Health Consultation

VULCAN TIE YARD

VULCAN, IRON COUNTY, MISSOURI

SEPTEMBER 7, 2005

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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HEALTH CONSULTATION

VULCAN TIE YARD

VULCAN, IRON COUNTY, MISSOURI

Prepared by:

Missouri Department of Health and Senior Services
Division of Community and Public Health
Section for Environmental Public Health
Under Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

STATEMENT OF ISSUES AND BACKGROUND

Statement of Issues

The Missouri Department of Natural Resources has requested the Missouri Department of Health and Senior Services (DHSS), in conjunction with the federal Agency for Toxic Substances and Disease Registry (ATSDR), to complete a health consultation for the Vulcan Tie Yard in Vulcan, Iron County, MO. This health consultation focuses on nearby residents' exposure to contaminants originating from the Vulcan Tie Yard.

Background

The Vulcan Tie Yard is located along Highway 49 in Vulcan, Iron County, Missouri. The Vulcan Post Office is directly across the highway to the west of the tie yard, and there are approximately ten residences located north of the tie yard along Highway 49. The Vulcan Tie Yard is used as a storage yard for creosote-treated railroad ties (Figures 1 and 2). At any one time, there may be as many as 80,000 railroad ties stacked on pallets in the tie yard awaiting transport via rail. Railroad tracks traverse the tie yard. A small stream, Richland Creek, is to the south of the tie yard.

Nearby residents and post office employees have complained of creosote odors and expressed concern about possible adverse health effects associated with the creosote emissions. Creosote is a name used for a variety of products such as: wood creosote, coal tar creosote, coal tar, coal tar pitch, and coal tar volatiles (1). Coal tar creosote is a mixture of many chemicals widely used as a wood preservative (1). It is a thick, oily liquid typically amber to black in color. The chemical constituents typically include: phenanthrene, fluorene, fluoranthene, acenaphthalene, pyrene, dibenzofuran, methylanthracenes, naphthalene, methylfluorenes, methylphenanthrenes, chrysene, dimethylnaphthalenes, anthracene, carbazole, benzofluorenes, 1-methylnaphthalene, 2-methylnaphthalene, and biphenyl; in varying amounts depending upon the source of the creosote (2).

Site Investigations

In March 2004, the U.S. Environmental Protection Agency (EPA) visited the site to collect soil and water samples. Nine samples were collected, including two field duplicates (3). Soil samples were taken from four locations on the tie yard, three (including the field duplicate) from the northern part of the site and two from the southern portion. One background soil sample was also taken off-site. Four on-site samples were collected at a depth of 0-1 inch, one at a depth of 0-12 inches, and the background sample at 0-2 inches of depth. Because there is no permanent standing water on the tie yard, three water samples were taken from puddles. Tables 1 and 2 are a listing of the sampling results.

In July 2004, the Missouri Department of Natural Resources (MDNR) received complaints from Vulcan residents about creosote odors emanating from the tie yard. The residents expressed their dislike of the odors and also their concern of potential adverse health effects associated with creosote emissions. As a result, MDNR collected outdoor ambient air samples, on July 20 and 21, 2004, at a residence that is northeast of, and immediately across the railroad tracks from, the tie yard. Three ambient air samples were collected, a 5.5, 6, and 24-hour sample. Table 3 is a listing of the ambient air sampling results. One groundwater water sample was collected from a residential drinking water well. Upon analysis, no contaminants were detected.

The analysis of the ambient air samples revealed the presence of naphthalene and other polycyclic aromatic hydrocarbons. The sampling results were compared to EPA reference concentrations as well as ATSDR Minimal Risk Levels (MRLs). The ambient naphthalene concentration quantified in the 24-hour sample was greater than the EPA reference dose level and the MRL. The other polycyclic aromatic hydrocarbon compounds detected at elevated levels were 2-methylnaphthalene, acenaphthalene, anthracene, fluoranthene, fluorene, phenanthrene, and pyrene.

Because the levels of naphthalene exceeded EPA's reference concentration and the MRL, MDNR was concerned about the ambient air quality near the tie yard. MDNR contacted DHSS requesting guidance on the potential impact on the health of Vulcan residents. DHSS decided to complete a risk assessment to better characterize the health risk to nearby residents. Using the 24-hour sampling data, DHSS calculated the theoretical noncarcinogenic risk to human health and risk-based concentrations (RBC) in both a residential and occupational scenario (4). The risk assessment methodology is a tool used to make decisions about the clean up of contaminated sites and is not intended to assess an individual's risk. The methodology is consistent with EPA Risk Assessment Guidance for Superfund (RAGS). The lifetime excess cancer risk was also calculated as an estimate of the probability of an individual developing cancer as a result of exposure to the specified carcinogenic contaminants of concern (4).

