

# Letter Health Consultation

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RADIAC ABRASIVES, INC.

CHICAGO, ILLINOIS

MARCH 24, 2014

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES  
Agency for Toxic Substances and Disease Registry  
Division of Community Health Investigations  
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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LETTER HEALTH CONSULTATION

RADIAC ABRASIVES, INC.

CHICAGO, ILLINOIS

Prepared By:

Agency for Toxic Substances and Disease Registry (ATSDR)  
Division of Community Health Investigations  
Central Branch



**DEPARTMENT OF HEALTH & HUMAN SERVICES**  
*Agency for Toxic Substances and Disease Registry,  
Region 5*

*Public Health Service  
77 W. Jackson Blvd., Room 413  
Chicago, IL 60604*

March 10, 2014

George Czerniak  
Director, Air and Radiation Division  
United States Environmental Protection Agency  
77 W. Jackson Blvd., MS A-18J  
Chicago, IL 60604

Dear Mr. Czerniak:

On August 6, 2013, ATSDR met with USEPA Region 5 Air and Radiation Division (ARD) regarding the Radiac Abrasives (referred to in the letter as "*Radiac*") facility to discuss the potential public health implications of exposure to naphthalene emissions from the facility. ARD requested that ATSDR review its modeling results of facility emissions and specifically, answer: *If Radiac Abrasive's modeled naphthalene concentrations are correct, would this concentration of naphthalene pose a public health problem?*

The air modeling data that U.S. EPA provided to ATSDR estimated potential short term and long term concentrations of naphthalene in the community surrounding the Radiac facility. Based on these modeled concentrations and the proximity to residences, a health threat may exist for community members exposed to these levels of airborne naphthalene. The models predict that residents as far away as 0.4 miles may be at increased risk of cancer if exposed for a lifetime. Additionally, the models predict that residents close to the facility boundary could be exposed to peak concentrations high enough that they may experience nasal and respiratory irritation and the exacerbation of pre-existing respiratory conditions. These concentrations are theoretical estimates based on mathematical models. The actual air concentrations are not known. Therefore, ATSDR recommends that air monitoring begin as soon as possible to measure ambient air levels of naphthalene on the Radiac property where it abuts the nearest residences.

### **Background**

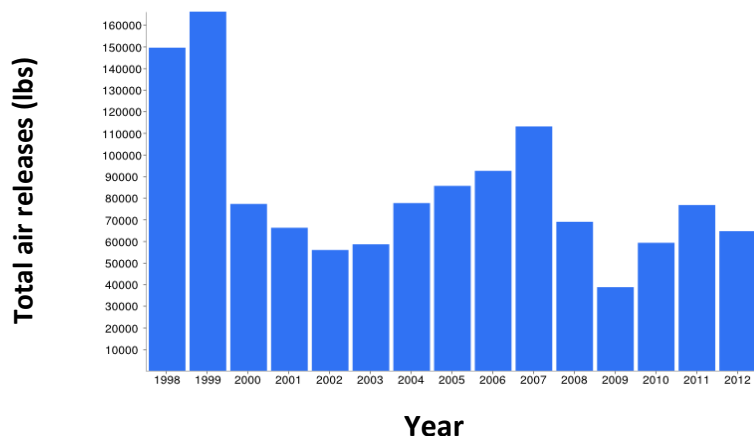
Radiac was constructed in Salem, IL in 1967-1968 by Simonds Abrasive (now "*Simonds International*"), which has been an industry leader in tool manufacturing since 1832. The 50,000 square foot plant was constructed on a 100-acre plot and opened in 1968. In 1975, the Simonds Abrasive Co. was sold to Unicorn Industries of Windsor, England (Universal Abrasives), then later to M&R Industries/DeSanno of Philadelphia. DeSanno-Universal consolidated operations into the expanded Salem, Illinois plant in

1983. The name was changed to Radiac Abrasives in 1985.<sup>1</sup> Today the company is owned by Tyrolit Schleifmittelwerke Swarovski K.G., of Austria, and in 2011 it had 250 employees.<sup>2</sup>

