounds. This is especially true for the very volatile and odorous compound, naphthalene.

Table 6. Non-cancer and Cancer Risk Calculations Using Median and Maximum Long-term (24-hour) Concentrations
Note: Blank spaces indicate values were unavailable

Hazard Quotient = Air Concentration/Reference Concentration
Cancer Risk = Air Concentration * Unit Risk

	Median		Maximum		Health Guidelines Used for Evaluating Risks		
	Hazard Quotient	Cancer Risk	Hazard Quotient	Cancer Risk	Reference Concentration (RfC)	Unit Risk (used to calc cancer risk)	Equivalency Factor
Compounds	Unitless	Unitless	Unitless	Unit less	[µg/m^3]	[µg/m^3]$^{-1}$	Unitless
Acenaphthene	-	3.6E-07	-	1.1E-06	-	1.1E-06[2]	0.001[3]
Fluorene	-	2.0E-07	-	5.5E-07	-	1.1E-06[2]	0.001[3]
Naphthalene	1.02	1.0E-04	4.3	4.4E-04	3[1]	3.4E-05[2]	-
Phenanthrene	-	2.0E-07	-	3.3E-07	-	1.1E-06[2]	0.001[3]
Total PAHs (BaP Equivalent) *	-	7.5E-07	-	2.0E-06	-	1.1E-03[2]	1.0[3]

[1]Environmental Protection Agency, Integrated Risk Information System (IRIS), Reference Concentration (RfC)
[2]California Environmental Protection Agency, Air Toxics Hot Spots Program Risk Assessment Guidelines, Part II: Technical Support Document for Describing Available Cancer Potency Factors, May 2005 [22]
[3]Nisbet et al., Toxic Equivalency Factors (TEFs) for Polycyclic Aromatic Hydrocarbons (PAHs) [10]

Table 7. Summary of Chemicals Detected During Short-term Monitoring Measured at Levels Nearing their Odor Thresholds

Chemical	Maximum Short-Term Concentration near J.H. Baxter	Documented Odor Threshold
Naphthalene	25.6	50
2-methylnaphthalene	19.4	36.7
Toluene	17	80

Cancer Investigation in Bethel, River Road, and Trainsong Neighborhoods

In a separate document, we have outlined a cancer investigation conducted in six census tracts in the Bethel, River Road, and Trainsong neighborhoods for the years 1996 to 2004. This investigation concentrated on four different types of cancer: acute myelogenous leukemia (AML), brain, nasal, and lung cancer. All types of cancer combined were also evaluated during this investigation. An updated cancer investigation report will be released shortly after the release of this document in the Spring of 2007.

Children's Health Considerations

SHINE and ATSDR recognize that infants and children may be more vulnerable than adults to exposures to contaminants in air, water, soil, or food. Infants in children breathe in larger amounts of air based on body weight when compared to adults and therefore children may face greater exposures relative to body weight. Infants also appear to be more sensitive than adults to the effects of naphthalene [23].

Conclusions

The air sampling conducted by LRAPA was designed to characterize emissions from the J.H. Baxter site. Based on the 24-hour air monitoring results, naphthalene was detected the most frequently and at the highest concentrations compared to the other compounds. The other commonly detected PAHs were acenaphthene, fluorene, and phenanthrene. These four PAHs are known to be major constituents of creosote. They were detected at concentrations 10 to 100 times above the highest background concentrations found at the Amazon air monitoring site in South Eugene. The detection of these compounds near J.H. Baxter does not confirm that the company is the sole emitter of these chemicals. However, it appears that J.H. Baxter is the primary source of the four elevated PAHs, especially naphthalene. Conclusions can not be drawn about the effects of acute or chronic exposure to the chemical mixtures emitted during creosote and pentachlorphenol wood treatment due to a lack of scientific understanding about the effects of complex mixtures.

The concentrations of naphthalene and the other PAHs detected near J.H. Baxter do not appear to be a public health concern in terms of the chronic health effects associated with creosote, PAHs, and naphthalene. Based on the available air data, emissions from J.H. Baxter are associated with what SHINE considers to be a low cancer risk. The concentrations of the four PAHs most frequently detected near J.H. Baxter are well below levels where chronic health effects (cancer and non-cancer) that have been associated with these PAHs in occupational and laboratory animal studies.

The chronic health effects related to PAHs based on toxicological laboratory studies are different than short-term physical responses that can be triggered by strong odors, such as those emitted by naphthalene. It is possible that residents living near J.H. Baxter may experience physical

symptoms due to the odors released from the creosote compounds. These effects could include acute and potentially serious health symptoms - asthma attacks or eye, nose and lung irritation - from exposure to creosote compounds following elevated short-term exposures (lasting 1 to 3 hours). This is especially true for the very volatile and odorous compound, naphthalene.

Recommendations and Action Plan

The current air monitoring data do not indicate that people will become chronically ill from the PAHs from J.H. Baxter creosote emissions. Although SHINE does not anticipate adverse health effects from the emissions, physical responses to the stress from the odors could be a public health concern. SHINE recommends that J.H. Baxter take additional actions to reduce the odors from creosote emissions from J.H. Baxter into nearby neighborhoods.

Additional air monitoring around J.H. Baxter may be useful to better characterize the emission concentrations in each of the areas where residents have detected odors. Additional air data may not impact SHINE's conclusions about exposure related to emissions from J.H. Baxter.

SHINE will re-visit the findings of this report if additional air monitoring data becomes available and differs substantially from the current monitoring results.

SHINE will conduct additional outreach and education in the Bethel, River Road, and Trainsong neighborhoods as needed and at the request of the community.

Site Team

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

Author of Report:

Kathryn Toepel, MS
Public Health Toxicologist

SHINE Team:

Jae Douglas, PhD
Epidemiologist

Julie Early, MS
Program Coordinator

Lorena Barck, PhD, JD
Environmental and Occupational Epidemiology, SHINE Team Manager

Agency for Toxic Substances and Disease Registry

Karen L. Larson, PhD
Regional Representative
Office of Regional Operations
ATSDR

Robert Knowles, REHS
Technical Project Officer
Division of Health Assessment and Consultation
ATSDR

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Response to Comments

Comment:
This whole assessment is based on 18 "air sampling events" (22 short-term samples on 8 different days, and 31 long-term samples on 10 days), characterized as "initial screening" data. Perhaps this is sufficient as a first cut at testing monitoring methods and as a screening to identify gross hazards, but it is a small data set on which to base an assessment. Is this screening data really sufficiently accurate for use in a risk assessment? A more comprehensive and longer-term air monitoring effort is needed to fully characterize the emissions and potential health hazards.