From the risk assessment analysis, DHSS concluded that there is a slight increase in the risk of non-carcinogenic health effects from the elevated levels of 2-methylnaphthalene and naphthalene that were detected in the ambient air. DHSS also calculated risk-based concentrations for the contaminants of concern that should be used for comparison to ambient air quality data. Table 3 is a list of the contaminants of concern, the detected levels; DHSS recommended risk-based concentrations, and EPA and ATSDR comparison values. From this comparison, naphthalene is the only contaminant that exceeds recommended air concentrations.

Odor thresholds were available for acenaphthalene, naphthalene, phenanthrene, and 2-methylnaphthalene (Table 4). Odor thresholds are defined as the lowest concentration of a substance in air or water that can be detected by the human sense of smell. The air contaminant odor thresholds are significantly higher than the health-based comparison values. Therefore, the contaminants could be present at levels that adversely affect human health before they could be detected by the human nose. The contaminant levels detected in the ambient air samples did not exceed the air sample odor thresholds.

On November 4, 2004, DHSS staff conducted a site visit. It was observed that the closest building is the Vulcan Post Office immediately across Hwy 49 from the tie yard. There is a residence in the rear part of the post office. Other residences were visible from the tie yard and were less than one-quarter mile north of the tie yard. DHSS staff did notice an unpleasant odor emanating from the tie yard. There were no employees or activity on-site on the day of the visit.

DISCUSSION

Access to the Vulcan Tie Yard is unrestricted. There is no fencing or other physical barrier to prevent people from walking onto or around the site. Children could easily play in the contaminated soil or climb on the treated wood ties. The ties are treated with creosote at another location and stored at the tie yard in tall stacks. After treatment with creosote, the ties will leak and seep. Therefore, they present a chemical and physical hazard to children. There are railroad tracks and a small stream near the tie yard, both of which could attract the attention of children. It is not known how many people are exposed to the site. Because access is unrestricted, residents and children could potentially visit the site daily. It is also unknown how many tie yard employees frequent the site and how much time is spent at the tie yard.

The soil contamination at the tie yard is of the most concern for visitors to the site. The levels of contaminants found in the soil samples were compared to MDNR Cleanup Levels for Missouri (CALM). CALM values are risk-based soil and groundwater cleanup levels for sites contaminated with hazardous substances. The cleanup levels are designed to be protective of human health and the environment, and reflect the land use and varied human exposure those uses imply. In this health consultation, the CALM values used for comparison are values for industrial land use.

Levels of 11 contaminants were found in the soil above CALM values. The highest levels of contaminants were found in the southern portion of the tie yard making it the area of most concern. Samples #1, 1-field duplicate, 2 and 3 were taken from 0-1 inches in depth. Sample #4 was taken from 0-2 inches due to gravel. These samples do not indicate how deep the contamination exists or the total area of the yard that is contaminated. The soil that is beneath the ties was not tested and could be highly contaminated.

2-Methylnaphthalene and naphthalene were present in the on-site water puddles. It is unknown if surface water runoff is occurring and affecting the nearby stream or groundwater. Also, since this a rural area, it is assumed that most residents have private drinking water wells that could potentially be impacted by contaminated groundwater. It is unlikely that nearby residents are being exposed to the contaminated on-site water puddles. However, there is the potential for contaminant migration and for children to play on the site in the puddles. Further investigation is needed to determine the proximity of private drinking water wells and the potential for contamination.

The levels of contaminants were compared to ATSDR comparison values (CVs) and MRLs. ATSDR has developed CVs that are media-specific concentrations used by health assessors to select environmental contaminants of concern. Contaminant concentrations that are less than the

CV are unlikely to pose a health threat. Contaminant levels above the CV do not necessarily indicate that a health threat is present, but that further evaluation of the chemical and pathways is needed. MRLs are an estimate of daily human exposure to a substance that is likely to be without an appreciable risk of adverse effects (noncancer) over a specified duration of exposure. MRLs can be derived for acute, intermediate, and chronic duration exposures by the inhalation or oral routes. Acute exposure is defined as exposure that occurs for less than 14 days. Intermediate exposure occurs for more than 14 days but less than 364. Chronic exposure is exposure that occurs for more than 365 days.