The facility manufactures grinding wheels for commercial use. Its manufacturing processes include raw materials receiving and inspection, abrasive grain mixing (dry and wet type vitreous and organic mixes), mix drying, wheel molding, wheel drying, wheel bonding, wheel firing, finishing, and shipping.<sup>3</sup> Radiac mixes two types of raw materials: vitreous bonded and organic bonded (resins). The vitreous-bonded material is first mixed, dried to remove moisture (at approximately 195 degrees Fahrenheit), molded and fired in a kiln (at 2000-2300 °F). The organic-bonded resin material is mixed, molded and cured in curing ovens. The raw materials are dried in a dryer for 24 to 48 hours. Cycle times for the kilns are typically 5 days. Radiac currently operates 16 natural gas-fired kilns (2 utilize thermal oxidizers for emission control) and 27 natural gas-fired curing ovens.<sup>4</sup> The most recent Toxic Release Inventory (TRI) facility estimates of emissions are 38 tons per year of total volatile organic material (VOM), comprised almost completely of naphthalene with trace amounts of other polycyclic aromatic hydrocarbons (PAHs).<sup>6</sup>

In 2007, USEPA Region 5 issued a notice of violation (NOV) because the facility was exceeding the Illinois State Implementation Plan (SIP) emissions regulations of “volatile organic material” (VOM) from 19 kilns (Illinois Administrative Code Title 35, Sections 215.301 and 215.302). This NOV was the result of stack testing, and USEPA determined that individual kilns were emitting up to 17.9 pounds per hour (lbs/hr) of VOM—over twice the SIP emissions standard (8 lbs/hr). Up to that point, there were no emissions controls on any of the 19 stacks.<sup>5</sup> As part of the NOV, a thermal oxidizer was installed to treat emissions from two of the 19 kilns; emissions from the rest remain uncontrolled.<sup>6</sup> Figure 1 illustrates the total reported emissions (lbs/yr) of naphthalene from Radiac by year.

**Figure 1. TRI On-site Total Air Emissions Reported (in pounds), by Radiac Abrasives Inc (TRI ID 62881RDCBR1015S) for NAPHTHALENE U.S. 1998-2012**



<sup>1</sup> <http://www.simondsinternational.com>

<sup>2</sup> <http://www.wjbradio.com/LocalNews/Future-of-Radiac-Abrasives-Discussed-at-Salem-Chamber-Meeting>

<sup>3</sup> Title 5 permit, Radiac Abrasives, April 28, 2011

<sup>4</sup> USEPA. Plant Inspection Report-Radiac Abrasives, Salem, IL. Air Enforcement and Compliance Assurance Section IL/IN). July 14, 2006.

<sup>5</sup> USEPA.2007. Notice of Violation, Radiac Abrasives, Inc. EPA-5-07-10-IL

<sup>6</sup> Personal correspondence between Michelle Colledge and U.S. EPA Air Enforcement on August 6, 2013.

The city of Salem, IL is a small town with approximately 7,500 residents.<sup>7</sup> About 1,100 people live within 0.5 miles of the facility boundary, predominantly east and northeast of the facility. A number of residential properties are adjacent to the facility property and a Head Start facility (preschool aged children) is located within 0.25 miles to the east-southeast (Figure 2). The closest residence is approximately 250 feet from the building entrance of the facility.

**Figure 2. Aerial map of property surrounding Radiac Abrasives**



### **Air Modeling**

USEPA modeled two scenarios of short and long-term ambient naphthalene concentrations to evaluate the potential impact of site emissions. Scenario 1 assumes the permit maximum estimated emissions during 24-hour operations from onsite point sources (comprised primarily of kiln and oven stacks). Scenario 2 assumes estimated emissions during scaled operational hours that reflect actual current plant processes and emission rates as identified from TRI data. Two scenarios were modeled to determine concentrations possible a) within the allowable limits of the permit (emissions at the allowable limits of the permit represented “worst case” emissions), and b) within the current operational limits. Both scenarios estimated a 5-year average to represent chronic exposures and maximum 1- and 24-hour averages to represent acute exposures at 2,940 community receptor points. The statistical distributions of the modeled air concentrations are presented in Table 1.