Response:
SHINE believes that the data is sufficient for conducting a health assessment but acknowledges that additional data would be useful to more fully evaluate people's exposure to air emissions from J.H. Baxter. Health assessments are conducted with data sets of varying size. SHINE recognizes that this data set may not represent actual exposure to residents in the area – it could be providing either an underestimation or an overestimation of exposure. The *Recommendation* section on page 21 of the report states that:

> Additional air monitoring around J.H. Baxter may be useful to better characterize the emission concentrations in each of the areas where residents have detected odors. Additional air data may not impact SHINE's conclusions about exposure related to emissions from J.H. Baxter.
>
> SHINE will re-visit the findings of this report if additional air monitoring data becomes available and differs substantially from the current monitoring results.

Comment:
PAHs including naphthalene are notoriously difficult to capture and measure by standard methods. Low recovery rates can occur due to various factors (sampling efficiency, temperature dependence of vapor-particle phase distribution, stability of samples, extraction processes, etc.). The fact that measured levels of naphthalene during odor episodes were far below published "odor thresholds" for naphthalene does not give reassurance that this chemical has been accurately measured. There are many reports of Baxter's creosote odors detected two miles or more north and east of the plant, including first-hand reports by LRAPA's inspectors. Has the data been validated relative to certified reference samples, etc?

Response:
It is true that naphthalene and other PAHs are difficult to capture and measure in air samples but it can not be assumed that there were methodological problems with data collection and that naphthalene levels measured in air surrounding J.H. Baxter are an underestimate. The questions about data validation – data quality control, quality assurance, and analysis of recovery rates - regarding sample collection and are best suited for LRAPA.

Comment:
Even with the difficulties and discrepancies, naphthalene levels found in the air outside the perimeter of the JH Baxter facility exceed health guidelines (for cancer and chronic non-cancer hazards). In general, given the shortcomings of the data and methods, I don't think it is reasonable to draw the conclusion that people in nearby neighborhoods will not become chronically ill from contaminant levels found in Baxter's emissions.

Response:
Health guidelines are developed to be health protective and are set at levels where no health effect is expected following many years of exposure. When a chemical is measured at levels that exceed a health guideline, it does not necessarily mean there is an increased risk for adverse health effects from exposure at that level. Naphthalene levels in several of the 24-hour samples did slightly exceed the chronic health guideline of 4 $\mu g/m^3$ used by ATSDR and 3 $\mu g/m^3$ used by EPA. Scientific animal studies and human exposure studies were taken into consideration in addition to these health guidelines. In these studies, the lowest levels at which chronic health effects were observed were nearly 5000 times higher than these guidelines (see the *Public Health Implications – Chronic Exposure* section, p.17 for further discussion about the guidelines).

Comment:
Why is pentachlorophenol not picked up in air monitoring near Baxter? Baxter uses it in large quantities in a process similar to that used for creosote. Penta is found in ambient air in various studies of urban areas and near other wood preserving plants. Accurate assessment of the emissions of these compounds seems critical to a complete an assessment of exposure risks. Is it reacting or metabolizing or degrading into something else that is not being measured? Or, is it present at levels lower than the quantifiable limit of the method being used? I have similar questions about why benzo(a)pyrene was not found. If these chemicals were not detected here, I suspect it is due to a methodological flaw, not because the compounds are not present.

Response:
It is unknown why pentachlorophenol was not detected because sampling was conducted on days when pentachlorophenol treatment was taking place. Based on the LRAPA report released in February 2007, the reporting limit for pentachlorophenol for the TO-13A method appeared to be 20 µg (Table 7, page C-2) (the reporting limit is often three times the detection limit). To SHINE's knowledge, all pentachlorophenol wood treatment operations are going to cease at J.H. Baxter so future exposures to pentachlorophenol should not be an issue for the Northwest Eugene communities. Any additional questions about pentachlorophenol should be directed to LRAPA.

Benzo(a)pyrene is a 5-ring PAH that is found mostly in the particulate form [14] and air sampling around J.H. Baxter did not target particulate phase PAHs. Vapor-phase PAHs such as naphthalene are more likely to migrate off-site and result in inhalation exposure for residents living near J.H. Baxter. Although much of the exposure to emissions from J.H. Baxter is

expected to be from vapor-phase chemicals, it is suggested that any future sampling methods target both vapor-phase and particle-phase PAHs to more fully characterize PAH exposures.

Comment:
It seems that there was also no testing for arsenic and ammonia, nor consideration of their risks, though they are known hazardous constituents of Baxter's emissions?

Response:
SHINE can only evaluate health risks for which there is available data. The report has a section on page 4 titled *On and Off-site Soil, Groundwater, and Surface Water Investigations* related to J.H. Baxter. The second sentence of that paragraph recognizes the community's concerns about arsenic exposures related to J.H. Baxter and states that other exposures can be evaluated in the future if the concern level warrants another assessment and the necessary data becomes available. The data required for an additional assessment would need to include comprehensive off-site air monitoring for both VOCs and particulates to capture emissions during ACZA treatment and off-site soil sampling in several yards of homes surrounding J.H. Baxter. Air sampling would also need to occur during a variety of meteorological conditions to be most useful for assessment purposes. If soil contamination was found close in to the site, sampling would need to be conducted incrementally outward from the site to determine the extent of contamination.

Comment:
The report says 24-hour sampling for volatile organic compounds (VOCs) was suspended in part because it was apparent that semi-volatiles (SVOCs) make up the majority of emissions from JH Baxter. However, the data tables show that the VOCs acetone, benzene, toluene and xylene were found in 27-50% of the short term samples collected near Baxter's perimeter. Perhaps these chemicals are coming from other sources, but the report should provide more of an explanation of why that is thought to be the case. In any case, it would be of interest to the neighborhoods to have more thorough assessment of VOC sources and potential exposures, too.

Response:
SHINE can not draw conclusions about other sites for which there is no data. Additionally, the purpose of this document was intended to only evaluate exposure to chemicals that were screened in as contaminants of concern (COC) related to J.H. Baxter. The Union Pacific Railyard site in Trainsong is the only other site in the area that SHINE does have VOC data and exposure to chemicals at that site are addressed in a separate report. The request for a more thorough assessment of VOC sources should be directed to LRAPA.