The concentration of naphthalene in the ambient air data exceeded EPA's reference concentration and ATSDR's MRL. MDNR was also concerned about the concentration of 2-methlynaphthalene that was detected. The DHSS risk assessment analysis concluded that there is a slight increase in the risk of non-carcinogenic health effects from the elevated levels of 2-methylnaphthalene and naphthalene that were detected in the ambient air (4).

The initial sampling results indicate that 2-methylnaphthalene and naphthalene are present in the ambient air; however, more sampling may be needed to fully evaluate the ambient air quality in the area. When ties are delivered from the treatment facility and placed on the yard for storage, there will be an off-gassing period. During this time, the concentration of contaminants in the air will be higher. Also, during summer when temperatures are higher or when ties are removed from stacks, additional volatiles will evaporate and be present in the ambient air. Vapors in the ambient air could present an occupational hazard for tie yard employees that are handling ties. The odor thresholds for the contaminants that were detected in ambient air samples are lower than detected concentrations. Because many nearby residents and post office employees and patrons complained of odors, it is obvious that this one 24-hour sampling event is not indicative of the concentrations of contaminants that could be present in the ambient air. Directly dependent on the concentration of contaminants, odors will fluctuate depending on when freshly treated ties are delivered to the yard or seasonal weather fluctuations. Freshly treated ties will be more odorous while off gassing. Also, because most of the contaminants are volatile, the tie yard may be more odorous on higher temperature days or when ties are removed from the stacks. Depending on the wind direction and speed, some residents may be more or less likely to be able to smell the odors emanating from the tie yard.

TOXICOLOGICAL EVALUATION

All of the contaminants found at elevated levels are either a constituent of creosote, part of the polycyclic aromatic hydrocarbon (PAH) group of chemicals, or both. The exposure route and potential health effects are expected to be similar for chemicals in a group. Therefore, the toxicological evaluation will be discussed in two parts, creosote and PAHs.

Creosote

Coal tar creosote is the mostly widely used wood preservative in the United States (5). It can only be used by people who have been trained to use it safely, as it is a restricted-use pesticide.

Coal tar products are also used in low doses as ingredients in medicines and shampoos used to treat skin diseases such as psoriasis and dandruff (5).

When coal tar creosote enters the environment as waste from the wood preservative industry, some of its components will break down easily. Others remain in the soil and groundwater being potentially toxic to animals and humans. Coal tar creosote components may also leak or seep from the treated lumber, like railroad ties. The volatile components of coal tar creosote, that is the chemicals that evaporate easily, may evaporate and enter the air.

People can be exposed to creosote by ingestion, inhalation, or dermal contact. People, especially children, may be exposed through ingestion if they put unwashed hands in their mouths after touching soil or wood contaminated with creosote. People could also be exposed through the ingestion of contaminated water. Exposure through the skin occurs when people touch treated wood or contaminated soil. Since many of the constituents of coal tar creosote are volatile, the inhalation of vapors is a very likely exposure pathway.

Exposure to large amounts of creosotes, including coal tar creosote, may be harmful to human health. Eating food or drinking water contaminated with a high level of these compounds may cause a burning in the mouth and throat and stomach pain (5). Brief exposure to high concentrations of coal tar creosote may result in a rash or severe irritation of the skin, chemical eye burns, convulsions and mental confusion, kidney or liver problems, unconsciousness, or even death. Longer exposure to lower levels of coal tar creosote by direct contact with the skin or inhaling the vapors can also result in sensitivity to sunlight, damage to the cornea, and skin damage such as reddening, blistering, or peeling (5). Longer exposures to the vapors of creosotes can also cause irritation of the respiratory tract. Skin cancer and cancer of the scrotum have also resulted from long-term exposure to low levels of creosote.

Chronic oral or dermal contact with the contaminated soil at the Vulcan Tie Yard could potentially cause adverse health effects. There is a slight increase in risk of non-carcinogenic health effects from the contaminated ambient air. However, without additional ambient air sampling, a full evaluation of the potential health effects cannot be completed.

Polycyclic Aromatic Hydrocarbons

Many PAHs are components of creosote, including coal tar creosote. PAHs have been detected in ambient air from sources including cigarette smoke, vehicle exhausts, asphalt roads, coal, coal tar, wildfires, and agricultural burning. In general, PAHs do not easily dissolve in water. In soils, PAHs are most likely to stick tightly to particles. Some plants can absorb PAHs from contaminated soil via the roots depending on the concentration, solubility and molecular weight of the PAH and on the plant species.