<sup>7</sup> <http://www.census.gov>, 2010 census estimates

**Table 1. Statistical distribution of naphthalene modeling**

Statistic	Scenario 1			Scenario 2		
	5 year averages ( $\mu\text{g}/\text{m}^3$ )	24-hr averages ( $\mu\text{g}/\text{m}^3$ )	1-hr averages ( $\mu\text{g}/\text{m}^3$ )	5 year average ( $\mu\text{g}/\text{m}^3$ )	24-hr averages ( $\mu\text{g}/\text{m}^3$ )	1-hr averages ( $\mu\text{g}/\text{m}^3$ )
Min	0.18	3.74	35.57	0.07	1.49	13.79
25th percentile	0.63	12.07	<b>113.76</b>	0.25	4.91	45.56
50th percentile	1.18	21.38	<b>177.86</b>	0.48	8.76	<b>71.73</b>
75th percentile	2.11	34.34	<b>223.57</b>	0.86	14.01	<b>89.02</b>
95th percentile	<b>6.03</b>	<b>69.41</b>	<b>328.54</b>	2.47	28.49	<b>127.33</b>
Max	<b>43.68</b>	<b>268.37</b>	<b>916.14</b>	<b>17.85</b>	<b>117.00</b>	<b>361.75</b>
Mean	1.92	27.39	<b>179.84</b>	0.78	11.17	<b>71.34</b>
Median	1.18	21.38	<b>177.86</b>	0.48	8.76	<b>71.73</b>

**Bolded values** exceed the ATSDR chronic minimal risk level (MRL) for naphthalene of  $3.7 \mu\text{g}/\text{m}^3$  and the USEPA reference concentration of  $3 \mu\text{g}/\text{m}^3$  or the ATSDR calculated comparison value of  $60 \mu\text{g}/\text{m}^3$  for acute exposure

### Acute Exposure

The modeled ambient air concentrations of naphthalene at various locations off-site predicted maximum 1-hour averages ranging from 36-916  $\mu\text{g}/\text{m}^3$  for Scenario 1 and 14-362  $\mu\text{g}/\text{m}^3$  for Scenario 2. Very few agencies have developed acute health based guidelines for naphthalene, likely due to a lack of human data for a toxicity assessment of acute inhalation exposures. Dodd et al., (2010) conducted a study on rats with whole body exposure to naphthalene and suggested a range of inhalation exposure between 500-1,600  $\mu\text{g}/\text{m}^3$  could be a threshold for injury to the nasal epithelium. The lower end of this range was exceeded for 15 receptors (Scenario 1). In two different rat studies, necrosis of the olfactory epithelium occurred from exposure to 5,000  $\mu\text{g}/\text{m}^3$  naphthalene;<sup>8</sup> no modeled concentrations exceeded this effect level.

Human studies of acute (short term) exposure are typically of dermal uptake from clothes treated with naphthalene mothballs or unintentional ingestion of mothballs by infants and toddlers. Hemolytic anemia is a common health effect observed in humans from acute dermal or ingestion exposure; it has not been observed in animal studies. Based on chronic inhalation studies, it is anticipated that the nasal epithelium is the most sensitive tissue in the respiratory tract. Unfortunately, there are no acute studies that have evaluated the effect of naphthalene on the nasal epithelium in humans or in animals. ATSDR has not developed an acute CV for naphthalene since there are no acute studies of the most sensitive endpoint. However, several animal studies have documented the toxic effect of naphthalene on cells deeper in the respiratory tract, specifically the induction of necrosis of non-ciliated bronchiolar epithelial cells, known as Clara cells (Buckpitt, 1982<sup>9</sup>; NTP, 1992; West et al., 2001<sup>10</sup>).

<sup>8</sup> Dodd D., Gross E., Miller R., Wong B. Nasal olfactory epithelial lesions in F344 and SD rats following 1- and 5-day inhalation exposure to naphthalene vapor. *Int. J. Toxicol.* 2010;29:175-184.

<sup>9</sup> Buckpitt, A.R. (1982). Comparative biochemistry and metabolism. Part 2: Naphthalene lung toxicity. AFAMRL-TR-82-52, pg 25-30. Air Force Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio.

<sup>10</sup> West, J., Pakeham, G., Morin, D., Fleschner, C., Buckpitt, A., Plopper, C. Inhaled naphthalene causes dose dependent clara cell cytotoxicity in mice but not in rats. *Toxicol Appl Pharmacol.* 2001: 173(2):114-9.