Comment:
Was this really worst case scenario testing? Samples were collected on days when winds were blowing from the south. Windy conditions likely do carry vapors to the neighborhoods, but they are also likely to disperse and dilute vapors. The report acknowledges--but does not otherwise address--the fact that LRAPA did not collect samples during inversion conditions, and also that inversion conditions could well be a "worst-case" scenario. At the least, to capture real worst

case scenarios, it seems that more testing needs to be done during inversion and fog conditions, and also during high creosote production periods and when 2 creosote retorts are open at once. Baxter's permit allows 2 retort openings per hour.

Also, because naphthalene measurements are of questionable validity due to difficulties related to monitoring methods, they may not really represent the worst case.

The report says that LRAPA tried to sample when "emission rates were at their maximum", but only 25% (of long-term samples) and 50% (of short-term samples) were taken during creosote treatment. Since "contaminants of concern" were later determined to be just a few constituents of creosote (and not penta), it seems that maximum emission rates of those constituents would have occurred during creosote treatment (and retort door openings).

Response:
SHINE agrees that windy conditions are more likely to result in increased mixing of air and could be diluting emissions. It is possible that inversions could result in high exposures to chemicals measured in air around J.H. Baxter but it can't be confirmed because these conditions were not targeted or recorded during past sampling events. If future sampling is conducted, SHINE agrees that it would be useful to target stagnant meteorological conditions. In addition, sampling should target days where significant air mixing is expected so that a wide variety of exposure conditions are captured. The meteorological conditions should be recorded upon the time of sampling to aid in the interpretation of how conditions impact exposures. Sampling should also take place during different seasons and different times of day.

Comment:
Questions remain about how useful it is to try to calculate numerical estimations of cancer or non-cancer risks...and how to decide what numerical levels constitute "low" or "significant" risks.

What is "low" cancer risk? There is no standard among federal and state agencies about interpretation of what is "low" risk or "significant" risk. Levels of cancer risk that are considered significant (or negligible) in one program are not necessarily considered significant (or negligible) in another. In many programs, the aim is to reduce excess risk to below a "minimal risk" standard of 1 in a million. According to a recent GAO report to Congress on air toxics, "Section 112 of the Clean Air Act identifies a lifetime cancer risk of 1 in 1 million as a threshold above which regulation may be warranted for individual sources of toxics, considering feasibility and costs", and "EPA generally uses a lifetime cancer risk of 1 in 10,000 as the upper boundary of acceptability." [1] There is no consistent standard for what constitutes "minimal" or "acceptable" or "unacceptable" risk.

The maximum measured level of naphthalene in 24-hour sampling (12.9 ug/m3) translates to more than 4 excess cancers per 10,000 people. This is four times higher than the "upper boundary of acceptability" as above and 400 times higher than the threshold above which the Clean Air Act states that regulation may be warranted--and this is based on levels of just a single

chemical, and one for which the measured air levels are suspect and likely not worst case. Yet, for the purposes of this consultation, SHINE has chosen to interpret a cancer risk "greater than 1 excess case per 10,000 people" as "low risk". This seems to be an arbitrary choice, and one that tolerates risks much higher than other agencies (or the Clean Air Act) deem acceptable. In fact, a cancer risk greater than 1 excess case per 10,000 people commonly is interpreted as "unacceptable" risk.

Of course, other individual contaminants were also found to be just above or just below the "cancer risk evaluation guide". Still other chemicals found in the toxic soup were not even evaluated as cancer risk contributors because there are no inhalation risk guidelines or sufficient toxicological information.

It does not seem credible to conclude that Baxter's emissions do not pose cancer risks. It also does not seem acceptable under the Clean Air Act.

Response:
The guidelines used to calculate cancer risks and the levels of acceptable risk aid in regulatory decision making are set at levels that ensure that regulations are protective of public health and provide negligible risk. An elevated theoretical cancer risk estimate does not necessarily translate directly into actual risks and is difficult to interpret in terms of real cancer risk. An increased cancer risk of 1 in 1,000,000 over a lifetime of exposure is accepted as a negligible cancer risk by most agencies and is a common regulatory goal. It is an appropriate regulatory goal but SHINE and ATSDR are not regulatory agencies and are charged with interpreting what these risk estimates mean in real life terms. It is appropriate to assume that an increased cancer risk of 1 in 10,000 is a low cancer risk for exposure estimates that were based on very health protective exposure assumptions, i.e. maximum exposure levels that persist over many years. Additionally, the maximum exposure levels used to estimate cancer risk were based on measurements taken immediately adjacent to the Baxter facility which were shown to be higher than the levels found near people's homes. Exposures to chemicals in air are more likely to fluctuate daily and will only reach levels close to the maximum level measured near the site periodically so actual risks are lower than theoretical risks.

SHINE is confident that the cancer risk estimates are health protective and actual cancer risks for naphthalene exposure from J.H. Baxter are lower than what was calculated. Naphthalene is a probable carcinogen (not a known human carcinogen) according to EPA and that risk is based on scientific studies where animals were exposed to naphthalene at levels far above those detected in ambient air surrounding creosoting facilities. The estimates used to calculate cancer risks for naphthalene are theoretical calculations based on risks derived from animal studies not human studies. Human studies provide more accurate estimates for actual cancer risks. There are several uncertainty factors built into the cancer risk guidelines that are designed to be very protective of human health.

Comment:
The report does mention the separate cancer investigation in nearby neighborhoods but does not discuss the results of that investigation--namely that elevated rates of certain cancers (acute

myelogenous leukemia, lung cancer, etc.), investigated because of a plausible link to chemicals emitted from this facility, have been found. The investigation of the causes is not complete.

Response:
SHINE did not proceed with the cancer investigation because of a "plausible link to chemicals emitted by this facility" (referring to J.H. Baxter) as [commenter] suggests. The cancer investigation was brought to SHINE's attention through our work at J.H. Baxter and was recommended by SHINE in a previous health consultation in order to address community concerns about cancer rates in the area. SHINE made no predetermination that chemicals being emitted by J.H. Baxter were plausibly associated with the cancers of concern – Acute myelogenous leukemia and brain cancer.

It is true that a cancer investigation in Northwest Eugene showed increased rates of two types of cancer in the area. [Commenter] is also correct that no conclusions can be drawn about causes of the elevated rates at this time. It is very unclear whether the increased rates could be due to personal lifestyle choices, environmental contaminants, occupational history, or a combination of these. This is the reason the cancer investigation was released in a separate report. SHINE can not draw conclusions about the cancer cases and possible associations between common causes of cancer of chemicals released by industrial facilities in the area. It is possible that no clear associations between the cancer cases and potential causes will be identified and SHINE intends to keep the cancer investigation separate from individual site investigations at this time.