People can be exposed to PAHs by ingestion, inhalation, or dermal contact. No reports of effects to humans following short-term exposure to PAHs are available. Studies in animals have shown that PAHs can cause harmful effects on the skin, body fluids, immune system, and reproductive system, along with birth defects and low birth weight. Similar effects could occur in people; however, no information is available to show that these effects do occur (6). It is not known how

rapidly lungs absorb PAHs. Absorption is generally slow when PAHs are swallowed. PAHs enter all tissues that contain fat. They tend to be stored in kidneys, liver, and fat. Smaller amounts can be stored in the spleen, adrenal glands, and ovaries. Most PAHs that enter the body leave within a few days (6). Cancer is the major concern from exposure to PAHs, especially benzo(a)pyrene.

Chronic ingestion of the contaminated soil on the Vulcan Tie Yard could increase one's chance of having cancer, however, this type of exposure is not anticipated to occur. It is unknown if the contaminants from the site have impacted the area surface water. It appears that the contaminants have not affected nearby groundwater.

Children's Health

In general, children are more likely than adults to become exposed to contaminants in soil or water. In their daily activities, children have a tendency to have frequent hand-to-mouth contact and introduce non-food items into their mouths. Because children are smaller and their bodies typically retain more of the contaminants, it usually takes less of a contaminant to cause adverse health effects in children than adults.

Children exposed to creosote are likely to experience the same adverse health effects, as would adults. However, it has been noted that children who played on soil contaminated with creosote had more skin rashes than children who did not (5). Since some of the constituents of creosote may be stored in body fat, it is possible for them to be passed to nursing infants. Some animal studies indicate that creosotes could cross the placenta and reach the fetus. However, there have been no effects reported for human children who were exposed to creosote before birth.

It is anticipated that children would experience similar health affects to adults when exposed to PAHs. It is noted that human fetuses may also be particularly susceptible to the toxic effects produced by exposure to PAHs.

CONCLUSIONS

Ambient air data does indicate that contaminants are present. However, the one 24-hour sampling event does not adequately characterize the overall ambient air quality of the area surrounding the tie yard. The contaminants were measured at levels below their respective odor thresholds, yet residents have complained of odor originating from the tie yard. Elevated levels of creosote components and PAHs were found in the four soil samples that were taken on-site. The extent and depth to which the soil contamination persists is not known. On-site puddle water samples did contain two contaminants; however, the surface water of the area has not been evaluated. The groundwater sample collected from the residential well did not contain any contaminants.

Access to the site is unrestricted and it is not known how frequently nearby residents and children visit the site. It is also not known how many tie yard employees visit the site or the duration of their visits.

Based on the lack of information about the ambient air surrounding the site, the extent of soil contamination on-site, and the surface water quality in the area, the Vulcan Tie Yard is considered to be an *Indeterminate Public Health Hazard* for current exposures. The *Indeterminate Public Health Hazard* category is used by ATSDR and cooperative agreement partners for sites with incomplete information.

1. Access to the site is unrestricted. There are contaminants present in the on-site soil and water, as well as physical hazards, such as tall stacks of railroad ties, on-site.

2. Ambient air quality monitoring near the site did indicate that contaminants were present in the ambient air. However, contaminant levels detected in the ambient air sampling from one 24-hour sampling event were not consistent with complaints from nearby residents and post office employees and patrons.

3. Although temporary standing water on-site did have levels of contaminants, contaminant migration to area surface water has not been investigated.

4. Eleven contaminants were detected in the soil samples collected on-site, with the highest levels being on the southern portion of the site.

RECOMMENDATIONS

1. DHSS/ATSDR recommends that fencing or physical barriers should be constructed to prevent public access to the site.

2. DHSS/ATSDR recommends more extensive ambient air sampling to characterize the ambient air quality over extended time periods. Sampling should be conducted in varying weather conditions and during times of tie delivery to the site.

3. DHSS/ATSDR recommends further soil sampling of the tie yard including the area beneath the ties that could be impacted by contaminants leaking from the ties and seeping into the soil.

4. DHSS/ATSDR recommends sampling of the nearby surface water.

5. DHSS/ATSDR recommends investigating the occupational hazards for tie yard employees.

PUBLIC HEALTH ACTION PLAN

This Public Health Action Plan (PHAP) for the Vulcan Tie Yard site contains an explanation of the actions to be taken by the Missouri Department of Health and Senior Services (DHSS), the Agency for Toxic Substances and Disease Registry (ATSDR), and other stakeholders. The purpose of the PHAP is to ensure that this public health consultation not only identifies public health hazards, but provides an action plan to mitigate and prevent adverse human health effects resulting from past, present, and future exposures to hazardous substances at or near the site. Below is a list of commitments of public health actions to be implemented by DHSS, ATSDR, or other stakeholders at the site:

1. DHSS/ATSDR will coordinate with the appropriate agencies or stakeholders to implement the recommendations in this public health consultation.