West et al. (2001) exposed mice to naphthalene vapors for 4 hours and reported that the Lowest Observed Adverse Effect Level (LOAEL) was 50 mg/m<sup>3</sup> (10 ppm) and the No Observed Adverse Effect Level (NOAEL) was 10 mg/m<sup>3</sup> (2 ppm) for necrotic effect on Clara cells. In the absence of data on the acute effects of naphthalene on the nasal pathways, our toxicological evaluation focuses on the dose-response for Clara cell toxicity. To estimate a “no effect” level for humans, we applied an adjustment for differences in the respiratory system of 10 mg/m<sup>3</sup> x 0.178 to yield a human no effect level of 1.8 mg/m<sup>3</sup> (1800 ug/m<sup>3</sup>). Typically, uncertainty factors are applied in the calculation of CVs, and in this instance we applied an uncertainty factor of 10 for intraspecies variability and an uncertainty factor of 3 for interspecies variability, resulting in a predicted NOAEL for humans of 60 ug/m<sup>3</sup> (1800 ug/m<sup>3</sup> divided by a total uncertainty factor of 30). ATSDR is applying the 60 ug/m<sup>3</sup> value as a health-based screening level for acute health impacts for this assessment. In modeling Scenario 1, 36.4% (n=1,071) of modeled concentrations exceeded this acute guideline over a 1-hour period, and 7.3% (n=216) exceeded the acute guideline over a 24-hour period; in Scenario 2, the percent was much lower, with 0.34%, (n=10) of modeled concentrations exceeding this value over a 1-hour period, and 0.44% (n=13) exceeding the acute guideline over a 24-hour period.

Some individuals may experience adverse reactions to odor, and at times naphthalene is present in the community at concentrations that exceed the odor threshold. Residents exposed to strong naphthalene odors in this community may experience a reduced quality of life, and non life-threatening symptoms such as fatigue, headache, and nausea.

### **Chronic Exposure**

ATSDR also reviewed modeling results of long-term (5-year) naphthalene concentrations in the area (Table 1). The predicted long-term average naphthalene concentrations in ambient air at locations in the community ranged from 0.07-43.7 µg/m<sup>3</sup>. Based on the California EPA’s inhalation unit risk<sup>11,12</sup> for naphthalene of 3.4 E-5 (µg/m<sup>3</sup>)<sup>-1</sup>, the estimated concentrations suggest a cancer risk that is elevated above U.S.EPA’s target risk range (greater than or equal to 10<sup>-4</sup>) for at least 15% of the modeled receptor points (see Figure A, which illustrates the long term modeling conducted by U.S.EPA). The air model calculated cancer risk as high as 1.5 in 1,000 from exposure to naphthalene in the community. Two studies, of rats and mice, respectively, identified the development of alveolar/bronchiolar adenomas and epithelial neuroblastomas that were associated with chronic exposure (6 hours a day/5 days a week/105 weeks) to naphthalene at 52 mg/m<sup>3</sup>.<sup>13,14</sup>

The RfC is based on respiratory effects (nasal inflammation, olfactory epithelial metaplasia, respiratory epithelial hyperplasia) in rats and mice with a Lowest Observed Adverse Effect Level (LOAEL) of 52 mg/m<sup>3</sup>, which was the lowest dose the animals were exposed to (this is a human equivalent concentration (HEC) of 9.3 mg/m<sup>3</sup>). Although the highest chronic value modeled in this investigation of 43 µg/m<sup>3</sup> is 14 times higher than the U.S. EPA RfC of 3 µg/m<sup>3</sup>, it is 216 times lower than the human

<sup>11</sup> Cal EPA. Chronic Toxicity Summary for Naphthalene. [http://oehha.ca.gov/air/chronic\\_rels/pdf/91203.pdf](http://oehha.ca.gov/air/chronic_rels/pdf/91203.pdf)

<sup>12</sup> [http://www.epa.gov/reg3hwmd/risk/human//rb-concentration\\_table/Generic\\_Tables/docs/master\\_sl\\_table\\_run\\_MAY2013.pdf](http://www.epa.gov/reg3hwmd/risk/human//rb-concentration_table/Generic_Tables/docs/master_sl_table_run_MAY2013.pdf)

<sup>13</sup> National Toxicology Program. 2000. *Toxicology and carcinogenesis studies of naphthalene (CAS No 91-20-3) in F 344/N rats (inhalation studies)*. Research Triangle Park, NC (Technical Report Series 500).