Comment:
The report does not include a section on public health implications of acute exposure, evidently because measured levels of the few contaminants considered did not exceed established comparison values. The report does mention residents' potential physical "stress" reactions to odors, including the possibility of acute asthma attacks. It also notes that residents report symptoms that "defy toxicological explanation", as they seem to occur at levels below those known to pose adverse effects.

Characterizing symptoms as due to "stress" makes it sound like these reactions are completely within the emotional control of the people who experience the effects, rather than natural and unavoidable reactions their bodies have to chemical assaults. I doubt that "emotional" reactions to odor are the cause of most eye, nose and respiratory irritation.

I wonder what serious or life threatening acute health effects are not taken into account by the acute "health guideline" values? It seems that odors are occurring at the levels measured at J.H. Baxter, and trigger serious reactions, yet the "comparison values" for acute health effects available for the chemicals measured suggest that the measured levels are far below "health guideline" levels of exposure for each chemical. Are the levels based on preventing outright lethal exposures only?

Response:

Acute guidelines are not designed to protect lethal exposure but rather against short-term acute symptoms. Acute guidelines are generally based on exposures that occur in occupational settings where workers experience short-term effects due to high exposure, often in an indoor setting. It is very rare that individuals in the general public would be exposed to a chemical in ambient air at levels that will result in the acute effects for which the health guidelines are based.

The maximum levels of the VOCs mentioned above that were measured during short-term sampling were detected at levels well below acute guidelines and even well below chronic guidelines. The levels measured during short-term sampling only capture an air concentration that does not persist for an extended period of time. Even so, the maximum levels of benzene, toluene, and xylene measured during 1 to 3-hour sampling were at levels below the chronic guidelines that are meant to be protective of health for continuous daily exposure over several years.

SHINE was not trying to suggest that people are only experiencing health effects due to emotional stress caused by the odors. It is possible that people can experience other short-term symptoms following exposure to a chemical in ambient air but those effects may not be represented by health guidelines. This is especially the case for sensitive individuals who may not have been represented in a study population and is discussed in the *Exposure Evaluation – Odor Thresholds* section. That section discusses how different physical symptoms can result from the short-term exposures and odors related to those exposures. On page 18 of the report, it says that:

> It is possible that residents living near J.H. Baxter experience physical symptoms due to physiological reactions that can occur in response to breathing in odors released by creosote compounds. This is especially true for the very volatile and odorous compound, naphthalene.

This statement is referring to direct health effects that result from exposure to the odors themselves. Those health effect could include but are not limited to health effects that result from emotional stress caused by the odor.

Comment:
This document is titled a public health consultation, which, by ATSDR's definitions is distinguished from a comprehensive risk assessment.

According to ATSDR, a public health assessment is supposed to factor in information from citizens about actual exposures, including any health data that might be available. It is supposed to examine "the relationship between actual exposures to contaminants and subsequent signs of disease and illness." Public health assessments might include:

- Collecting and analyzing information on health concerns expressed by community members;
- Gathering information on how people in the community actually interact with the site (for example, whether children play there or people picnic or fish nearby);
- Conducting (or working with others to conduct) blood, hair, urine, tissue, or environmental sampling;

- And, if available, collecting and evaluating information from county or state health departments about certain types of illnesses in the community.

It seems that this consultation is really some kind of hybrid between a risk assessment and a public health assessment--and that it does neither of these things well. It is not a comprehensive assessment of theoretical risks, and it does not really factor in health data and signs of illness or disease as a public health assessment should. There was no effort to collect valid data on actual health impacts in the community (except one open-ended comment form passed out during the initial public availability session that asked people about their "concerns").

Response:
[Commenter] is correct that the ATSDR health assessment process is distinguished from the risk assessment process. Public health assessments differ from risk assessments in that health assessments are not directly used for regulatory purposes and they are intended to, "provide perspective on what the risk estimates mean in the context of the site community" [ATSDR Health Assessment Guidance Manual]. Health assessments consider, "the same environmental data as EPA, but focuses more closely on site-specific exposure conditions, specific community health concerns, and any available health outcome data to provide a more qualitative, less theoretical evaluation of possible public health hazards." SHINE followed the standard health assessment procedures outlined by ATSDR for the J.H. Baxter Follow-up Health Consultation.

It is true that health assessments can include or address the information described above by [commenter] but these are not the required considerations. The factors that SHINE must consider in an assessment as mandated by ATSDR are:

- The nature and extent of contamination,
- Demographics – population size and special populations, i.e. children,
- Pathways of exposure,
- And, health effects and disease-related data – i.e. Compare exposure levels at the site with observed health effects in toxicological or epidemiological studies.

Comment:

Where's the community health data? There are many other potential acute or chronic health conditions in the community that could plausibly be related to exposure to the toxic soup of hazardous air pollutants emitted by Baxter--such as asthma, respiratory effects, immune or endocrine system impairment, etc. Medical testing and expertise is needed to evaluate some conditions. At a minimum, data is needed on incidence of asthma and respiratory illness in the community, and whether hemolytic anemia or blood disorders that have been linked to naphthalene exposure (and found to be precursors to acute myelogenous leukemia) might be present or prevalent.

A health survey and medical screening study done in another community near a wood preserving plant similar to Baxter found that exposed residents had significantly more cancer, respiratory, skin, and neurological health problems than a control group. [2] A similar health survey/medical

screening study is needed here to investigate rates of acute and chronic illness and health symptoms.

There was no attempt to measure actual bodily exposure (via human blood or tissue sampling) or environmental exposure (via surface wipe sampling in or near residents' homes). An investigation is needed near J.H. Baxter similar to that study done in another community surrounding a wood preserving plant that used creosote and penta found elevated levels of chlorinated dioxin and furan compounds in residents' blood "compatible with PCP as the source".

Additional investigation of Baxter's emissions and potential health impacts on nearby neighborhoods is needed. This report should recommend:

- More health data collection (survey and medical screening of the neighborhoods for asthma, blood disorders, cancers, etc);
- Human tissue sampling, looking for bio-markers of exposure to creosote and pentachlorophenol;
- Environmental sampling of soil in yards and swabs of surfaces in homes, including for arsenic, PAHs and chlorinated dioxins and furans;

Response:
The information that [commenter] suggests be gathered would be useful, but based on the available emissions data, SHINE can not justify making the recommendations described above in the health assessment report. This type of in-depth research may be best suited for a university-based research study.

