HEALTH CONSULTATION

BROWN BARGE MIDDLE SCHOOL

ROAD WIDENING PROJECT

PENSACOLA, ESCAMBIA COUNTY, FLORIDA

Prepared by:

Florida Department of Health
Bureau of Community Environmental Health
Under Cooperative Agreement with the
U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

Contents

Foreword

This document evaluates soil data along the right-of-way north of Brown Barge Middle School in Pensacola. Florida Department of Health (DOH) evaluates site-related public health issues through the following processes:

- Evaluating exposure: DOH scientists begin by reviewing available information about environmental conditions. The first task is to find out how much contamination is present, where a contamination occurs, and how people might contact it. Usually, DOH does not collect its own environmental sampling data. Florida Department of Environmental Protection (DEP) provided the information submitted by Florida Department of Transportation (DOT) for this Health Consultation.
- Evaluating health effects: If there is evidence that people are contacting, or might contact hazardous substances in the future, DOH scientists will determine whether that exposure could be harmful to human health. This report focuses on public health; that is, the health impacts on the community as a whole, and we base it on the available scientific information.
- Developing recommendations: In this evaluation report, DOH outlines its conclusions regarding any potential health threat posed by road construction to occur north of the Brown Barge Middle School site, and offers recommendations for reducing or eliminating human exposure to contaminants. The role of the DOH in dealing with hazardous waste sites is primarily advisory. For that reason, we will typically recommend actions for other agencies, including DEP and DOT, should take. If, however, an immediate health threat exists or is imminent, DOH will issue a public health advisory warning people of the danger, and will work to resolve the problem.
- Soliciting community input: The evaluation process is interactive. DOH starts by soliciting and evaluating information from various government agencies, individuals or organizations responsible for cleaning up the site, and those living in communities near the site. We share any conclusions about the site with the groups and organizations providing the information. Once an evaluation report has been prepared, DOH seeks feedback from the public. If you have questions or comments about this report, we encourage you to contact us.

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Summary and Statement of Issues

Florida Department of Transportation (DOT) is widening Interstate 110 near the Brown Barge School in Pensacola. Land for this widening is next to the Agrico Chemical Superfund hazardous waste site. At an April 19, 2004 public meeting, Brown Barge Middle School parents and nearby residents were concerned that road construction in this area would expose their children or themselves to hazardous chemicals in the soil. Florida Department of Environmental Protection (DEP) asked Florida Department of Health (DOH) to evaluate the public health threat. This health consultation evaluated the public health threat from accidental soil ingestion and inhalation of dust from soil from widening of Interstate 110 near the school.

DOT's contractor, Workable, Responsive, Solutions, (WRS) Inc. took soil samples at three depths, at 12 locations and one background location in the road widening project. The area is of concern to DOT because it is south, southeast, and east of a former agricultural chemicals manufacturing facility. Figure 2 shows the road-widening project near the school. Severn Trent laboratory analyzed all of WRS's samples for dioxins and furans, PCBs, pesticides, semi-volatile organic compounds, fluoride, target analyte compound metals, radium 226 and 228, and total uranium.

DOH categorizes the soil in the road-widening project near the Brown Barge Middle School as "No Apparent Public Health Hazard." Although levels of arsenic, lead, mercury, and polycyclic aromatic hydrocarbons (PAHs) are slightly above their screening values, these levels are unlikely to cause non-cancer health effects. Although measured levels are theoretically high enough to increase risk of cancer, it is likely anyone would have the daily long-term exposure to the highest measured levels we assumed in the calculations we performed to determine that increase level of risk.

DOH calculated theoretical increased cancer risks assuming daily, long-term exposure to the highest measured levels of arsenic and PAHs (mercury and lead are not regulated as carcinogens). For incidental soil ingestion (accidentally eating soil), the increased theoretical risk is "low" to "no apparent" (an increase of 3 theoretical cases in 100,000 for both arsenic and PAHs). For dust inhalation, the increased theoretical risk is not significant (an increase of less than 1 theoretical case in 1,000,000 for PAHs and 2 in 1,000,000 for arsenic). DOH recommends road construction workers in the road-widening project follow the DOT Environmental Compliance Program, suppress dust formation, and avoid hand-to-mouth contact.

DOH, Bureau of Community Environmental Health staff will evaluate additional test results as they become available. DOH will also inform and educate Brown Barge School parents and nearby residents of the findings in this health consultation

Purpose

The purpose of this report is to assess the health threat to students, workers, residents, and passers-by from exposure to soil and dust in the road-widening project during widening of Interstate 110.