2. DHSS/ATSDR will address community health concerns and questions as they arise and provide necessary community and health professional education.

3. DHSS/ATSDR will review additional sampling data as it becomes available and provide guidance regarding possible health risk if necessary.

4. DHSS/ATSDR will update this public health consultation as needed.

Preparers of the Report:

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Attachments:

Figures:

Figure 1. Picture of Vulcan Tie Yard to the north..
Figure 2. Picture of Vulcan Tie Yard from Vulcan Post Office front yard.

Tables:

Table 1. Soil Sampling Results (March 2004)
Table 2. Water Sampling Results (March 2004)
Table 3. Ambient Air Sampling Results (July 2004)
Table 4. Odor Thresholds

CERTIFICATION

This Vulcan Tie Yard site, Vulcan, Missouri, Public Health Consultation was prepared by the Missouri Department of Health and Senior Services (DHSS) under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It was completed in accordance with the approved methodologies and procedures existing at the time the health consultation was initiated. Editorial review was completed by the Cooperative Agreement partner.

Technical Project Officer, CAT, SPAB, DHAC

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

Team Lead, CAT, SPAB, DHAC, ATSDR

References

1. Agency for Toxic Substances and Disease Registry. Division of Toxicology ToxFAQs for creosote. Atlanta: U.S. Department of Health and Human Services; 2002 September.

2. Missouri Department of Natural Resources. Memorandum to Scott Clardy from Calvin Ku requesting guidance on the analysis of the Vulcan Tie Yard ambient air quality data. Jefferson City, Missouri. October 1, 2004.

3. United States Environmental Protection Agency. Memorandum to Dedriel Newsome from Dale Bates providing sample analysis results from the Vulcan Tie Yard. Kansas City, Kansas. May 3, 2004.

4. Missouri Department of Health and Senior Services. Letter to Calvin Ku from Scott Clardy regarding Vulcan Tie Yard ambient air quality data. Jefferson City, Missouri. October 19, 2004.

5. Agency for Toxic Substances and Disease Registry. Toxicological profile for creosote, update. Atlanta: U.S. Department of Health and Human Services; 2002 September.

6. Agency for Toxic Substances and Disease Registry. Toxicological profile for polycyclic aromatic hydrocarbons, update. Atlanta: U.S. Department of Health and Human Services; 1995 August.

Figure 1. Picture of Vulcan Tie Yard from Vulcan Post Office front yard.

Figure 2. Picture of Vulcan Tie Yard to the north.

Table 1. Soil Sampling Results (March 2004)

Contaminant of Concern	Sample #1 (NW)§	Sample #1-FD (NW)§	Sample #2 (SW)§	Sample #3 (SE)§	Sample #4 (NE)§	Sample #5 *	ATSDR Comparison Values	CALM Values
Acenaphthene	13	14	1100	2900	20U	0.32U	30,000 (child) 400,000 (adult)†	5400
Anthracene	11	10	390	930	20U	0.32U	500,000 (child) 1,000,000 (adult)†	27,000
Benzo(a)anthracene	**99**	**10**	**480**	**990**	20U	0.32U	NA	4
Benzo(a)pyrene	**3.50**	**3.40**	**180**	**400**	20U	0.32U	NA	0.6
Benzo(b)fluoranthene	**8.70**	**8.80**	**290**	**570**	20U	0.32U	NA	4
Benzo(g,h,l)perylene	2.90	2.30	51	400	20U	0.32U	NA	NA
Benzo(k)fluoranthene	3.00	2.80	**100**	**400**	20U	0.32U	NA	32
Carbazole	4.60	4	100	**1000**	50U	0.80U	NA	320
Chrysene	14	14	**470**	**1100**	24	0.32U	NA	140
Dibenz(a,h)anthracene	**1.10**	**1.10**	**30**	**400**	**20U**	**0.32U**	NA	0.6
Dibenzofuran	6.30	7.10	**580**	**1900**	20U	0.32U	NA	360
Fluoranthene	100	100	3200	**7400**	140	1.10	20,000 (child) 300,000 (adult)†	5,200
Fluorene	13	14	1100	3300	20U	0.36	20,000 (child) 300,000 (adult)†	3,600
Indeno(1,2,3-cd)pyrene	3.70	3.40	**84**	**780**	**20U**	0.32U	NA	11
2-Methylnaphthalene	2.90	3.30	20	400	20U	0.32U	NA	NA
Naphthalene	2.40	2.80	20	**400**	20U	0.32U	1,000 (child) 10,000 (adult)†	240
Phenanthrene	35	35	4000	11000	33	1.60	NA	NA
Pyrene	64	62	2100	4800	92	0.70	2,000 (child) 20,000 (adult)‡	6,900