<sup>14</sup> National Toxicology Program. 1992. *Toxicology and carcinogenesis studies of naphthalene (CAS No 91-20-3) in B6C3F1 mice (inhalation studies)*. Research Triangle Park, NC (Technical Report Series 410).



equivalent LOAEL of  $9.3 \text{ mg/m}^3$ . However, it should be noted that there are no human studies and very few animal studies evaluating chronic exposures to naphthalene, and no studies evaluating exposures in the range modeled in Salem. Since there is so much uncertainty regarding the toxicity of naphthalene, the substantial uncertainty (a factor of 3000- 10 to extrapolate from mice to humans, 10 to protect sensitive humans, 10 to extrapolate from a LOAEL to a NOAEL, and 3 for database deficiencies) was incorporated into the human equivalent concentration; the RfC of  $3 \text{ } \mu\text{g/m}^3$  is calculated by dividing HEC ( $9.3 \text{ mg/m}^3$ ) by the uncertainty factor of 3000.

## **Health Implications**

*The following discussions on health implications assume the modeled results accurately estimate naphthalene concentrations in the community's air.*

### *Acute exposure*

1- and 24-hour modeling results indicate that peak exposures are considerably higher than long term modeled averages. Hourly maximum concentrations, under maximum allowable emissions, of up to  $916 \text{ } \mu\text{g/m}^3$  of naphthalene were modeled at surrounding receptor sites. This value exceeds a range of inhalation exposure that has been identified as within a range that could cause damage to the nasal epithelium ( $\geq 500 \text{ } \mu\text{g/m}^3$ ). Therefore, there is a potential health risk to area residents from exposure to maximum peak concentrations of naphthalene modeled in the community. Residents in Salem have complained about the odors emanating from the Radiac facility. These peak concentrations could cause respiratory irritation and the exacerbation of pre-existing respiratory conditions and may irritate the nasal passage and airways of exposed individuals.

### *Chronic exposure*

The modeled concentrations of naphthalene are at concentrations that suggest an increased cancer risk (at or greater than  $10^{-4}$ ) for at least 15% of the modeled receptor points, which are located within the surrounding community (projecting approximately  $2.4 \text{ km}^2$  from the site); between 3.7% and 14.5% of modeled concentrations of naphthalene for both emissions scenarios exceeded the USEPA chronic comparison value of  $3.0 \text{ } \mu\text{g/m}^3$ . As mentioned previously, the facility is located at the southwest corner of the city of Salem. There are a number of residential properties abutting the facility property and a preschool within 0.25 miles to the east-southeast of the facility. ATSDR does not have adequate information to know how many of these residents live within areas with modeled results above health-based comparison values.

## **Conclusions:**

U.S. EPA has provided modeled data suggesting that residents are exposed to elevated airborne naphthalene concentrations from facility emissions. Based on this information, ATSDR has concluded the following:

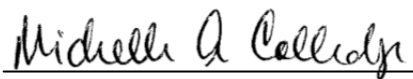
- 1) It is difficult to assess potential public health implications from facility emissions because there has been no historical air monitoring in the community.
- 2) The modeled concentrations indicate that exposure to naphthalene from plant emissions may be a health concern.

**Recommendations:**

- 1) ATSDR recommends beginning air monitoring as soon as possible to measure ambient air levels of naphthalene on the property of Radiac where it abuts the nearest residences.
- 2) ATSDR recommends the monitors be placed in locations that are capable of yielding worst-case offsite naphthalene concentrations to determine actual exposures.
- 3) ATSDR recommends exploring options with the facility to reduce naphthalene emissions if elevated ambient concentrations of naphthalene are identified.
- 4) ATSDR recommends that ongoing ambient air monitoring be conducted to demonstrate the effectiveness of these actions in reducing the levels of exposure in the community.

Please do not hesitate to contact me at 312-886-1462, if you have any questions regarding this letter.