Comment:
This report should recommend more emission reduction and control be required for Baxter (and other facilities in area).

Response:
Based on available data, SHINE recommended that J.H. Baxter add additional controls to reduce odors related to creosote emissions which should also lower short-term emission levels. The current data does not justify that SHINE should make a recommendation to require J.H. Baxter reduce overall emissions related to chronic exposures.

Comment:
I agree with the SHINE recommendation that JH Baxter take additional actions to reduce odors from creosote emissions into nearby neighborhoods.

I also agree that additional monitoring may be useful to better characterize emission concentrations, and hope this will be undertaken.

Response:
Thank you for your comments.

Comment:
I do not think that SHINE's conclusion that air levels of naphthalene above health guidelines are not likely to result in adverse health effects, is warranted. In any case, since the levels found are four times higher than the "upper boundary of acceptability" under the Clean Air Act, this level of naphthalene pollution should be deemed "unacceptable" and Baxter required to reduce its emissions below those levels.

For the same reasons, the conclusion that "the current air monitoring data do not indicate that people will become chronically ill from the PAHs from J.H. Baxter creosote emissions" seems unwarranted. This statement also seems prone to being mischaracterized. I can already hear some of LRAPA's board members saying that this report shows that "there is no cancer or other health risk" from Baxter's emissions.

I think that a more reasonable conclusion would be: The overall risk to nearby residents of emissions from JH Baxter is indeterminate. There is no scientific method to conclusively analyze the health effects of the complex mixture of chemicals that is emitted by Baxter. There is insufficient toxicological information and no health guidelines for many of the individual chemicals. Not all chemicals emitted by Baxter were tested for, and there are uncertainties about the validity of monitoring data. One chemical, naphthalene has been found in air above health guidelines near and off the JH Baxter site. Residents exposed to this chemical at the levels it has been measured in air are expected to have small, but elevated risks of additional cancers and chronic health effects. LRAPA needs to take action to require Baxter to reduce its naphthalene emissions. Residents may also experience acute and potentially serious health symptoms, including asthma attacks or eye, nose and lung irritation, from exposure to creosote odors. Collection of more data and additional risk and health assessment is needed to more fully characterize and estimate the risks of Baxter's emissions.

Response:
Thank you for your comment. SHINE will add a few additional points to the *Conclusion* section of the report at [commenters] recommendation but will also retain all previous conclusions and recommendations. SHINE drew conclusions and recommendations only based on available data and the report also stated that if additional data becomes available in the future, the conclusions and recommendations can be revisited.

In terms of addressing the complexity of evaluating mixtures, SHINE has added a conclusion statement on page 20 at [commenters] suggestion that state the following:

> Conclusions can not be drawn about the effects of acute or chronic exposure to the chemical mixtures emitted during creosote and pentachlorphenol wood treatment due to a lack of scientific understanding about the effects of complex mixtures.

At [commenters] suggestion, a sentence has been added to the last paragraph of the *Conclusions* section on page 20 which addresses odors health effects due to short-term exposures to emission from J.H. Baxter. The paragraph now reads:

The chronic health effects related to PAHs based on toxicological laboratory studies are different than short-term physical responses that can be triggered by strong odors, such as those emitted by naphthalene. It is possible that residents living near J.H. Baxter may experience physical symptoms due to the odors released from the creosote compounds. These effects could include acute and potentially serious health symptoms - asthma attacks or eye, nose and lung irritation - from exposure to creosote compounds following elevated short-term exposures (lasting 1 to 3 hours). This is especially true for the very volatile and odorous compound, naphthalene.

Comment:
As the report acknowledges, scientists believe there is no safe level of exposure to a carcinogen.

Response:
In risk assessment and health assessment, there is an assumption made for estimating cancer risk which is that there is no safe threshold. This assumption is used only for calculating theoretical cancer risks. It is an assumption that may or may not be scientifically true, depending on the chemical/s in questions and the levels of exposure.

Appendix A. LRAPA's Air Sampling Proposal.

Initial Assessment of Hazardous Emission Impacts from a Wood Treating Facility

Narrative Statement (Work Plan)

Purpose: This is a project to conduct initial air sampling to address public health concerns of potential hazardous emission impacts from a wood treating facility on adjoining neighborhoods.

Applicant Organization:

Lane Regional Air Pollution Authority
Brian L. Jennison, Ph.D., Director
(541) 736-1056 ext. 216
FAX (541) 726-1205
brian@lrapa.org

Amount Requested: $26,000 is requested

Project Period: September 1, 2004 to August 31, 2005

Air Pollution Control Agency Statement:

The Lane Regional Air Pollution Authority is an air pollution control agency as defined under Section 302(b) of the Clean Air Act.

Project Timeframe: LRAPA anticipates that work on this project will commence upon notification of funding. Monitoring should begin by September 1, 2004 and run for a period of 12 months. The entire project will be completed within 15 months of the commencement of monitoring.

Project Deliverables: LRAPA will produce a final report summarizing the work and the results of the project.

Introduction:

LRAPA has received numerous complaints from people living near the J.H. Baxter wood treating facility for several years. The number of complaints has steadily risen , and frequently come from neighborhoods immediately north and northeast of the plant site. In addition to strong odors, the most common complaints are headaches,

dizziness, sore throat, nausea, eye irritation, and difficulty in breathing.

J.H. Baxter is a wood treatment facility in west Eugene that has been in operation at the same location since 1943. The company pressure treats wood products, including utility poles, cross arms, railroad ties, posts, and other wood products. Substances used by the company to treat the wood include creosote, pentachlorophenol (PCP), and ammoniated copper zinc arsenate (ACZA).

In response requests from concerned residents, LRAPA asked the Superfund Health Investigation and Education (SHINE) division of the Oregon Department of Human Services to evaluate the potential health risk incurred by persons living near the wood treating operations. SHINE completed their investigation but was only able to classify the site as an "indeterminate" health hazard due to a lack of air sampling data. See attached SHINE report for detailed source and chemical information.

Project Summary

The purpose of the proposed project is to conduct some initial "screening" air sampling to characterize the impact of hazardous air pollutants (HAPs) emitted from the J.H. Baxter facility on the adjacent neighborhoods.