Background

Agrico Chemical Company and other companies manufactured fertilizer on the property north and west of the road-widening project from 1889 to 1975 using sulfuric acid produced on the site. Some of these companies made sulfuric acid by heating the mineral pyrite in lead-lined vats. They pumped wastes from sulfuric acid and fertilizer production into ponds and spilled some on the ground. In the past, some of these wastes remained on the site as hardened "sludge" that looked like spilled cement. DOH evaluated data from samples of groundwater, soil and surface water on and near the Agrico site in nine reports since 1990. DOH found some elevated levels of chemicals on the site, which in the past could have presented a health hazard to persons accidentally ingesting soil or groundwater at the highest levels measured.

The US Environmental Protection Agency (EPA) contractors buried, solidified, and stabilized soil and sediment on the former agricultural chemicals manufacturing facility in an on-site landfill. The landfill has a slurry wall and a geo-synthetic cap, to minimize movement of the buried contaminants. EPA contractors completed the processes of soil and sediment remediation in 1997. The EPA and DEP required long-term groundwater monitoring to track the movement of groundwater contamination, which is on going.

DEP asked DOH to review DOT October 2003 soil tests in the road-widening project south and east of the former Agrico site and north of the Brown Barge Middle School. The road-widening project north of Brown Barge Middle School is approximately 12 acres (Figures 1 and 2). DOT purchased the northernmost 40 to 50 feet of the Brown Barge School property to expand the Interstate 110-entrance ramp. No buildings are currently present on the road-widening project.

DOT's contractor, WRS, Inc., sampled and analyzed soil in the right-of way property north of the Brown Barge Middle School and west of the intersection of I-110/East Fairfield Drive. WRS's laboratory, Severn Trent, tested the soil samples for chemicals that may have migrated from the former Agrico Chemical Company and/or the former Escambia Treating Company National Priorities List sites.

Based on the October soil sample analytical results, DOT prepared an Environmental Compliance Program for construction. Environmental Compliance Programs include a Quality Assurance Project Plan to cover any required sample collection and/or analytical work, and an approved health and safety plan to ensure that workers on the project are:

properly notified of the regulated metals in the project area and their associated hazards,

not exposed to levels above the OSHA actions levels and permissible exposure limits in accordance with 29 CFR 1910 Subpart Z and 29 CFR 1926 Subpart Z, and

the sub-contractors should not spread soil with regulated metals to uncontrolled areas.

The Environmental Compliance Program proposes to monitor arsenic levels in dust to ensure the safety of workers, motorists, adjacent landowners, and the public. The contractor may suspend air-monitoring activities if they can demonstrate over a 2-week period of earthwork and dust-generating activities, that the airborne arsenic levels are less than the OSHA arsenic Permissible Exposure Limit. The Environmental Compliance Program requires that the contractor will continue the dust suppression program even if the contractor suspends air monitoring, The Environmental Compliance Program also proposes appropriate measures for dermal protection, which the Certified Industrial Hygienist who prepares the site-specific health and safety plans will determine.

Additional work plan requirements include:

the containment of all soil excavated from within the road widening project within this area or within fill sections of the project, and a record of where the soils are moved to, if they are moved,

disposal of all solid wastes in accordance with federal, state and local laws and regulations,

- application of appropriate erosion control measures to control storm water run-on and run-off during all construction activities in the road-widening project. The site health and safety inspector should inspect the erosion controls, to ensure they are appropriate and maintained.

The Brown Barge Middle School and road-widening project are in a mix of residential, light industrial and commercial properties near downtown Pensacola. Figure 3 is a 1999 aerial photograph showing the agricultural chemicals manufacturing site (Agrico Chemical Company) as vacant land north and west of the road-widening project. The current owner of the southern portion of former Agrico Chemical Company built rental storage buildings (three long buildings just north of East Fairfield). A borrow pit operation and a sand-and-gravel supply business lie north of the former Agrico Chemical Company (Figure 1). The Escambia Treating Company hazardous waste site is about ²/₃ mile northwest of the school and road-widening project. Northeast of the sites are the CSX railroad yard and a residential neighborhood.

Immediately east of the school and the road-widening project are Roosevelt Drive and Interstate 110 (I-110). Land use east of I-110 is mixed-use commercial and residential. The former agricultural chemical manufacturing property and commercial and residential properties are west of the road-widening project. Brown Barge Middle School and residences lie immediately south of the road-widening project. Escambia County School Board uses the property south of the school as a school bus depot, for storage and maintenance, and as a community center. South, across Texar Drive, is a residential neighborhood.