All values are in milligrams per kilogram (mg/kg).
CALM=Cleanup Levels for Missouri for industrial use.
FD=Field duplicate.
U = Not detected at reporting limit.
*Background sample.
†EMEG=Environmental Media Evaluation Guide, Intermediate Exposure (occurring for more than 14 days but less than 364).
‡RMEG=Reference Media Evaluation Guide.
§Designates the area of the site in which the sample was collected. NE=Northeast, NW=Northwest, SE=Southeast and SW=Southwest.
Values in Boldface type exceed one or more of the comparison values.
PAH=Polycyclic Aromatic Hydrocarbons.

Table 2. Surface Water Sampling Results (March 2004)

Contaminant of Concern	Sample #101	Sample #101-FD	Sample #102	ATSDR Comparison Values	ATSDR Minimal Risk Levels§
Acenaphthene	200	200	57	6,000 (child) 20,000 (adult)†	6,000
Anthracene	39	32	13	100,000 (child) 400,000 (adult)†	10,000
Benzo(a)anthracene	17	16	8U	NA	NA
Benzo(b)fluoranthene	20	16	16	NA	NA
Carbazole	36	36	20U	NA	NA
Chrysene	29	23	21	NA	NA
Dibenzofuran	92	89	8U	NA	NA
2,4-Dimethylphenol	48	49	22	200 (child) 700 (adult)‡	NA
Fluoranthene	210	180	120	4,000 (child) 10,000 (adult)†	400
Fluorene	110	100	16	4,000 (child) 10,000 (adult)†	400
Indeno(1,2,3-cd)pyrene	16	15	15	NA	NA
2-Methylnaphthalene	**71**	**69**	8U	NA	50
2-Methylphenol	84	90	43	NA	NA
4-Methylphenol	120	120	20U	NA	NA
Naphthalene	**130**	**130**	**8U**	200 (child) 700 (adult)†	0.7
Phenanthrene	130	120	8U	NA	NA
Phenol	190	180	8U	3,000 (child) 10,000 (adult)‡	NA
Pyrene	120	110	66	300 (child) 1,000 (adult)‡	NA

All values in micrograms per liter (µg/L).
FD=Field duplicate.
U = Not detected at reporting limit.
NA=Not available.
†EMEG=Environmental Media Evaluation Guide, Intermediate Exposure (occurring for more than 14 days but less than 364).
‡RMEG=Reference Media Evaluation Guide.
§Minimal Risk Levels (MRLs) are in µg/L/day for intermediate exposure durations.

Table 3. Ambient Air Sampling Results (July 2004)

Contaminant	Concentration			EPA Reference Concentration	ATSDR MRL (Chronic, Inhalation)	MDHSS RBC	
	5.5-hour sample	6-hour sample	24-hour sample			Residential	Occupational
2-Methylnaphthalene	2.3	5.8	3.1	NA	NA	10	20
Acenaphthene	2.2	6.7	3.5	NA	NA	170	300
Anthracene	0.12	0.42	0.17	NA	NA	860	1500
Fluoranthene	0.23	0.71	0.27	NA	NA	110	200
Fluorene	1.4	4.2	2.1	NA	NA	110	200
Naphthalene	**2.8**	**11**	**4.6**	3	4	2	4
Phenanthrene	2.0	6.1	2.8	NA	NA	NA	NA
Pyrene	0.10	0.32	0.14	NA	NA	90	150

All values are in micrograms per cubic meter (µg/m^3).
NA=Not available.
MRL=Minimal Risk Level.
Values in boldface type exceeded one or more comparison value.

Table 4. Odor Thresholds

Contaminant	Odor Threshold in Air (µg/m^3)
2-Methylnaphthalene	58.1
Acenaphthene	3100
Naphthalene	440
Phenanthrene	55

Odor thresholds were available from EPA and ATSDR for these contaminants only.