Although the SHINE report recommends a comprehensive air monitoring program for the affected area, this study is a reasonable first step in assessing HAP's concentrations in the neighborhoods near the J.H. Baxter facility. It is expected that the information learned from this sampling would be valuable in designing more comprehensive future studies if necessary.

Basically the study would be a first cut at determining potential health risks in the adjacent neighborhoods. This study is designed to measure maximum exposures downwind of the plant site, and would include one "upwind", and two "downwind" predicted maximum impact sites for each sampling event.

Initially EPA screening modeling of the source will be used to select maximum impact sites.
To maximize "bang-for-buck", air samplers would be dynamically placed upwind/ downwind of the source in the quadrant of predicted "worst case" impact locations based on local meteorological conditions. To help with these microscale wind predictions LRAPA has already established a meteorological site at the northwest corner of the plant site. We plan to work closely with J.H.Baxter in determining appropriate sampling times. Sampling events will be selected concurrent with

maximum plant site emission rates based on process conditions.

This project will use the EPA evacuated canister monitoring method TO-15 to monitor for the 62 Urban HAPs. Semi-volatile organic compounds specific to the wood treating operation include pentachlorophenol, naphthalene, creosols, and other PAHs. LRAPA will use a battery powered sampler with a puf/xad/puf cartridge as per the TO-10A method to sample for these and other semi-volatile organic compounds with analysis for the TO-13 array of 64 compounds.

A VOC canister, and a SVOC cartridge would be collected at each site. Due to the dynamic placement of samplers, the sampling strategy is to use equipment that does not require AC power. At least 4-hours of sampling are needed for the SVOC analysis, but sampling times could be extended to improve detectable limits if the worst case conditions persisted. At the requested funding range only ten sampling events can be conducted.

Quality Assurance Statement:

All monitoring activities associated with this proposal will follow the EPA quality assurance guidelines. In addition to the requirements outlined in the analytical methods, LRAPA plans to conduct initial and final calibrations, and routine flow audits of the sampling equipment, as well as collecting duplicate samples at a 14% rate.

Budget Estimates:

To maximize the number of samples taken LRAPA is only requesting funding for the supplies and analytical services required to conduct the study. LRAPA will provide the personnel services required for completion of the project. As mentioned above LRAPA has already installed a meteorological monitoring site at the J.H.Baxter facility to aid in further study of the problem.

Analytical Services	$21,000
Supplies/ Equipment	$5,000
Total Request	$26,000

Appendix B. Raw data from LRAPA's Final Report: Initial Assessment of Hazardous Emission Impacts from the J.H. Baxter Wood Treatment Facility in Eugene, Oregon (February 2007).

This following data tables were provided by LRAPA.

JH Baxter neighborhood - 24-hour samples, concentrations in µg/m^3

	23-May-06			24-May-06		31-May-06			01-Jun-06			14-Sep-06			
Monitoring Site ID:	H	H	J	H	J	H	I	K	H	I	K	H	H*	I	K
% of time downwind of plant:	34%	34%	15%	44%	27%	27%	22%	14%	31%	20%	10%	63%	63%	65%	36%
1-Methylnaphthalene	0.5	0.5	0.2	0.7	0.3	0.2	0.2	-	0.7	0.4	0.1	1.0	-	1.2	0.5
2-Methylnaphthalene	1.1	1.1	0.4	1.3	0.5	0.3	0.4	0.2	1.4	0.9	0.3	2.2	-	2.6	1.1
Acenaphthene	0.3	0.3	-	0.3	-	-	-	-	0.3	0.2	-	0.4	-	0.3	0.2
Bis(2-ethylhexyl)phthalate	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Butylbenzylphthalate	-	-	-	-	1.4	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	0.2	0.2	-	0.2	-	-	-	-	0.2	-	-	0.2	-	0.2	-
di-n-Butylphthalate	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluorene	-	0.1	-	0.2	-	-	-	-	0.2	-	-	0.2	-	0.2	-
Naphthalene	3.2	3.3	1.0	3.0	1.1	0.7	0.7	0.4	3.4	1.1	0.4	5.8	-	5.1	2.4
Phenanthrene	-	-	-	-	-	-	-	-	0.1	-	-	0.2	-	0.1	-

* Sample is a breakthrough test

	02-Nov-06				03-Nov-06			11-Dec-06			12-Dec-06			13-Dec-06			
Monitoring Site ID:	H	H	I	K	H	I	K	H	I	K	H	I	K	H	I	D	B
% of time downwind of plant:	92%	92%	42%	7%	65%	47%	10%	72%	53%	27%	72%	58%	31%	50%	44%	47%	22%
1-Methylnaphthalene	1.2	1.1	0.8	0.2	0.8	0.7	0.2	2.3	1.3	-	2.0	2.3	0.8	0.5	0.5	0.8	0.2
2-Methylnaphthalene	2.8	2.4	1.8	0.3	1.7	1.7	0.4	5.2	3.1	1.2	4.8	5.7	1.9	1.2	1.1	1.6	0.5
Acenaphthene	0.6	0.5	0.3	-	0.2	0.4	-	0.7	0.5	0.2	0.8	1.0	0.3	0.2	0.2	0.3	-
Bis(2-ethylhexyl)phthalate	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Butylbenzylphthalate	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	0.4	0.3	0.2	-	0.2	0.2	-	0.5	0.3	0.1	0.5	0.7	0.2	0.1	0.2	0.2	-
di-n-Butylphthalate	0.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluorene	0.3	0.3	0.2	-	0.1	0.2	-	0.4	0.3	0.5	0.4	0.5	0.2	-	0.1	0.2	-
Naphthalene	6.9	6.7	3.7	0.6	3.1	4.2	0.7	9.9	6.3	2.4	11.4	12.9	4.9	2.1	1.3	3.1	1.0
Phenanthrene	0.3	0.2	0.2	-	0.1	0.2	-	0.2	0.2	-	0.2	0.3	-	-	-	-	-

JH Baxter neighborhood - short term samples (1 - 3 hours), concentrations in µg/m^3