In 2000, about 8,013 persons lived within 1 mile of the Brown Barge Middle School. Approximately 76% were black or African American and 21% percent were white. All other racial/ethnic groups made up less than 1%, with about 1% being two or more races (Bureau of the Census 2000). The neighborhood west of the site is low to lower-middle income. There are five other schools (Booker T. Washington, Pickens, Jehovah Lutheran, Petree and Semmes), and University Hospital and Clinic hospital, within 1 mile of Brown Barge Middle School.

The Sand and Gravel aquifer supplies Escambia County with water for drinking and other uses. Locally, this poorly sorted, coarse-grained, quartz, sand aquifer is about 300 feet thick. The interconnected spaces between the sediment grains allow rapid groundwater movement, making the aquifer vulnerable to groundwater contamination.

Community Health Concerns

At a public meeting held on April 19, 2004, Brown Barge Middle School parents and nearby residents were concerned that Interstate 110 widening would expose schoolchildren and residents to hazardous chemicals in the soil. If DOT's Environmental Compliance Program for this construction project is executed, it is unlikely that exposure pathways will be completed, for workers or for nearby residents, passers-by or schoolchildren.

Discussion

This section identifies current levels of chemicals present in the road-widening project area, exposure pathways for people's contact with those chemicals, and evaluates whether people's typical daily soil contact might cause illness. DOH's health consultations attempt to moderate the uncertainties inherent in the health consultation process by using conservative assumptions when estimating or interpreting health risks. Therefore, we base our dose calculations on the highest measured levels of chemical. Also, the health-based values (established by the federal ATSDR, US EPA and DEP) we use to screen the data include wide margins of safety. We intend the assumptions, interpretations, and recommendations made in this public health consultation to protect public health.

Environmental Contamination

In this section, DOH reviews soil data collected in October 2003. WRS collected 12 surface soil samples from ground surface to 3 inches below the level of ground surface, 12 subsurface soil samples at 2 feet below land surface, and 11 "vertical limit" soil samples to evaluate exposure scenarios during construction activities. They collected "vertical limit" samples at the predicted depth to which they expect construction activities to remove soil. WRS also took background samples at 0-3" and 2' depths (WRS 2004). DOH assumed that these data are valid.

DOH evaluated the sampling adequacy and identified arsenic, lead, mercury, and polycyclic aromatic hydrocarbons (PAHs) as the contaminants of concern. Burning organic materials (like diesel fuel and gasoline) creates PAHs. PAHs are also present in asphalt and tar. Lead was a gasoline additive prior to 1986. Both lead and PAHs may have entered the road widening project soil from roadway drainage, as well as from the agricultural chemicals manufacturing site. WRS notes the soil borings with detected analytes are located near drainage swales.

Exposure Pathways

Most chemical contaminants in the environment will only harm people through direct exposure. It is essential to determine or estimate the frequency of contact people could have with hazardous substances in their environment in order to assess the public health significance of the contaminants.

During road construction, workers, Brown Barge students, nearby residents, and passing motorists might inhale contaminated dust if DOT's contractors do not implement the recommended dust suppression measures, or warn road construction workers about accidentally ingest soil they get on their hands. However, if DOT's Environmental Compliance Program for this construction project is executed, it is unlikely that exposure pathways will be completed, for workers or for nearby residents, passers-by, or schoolchildren.

After construction activities are completed, no persons are likely to daily ingest soil from the right of way or daily inhale dust from this soil. Landscaping personnel mow the right-of-way infrequently; consequently, mowing would not likely put the landscapers or others at risk of significant dust exposure.

Public Health Implications

DOH evaluates exposures by estimating daily doses for children and adults (Table 2). Dose refers to the amount of chemical per weight; expressed in milligrams (mg) of contaminant per kilogram (kg) of body weight per day (mg/kg/day). A milligram is 1/1,000 of a gram; a kilogram is approximately 2 pounds.

To calculate the daily dose of each contaminant, DOH uses standard assumptions about body weight, ingestion and inhalation rates, and duration of exposure (ATSDR 1992, EPA 1997). We assume a person's exposures to the maximum concentrations measured at the site occur daily. Acute exposures are those with duration of 14 days or less; intermediate exposures are those with duration of 15 to 364 days; and chronic exposures are those that occur for 365 days or more (or an equivalent length for animal exposures).