Sincerely,

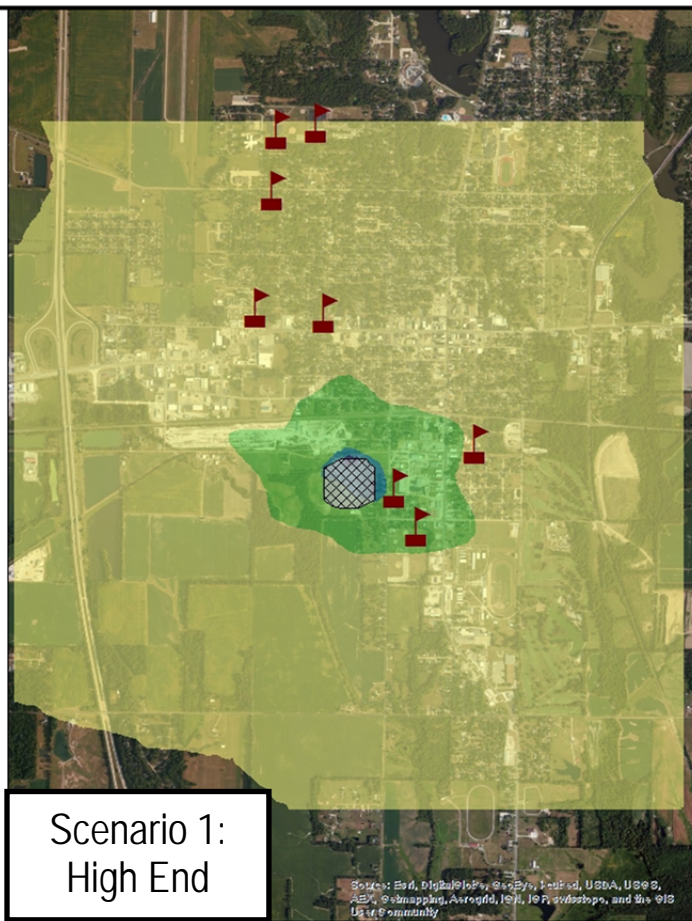


Michelle Colledge, MPH, PhD  
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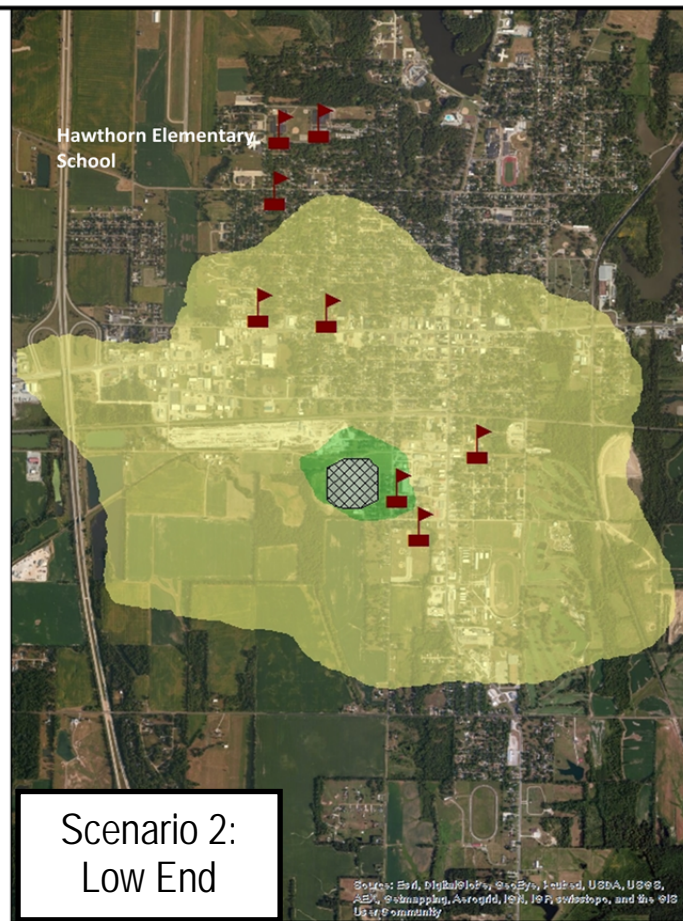
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# Radiac Abrasives Modeled Naphthalene Cancer Risks