	6-Jan-05		12-Jan-05		19-Mar-05			5-Apr-05			20-Aug-05			10-Nov-05			19-Jan-06			15-Mar-06		
Monitoring site ID:	E	H	E	H	E	H	G	E	H	G	E	H	L	E	H	I	H	F	A	E	H	C
Sample duration (hours):	1.4	1.8	1.3	1.2	2.3	2.3	2.5	2.5	2.4	2.5	2.5	2.5	2.6	3.2	3.3	3	2.2	2.1	2.2	2.8	2.6	2.4
% time downwind of plant:	0%	100%	0%	100%	0%	100%	100%	44%	33%	49%	51%	5%	4%	7%	69%	31%	96%	98%	30%	0%	99%	74%
1,2,4-Trimethyl Benzene	-	-	-	5.5	-	-	5	-	-	-	-	-	-	-	3.7	4.4	-	-	-	-	-	-
1-Methylnaphthalene	-	-	-	-	-	-	-	-	-	-	-	-	-	1.3	7.1	4.5	5.7	7.2	1.1	-	2.8	1.3
2-Methylnaphthalene	-	3.7	-	8	-	12.7	19.4	8.4	4.6	6.9	2.3	-	-	2.4	12.6	8.1	10.1	12.1	2.4	-	6.6	2.8
4-Ethyltoluene	-	-	-	9.3	-	4.8	10	-	-	-	-	-	-	-	5.2	5.2	-	-	-	-	-	-
Acenaphthene	-	-	-	-	-	3.1	4.6	3.2	1.6	2.4	0.9	-	-	-	0.8	0.6	-	-	-	-	1.9	0.9
Acetone	11	-	69	-	-	8.6	-	11	-	20	-	-	-	14	15	19	-	-	-	7.1	8.1	-
Benzene	4.2	2.7	-	7.6	-	-	-	-	-	-	-	-	-	2.4	4.2	4.8	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	23.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	-	-	-	-	-	1.8	2.7	2	0.8	1.2	-	-	-	-	-	-	-	-	-	-	0.9	-
Ethanol	-	-	-	-	-	-	-	-	-	-	-	-	-	24	15	18	-	-	-	-	-	-
Ethyl Benzene	-	-	-	5.3	-	-	5.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluorene	-	-	-	-	-	1.6	2.3	1.7	-	1	-	-	-	-	0.6	-	-	0.9	-	-	-	-
m,p - Xylene	5.1	5.2	-	8.2	-	-	9.5	-	-	3.4	-	-	-	3.9	9.9	11	-	-	-	-	-	-
Methyl Ethyl Ketone	4.9	-	2.3	-	-	-	-	-	-	3.2	-	-	-	-	-	-	-	-	-	-	-	-
Methylene Chloride	-	-	-	-	3.5	3.8	-	25	29	5.6	-	-	13	7.2	21	16	-	-	-	-	-	-
Naphthalene	-	9.8	-	20.6	-	18.7	24.5	13.9	11.1	16.8	4.7	-	-	1.7	6	4	2.4	3.4	5.6	-	25.6	10
n-Hexane	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.6	2.7	-	-	-	-	-	-
o, Xylene	-	-	-	-	-	-	3.4	-	-	-	-	-	-	-	-	3.5	-	-	-	-	-	-
Pentachlorophenol	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	-	-	-	-	-	1.2	1.6	1.1	-	0.8	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	8.1	7	-	11	-	4	11	-	3.6	4.4	-	-	-	7.8	17	17	-	-	-	-	4.3	-

APPENDIX C. Summary of the health assessment process and determination of contaminants of concern.

Screening Process

In evaluating these data, ATSDR used comparison values (CVs) to determine which chemicals to examine more closely. CVs are the contaminant concentrations found in a specific media (soil or water) and are used to select contaminants for further evaluation. CVs incorporate assumptions of daily exposure to the chemical and a standard amount of air, water, and soil that someone may inhale or ingest each day. CVs can also be referred to as health guidelines.

As health-based thresholds, CVs are set at a concentration below which no known or anticipated adverse human health effects are expected to occur. Different CVs are developed for cancer and non-cancer health effects. Non-cancer levels are based on valid toxicological studies for a chemical, with appropriate safety factors included, and the assumption that small children (22 pounds) and adults are exposed every day. Safety factors are included into the values to protect individuals who might be more sensitive to chemical exposure such as children, the elderly, or people with suppressed immune systems. Cancer levels are the media concentrations at which there could be a one in a million excess cancer risk for an adult eating contaminated soil or drinking contaminated water every day for 70 years. For chemicals for which both cancer and non-cancer numbers exist, the lower level is used to be protective. Exceeding a CV does not mean that health effects will occur, just that more evaluation is needed.

The comparison values used in this document are listed below:

Environmental Media Evaluation Guides (EMEGs) are estimated contaminant concentrations in a media where non-carcinogenic health effects are unlikely. The EMEG is derived from the Agency for Toxic Substances and Disease Registry's (ATSDR) minimal risk level (MRL).

Cancer Risk Evaluation Guides (CREGs) are estimated contaminant concentrations that would be expected to cause no more than one additional excess cancer in one million persons exposed over a lifetime. CREGs for most PAHs are calculated from toxicity equivalency factors (TEFs) based on the unit risk for benzo[a]pyrene.

Evaluation of Public Health Implications

Estimation of Exposure Dose

The next step is to take those contaminants that are above the CVs and further identify which chemicals and exposure situations are likely to be a health hazard. Child and adult exposure doses are calculated for the site-specific exposure scenario, using our assumptions of who goes

on the site and how often they contact the site contaminants. The exposure dose is the amount of a contaminant that gets into a person's body. For inhalation, a concentration measured in air is assumed to be the concentration that enters the body.

PAHs have different potencies so the health impacts of the individual compounds depend on the exposure concentration and the potency of that compound. Not all PAHs are considered carcinogens, sometimes due to lack of scientific information, but assumptions can be made to estimate their potency and potential for carcinogenicity relative to a well studied compound, benzo[a]pyrene (B[a]P). This also allows for the evaluation of PAHs that do not have health guidelines, as well as gives the ability to evaluate PAHs mixtures. The potencies, listed as toxicity equivalency factors (TEFs), of anthracene, fluorene, and phenanthrene are listed in Table 4. In this report, TEFs were used to calculate concentrations of these three PAHs relative to B[a]P and then they could be evaluated as a mixture. Naphthalene was evaluated separately from these three PAHs because it has specific health guidelines.

Non-cancer Health Effects for Chronic Exposure

The calculated exposure doses are then compared to an appropriate health guideline for that chemical. Health guideline values are considered safe doses; that is, health effects are unlikely below this level. The health guideline value is based on valid toxicological studies for a chemical, with appropriate safety factors built in to account for human variation, animal-to-human differences, and/or the use of the lowest adverse effect level. For non-cancer health effects, the following health guideline values are used.