To estimate exposure from incidental ingestion of contaminated soil, DOH used the following assumptions (EPA 1997):

1) children 1 to 4 years of age ingest an average of 200 mg of soil per day,
2) adults ingest an average of 100 mg of soil per day,

3) children 1 to 4 years of age weigh an average of 15 kg,
4) adults weigh an average of 70 kg,
5) children and adults ingest contaminated soil at the maximum concentration measured for each contaminant.

In the following section, we discuss the theoretical increases in cancer that might result with daily ingestion of soil containing the highest measured levels (Table 1) of arsenic and total equivalency polycyclic aromatic hydrocarbons (Appendix A), and the potential non-cancer health effects of lead exposure and mercury.

Arsenic— WRS's lab measured arsenic above 2.1 milligrams per kilogram (mg/kg) (Figure 3) in 11 of the 12 surface soil locations. The background location had 1.6 mg/kg. Background arsenic levels in the Pensacola area are often between 1.3 and 2.0 mg/kg (Chen et al. 1999, Figure 5). A very small amount of additional arsenic from other sources could bring soil levels above the arsenic screening values.

DOH calculated the increased theoretical risk for cancer in children and adults who might daily contact the highest measured level of **arsenic**:

> for the incidental soil ingestion– an increase of 3 theoretical cases in 100,000 – between levels described as "low" and "no apparent" increased risk, and
> for the dust inhalation– an increase of 2 theoretical cases in 1,000,000 – between levels described as "no apparent" increased risk, and "no significant" increased risk.

Chronic arsenic exposures have been linked to lung, basal and squamous cell skin cancers, liver cancer (haemangioendothelioma), urinary tract cancers (bladder, kidney, prostate, ureter, and all urethral cancers), and intra-epidermal cancers, from lowest to highest dose (ATSDR 2000 and Dr. Selene Chou, personal communications). Although measured arsenic levels are theoretically high enough to increase risk of cancer, it is unlikely anyone would have the daily long-term exposure to the highest measured Right-of-Way levels assumed in the calculations performed to determine that increased level of risk.

Total Equivalency Polycyclic Aromatic Hydrocarbons (TEQ PAHs)—DOH calculated the increased theoretical risk for cancer in children and adults who might daily contact the highest measured level of TEQ PAHs:

> for the incidental soil ingestion– an increase of 3 theoretical cases in 100,000 – this falls between increased theoretical risks described as "low" and "no apparent,"
> for dust inhalation– an increase of less than 1 theoretical case in 1,000,000 – this falls below increased theoretical risks described as "no significant" increase.

Cancer increases associated with workers exposed to TEQ PAHs occur at the points of contact: on the skin through dermal contact and in the lungs via inhalation. In animal studies, tumors have also formed at locations other than contact, for example lung tumors after dermal exposure. Although measured TEQ PAH levels are theoretically high enough to increase risk of cancer, it is unlikely anyone would have the daily long-term exposure to the highest measured Right-of-Way levels assumed in the calculations performed to determine that increased level of risk.

Lead—estimated blood levels more accurately predict health effects than traditional dose estimates for lead. DOH used a simple model to estimate blood lead levels and likely health effects for exposures to the highest measured levels of lead in soil (ATSDR 1999a). This model takes into account children and adults' exposures to lead from sources other than soil. We assumed people were exposed to lead-contaminated soil eight hours per day at the highest measured levels. However, it is unlikely anyone would have the daily long-term eight-hour exposure to the highest measured Right-of-Way levels assumed in the calculations performed to determine these estimated increased blood lead levels. Estimated blood lead concentrations range from 2.4 to 6.4 micrograms per deciliter (µg/dL) for children (Table 4) and 1.8 to 6.0 µg/dL for adults (Table 5).

Many studies have documented the effects of lead exposures in people. Lead in the bloodstream can interfere with the body's ability to make new red blood cells (ATSDR 1999a). Too few red blood cells (anemia) mean the body's uptake of energy from food and oxygen from air is less efficient. The processes leading to anemia are seen at all levels of lead exposure: there is no threshold for this effect. There also may be no threshold for adverse neurological effects of lead in children: decreased intelligence, balance, hearing, attention deficit/hyper-activity disorder, and alterations in visual evoked potentials as described in the list above (Table 4 and ATSDR 2002). However, as with arsenic and PAHs, children and adults are not accidentally likely to eat Right-of-Way soil every day, and the highest levels measured seem to be out of the ordinary (lead levels above 400 mg/kg were only measured in 2 samples out of 12 samples, or about 16%). In addition, DOT's Environmental Compliance Program calls for dust suppression measures and worker notification of chemical hazards.