Scenario 1:  
High End



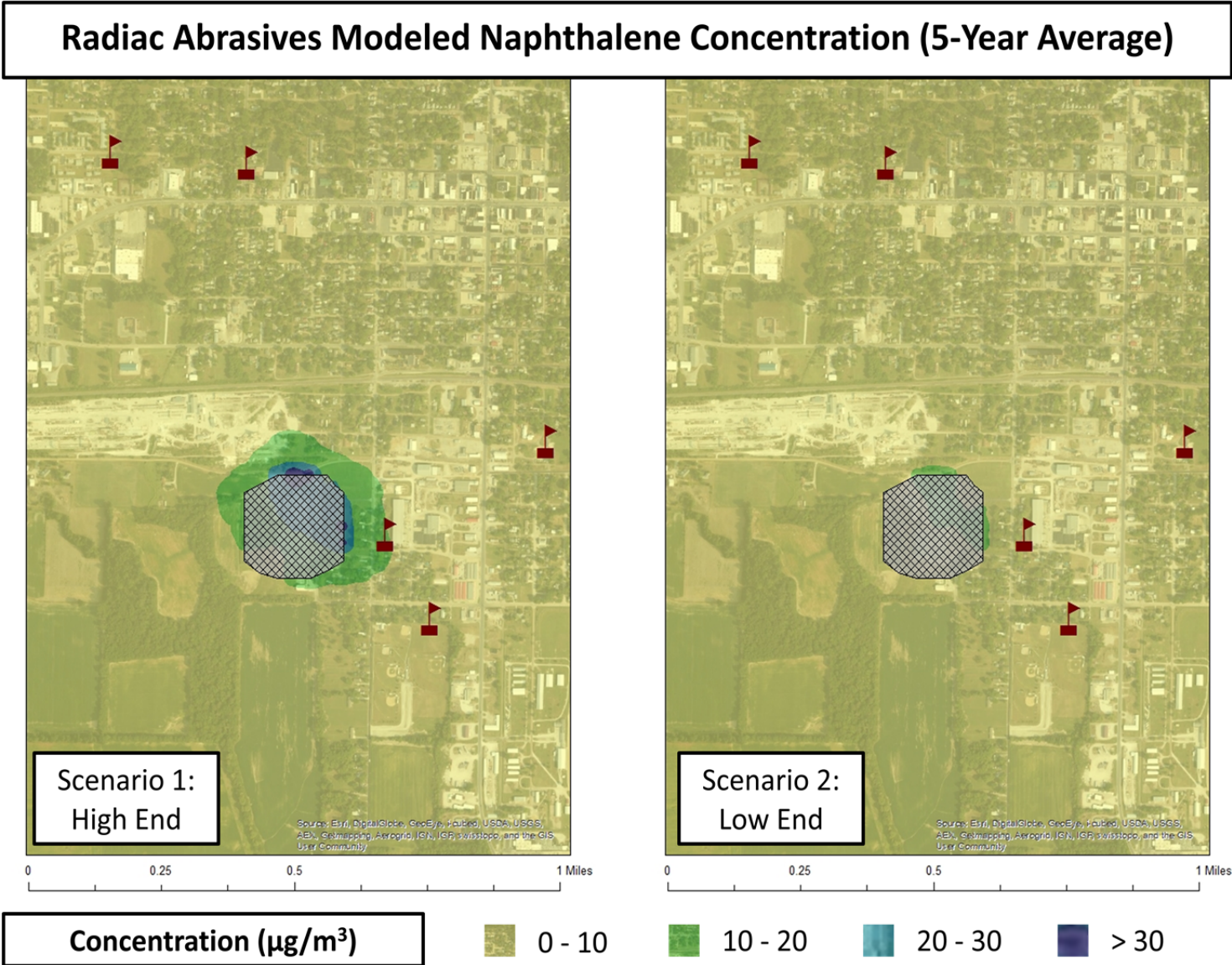
Scenario 2:  
Low End

## Cancer Risks in a Million



Source: U.S. EPA Region 5 Air and Radiation Division; note that flags indicate the location of schools

Figure B. Modeled long term averaged concentrations of naphthalene in the surrounding community



Source: U.S. EPA Region 5 Air and Radiation Division; note that flags indicate the location of schools