Minimal Risk Level (MRLs) - developed by ATSDR
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, non-cancerous effects. An MRL should not be used as a predictor of adverse health effects. A list of MRLs can be found at http://www.atsdr.cdc.gov/mrls.html.

Reference Dose (RfD or RfC) - developed by EPA
An estimate, with safety factors built in, of the daily, lifetime exposure of human populations to a possible hazard that is not likely to cause non-cancerous health effects. For air, they are often very similar to the EMEGs which are described in the previous section. The RfDs and RfCs can be found at http://www.epa.gov/iris/.

If the estimated exposure dose for a chemical is less than the health guideline value, then the exposure is unlikely to cause a non-carcinogenic health effect in that specific situation. If the exposure dose for a chemical is greater than the health guideline, then the exposure dose is compared to known toxicological values for that chemical and is discussed in more detail in the public health assessment (see Discussion Section). These toxicological values are doses derived from human and animal studies which are summarized in the ATSDR Toxicological Profiles. A direct comparison of site-specific exposure and doses to study-derived exposures and doses

found to cause adverse health effects is the basis for deciding whether health effects are likely or not.

Risk of Carcinogenic Effects

The estimated risk of developing cancer from exposure to the contaminants was calculated by multiplying the maximum and median air concentrations by the corresponding unit risks (found in Table 4). The resulting number estimates the maximum increase in risk of developing cancer after 70 years of exposure.

The actual risk of developing cancer is probably lower than the calculated number. The method used to calculate EPA's Cancer Slope Factor assumes that high-dose animal data can be used to estimate the risk for low dose exposures in humans. The method also assumes that there is no safe level for exposure. Little experimental evidence exists to confirm or refute those two assumptions. Lastly, the method computes the 95% upper bound for the risk, rather than the average risk, suggesting that the cancer risk is actually lower, perhaps by several orders of magnitude. It also assumes a person has a continuous exposure over 70 years, which is rarely the case for most individuals.

Because of uncertainties involved in estimating carcinogenic risk, ATSDR employs a weight-of-evidence approach in evaluating all relevant data. Therefore, the carcinogenic risk is described in words (qualitatively) rather than giving a numerical risk estimate only. The numerical risk estimate must be considered in the context of the variables and assumptions involved in their derivation and in the broader context of biomedical opinion, host factors, and actual exposure conditions. The actual parameters of environmental exposures must be given careful consideration in evaluating the assumptions and variables relating to both toxicity and exposure.

Appendix D. ATSDR Glossary of Environmental Health 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 serves the public by using the best science to take responsive public health actions and provides 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).

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.
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:	A group of diseases which occur when cells in the body become abnormal and grow, or multiply, out of control
Carcinogen:	Any substance shown to cause tumors or cancer in experimental studies.

CERCLA:	See **C**omprehensive **E**nvironmental **R**esponse, **C**ompensation, and **L**iability **A**ct.
Chronic Exposure:	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*.
Completed Exposure Pathway:	See **Exposure Pathway**.
Comparison Value: **(CVs)**	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.
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA):	**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.
Concern:	A belief or worry that chemicals in the environment might cause harm to people.
Concentration:	How much or the amount of a substance present in a certain amount of soil, water, air, or food.
Contaminant:	See **Environmental Contaminant**.
Delayed Health Effect:	A disease or injury that happens as a result of exposures that may have occurred far in the past.
Dermal Contact:	A chemical getting onto your skin. (see **Route of Exposure**).
Dose:	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".
Dose / Response:	The relationship between the amount of exposure (dose) and the change in body function or health that result.

Duration: The amount of time (days, months, years) that a person is exposed to a chemical.

Environmental Contaminant: 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.

Environmental Media: 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**.

U.S. Environmental Protection Agency (EPA): The federal agency that develops and enforces environmental laws to protect the environment and the public's health.

Epidemiology: The study of the different factors that determine how often, in how many people, and in which people will disease occur.

Exposure: Coming into contact with a chemical substance.(For the three ways people can come in contact with substances, see **Route of Exposure**.)

Exposure Assessment: 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.

Exposure Pathway: 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.

Frequency: How often a person is exposed to a chemical over time; for example, every day, once a week, twice per month.

Hazardous Waste: 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.

Health Effect: ATSDR deals only with **Adverse Health Effects** (see definition in this Glossary).

Indeterminate Public Health Hazard: 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.

Ingestion: Swallowing something, as in eating or drinking. It is a way a chemical can enter your body (See **Route of Exposure**).

Inhalation: Breathing. It is a way a chemical can enter your body (See **Route of Exposure**).

LOAEL: **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: **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.

NPL: 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.

NOAEL: **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 Apparent 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.

No Public Health Hazard:	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.
Order of Magnitude:	An order of magnitude is the class of scale or magnitude for a numerical value. It is often used to provide an approximate comparison of different values. For example, a number that is one order of magnitude larger than another, is about 10 times greater and one that is two orders of magnitude greater is about 100 times larger.
PHA:	**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:	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.
Population:	A group of people living in a certain area; or the number of people in a certain area.
PRP:	**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 Assessment(s):	See **PHA**.
Public Health Hazard:	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.
Public Health Hazard Criteria:	PHA categories given to a site which tell whether people could be harmed by conditions present at the site. Each are defined in the Glossary. The categories are: – Urgent Public Health Hazard – Public Health Hazard – Indeterminate Public Health Hazard – No Apparent Public Health Hazard – No Public Health Hazard

Reference Dose (RfD):	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 not likely to cause harm to the person.
Relative Bioavailability:	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.
Route of Exposure:	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).
Safety Factor:	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 not likely to cause harm to people.
SARA:	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 Size:	The number of people that are needed for a health study.
Sample:	A small number of people chosen from a larger population (See **Population**).
Source (of Contamination):	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**.
Special Populations:	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.
Statistics:	A branch of the math process of collecting, looking at, and summarizing data or information.
Superfund Site:	See **NPL**.

Survey:	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:	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.
Toxicology:	The study of the harmful effects of chemicals on humans or animals.
Tumor:	Abnormal growth of tissue or cells that have formed a lump or mass.
Uncertainty Factor:	See **Safety Factor**.
Urgent Public Health Hazard:	This category is used in ATSDR's Public Health Assessment documents for sites that have certain physical features or evidence of short-term (less than 1 year), site-related chemical exposure that could result in adverse health effects and require quick intervention to stop people from being exposed.