Mercury—The estimated doses DOH calculated from the highest measured levels of mercury in soil were thousands of times lower than the lowest doses associated with symptoms in animal mercury ingestion studies (Table 3). Estimated dust exposure levels were 20,000 times lower than the lowest doses associated with symptoms in animal mercury inhalation studies (Table 3). ATSDR found no animal studies or human epidemiological studies for evaluating the carcinogenicity of mercury via inhalation or dermal exposure, and the animal studies involving ingestion exposure did not show a clear cancer link. However, as with the exposure estimates we calculated for the other measured chemicals, children and adults may not accidentally eat soil every day, and the highest levels measured seem to be out of the ordinary (a mercury level above the screening value was only measured in 1 sample out of 35 samples or about 3%).

Child Health Considerations

ATSDR and DOH recognize the unique vulnerabilities of infants and children demand special attention. Children are at a greater risk than are adults to certain kinds of exposure to hazardous substances. Because they play outdoors and because they often carry food into contaminated areas, children are more likely to contact contaminants in the environment. Children are shorter than adults, which means they breathe dust, soil, and heavy vapors closer to the ground. They are also smaller, resulting in higher doses of chemical exposure per body weight. If toxic exposures occur during critical growth stages, the developing body systems of children can sustain permanent damage. Probably most important, however, is that children depend on adults for risk identification and risk management, housing, and access to medical care (ATSDR 1998). Thus, adults should be aware of public health risks in their community, so they can guide their children accordingly.

In recognition of these concerns, the federal ATSDR developed the chemical screening values for children's exposures that DOH used in preparing this report. These screening values are specific to children younger than the middle school-aged children attending the Brown Barge

Middle School are. Therefore, these screening values would be protective of any children that might live on (or near) the site.

Susceptible populations may have different or enhanced responses to toxic chemicals than will most persons exposed to the same levels of that chemical in the environment. Reasons may include genetic makeup, age, health, nutritional status, and exposure to other toxic substances (like cigarette smoke or alcohol). These factors may limit a susceptible persons' ability to detoxify or excrete harmful chemicals or may increase the effects of damage to their organs or systems.

Conclusions

DOH categorizes the soil in the road-widening project north of the Brown Barge Middle School as "No Apparent Public Health Hazard." We determined that while measured arsenic, lead, mercury, and TEQ PAH levels are slightly above their screening values, the assumptions we made to calculate daily doses are unlikely to be realistic. Because it is unlikely exposures will occur, both the slight increased arsenic and PAH cancer risks, and the non-cancer lead and mercury health effects—described and discussed in the Public Health Implications section—are unlikely.

DOH calculated theoretical increased cancer risks assuming daily, long-term exposure to the highest measured levels of arsenic and PAHs. For incidental soil ingestion (accidentally eating soil), the increased theoretical risk is "low" to "no apparent" (an increase of 3 theoretical cases in 100,000 for both arsenic and PAHs). For dust inhalation, the increased theoretical risk is not likely to be significant (an increase of less than 1 theoretical case in 1,000,000 for PAHs and 2 in 1,000,000 for arsenic).

Recommendations

DOH recommends workers in the road-widening project avoid hand-to-mouth contact. We also recommend that DOT's contractors follow the Environmental Compliance Program. Following the Environmental Compliance Program should prevent workers, Brown Barge students, nearby residents, and others from having daily long-term exposures through personal air monitoring, dust suppression, and institutional controls that govern what soil can be moved, where it can be moved to, and how it can be disposed of.

Public Health Action Plan

DOH, Bureau of Community Environmental Health staff will evaluate additional test results as they become available.

DOH will also inform and educate Brown Barge School parents and nearby residents of the findings in this health consultation.

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Appendix A - TEQs for Polynuclear Aromatic Hydrocarbons (PAHs)

Total Equivalency (TEQ)s for carcinogenic PAHs to benzo[a]pyrene: the PAH analytical results are multiplied by the following factors and then added together to obtain one number to be compared with the screening value for benzo[a]pyrene.

PAH	Toxicity Equivalency Factor
Dibenz[a,h]anthracene	5
Benzo[a]pyrene	1
Benzo[a]anthracene	0.1
Benzo[b]fluoranthene	0.1
Benzo[k]fluoranthene	0.1
Indeno[1,2,3-c,d]pyrene	0.1
Anthracene	0.01
Benzo[g,h,i]perylene	0.01
Chrysene	0.01
Acenaphthene	0.001
Fluoranthene	0.001
Fluorene	0.001
Phenanthrene	0.001
Pyrene	0.001

Source: ATSDR 1995b.

Appendix B - Figures and Tables

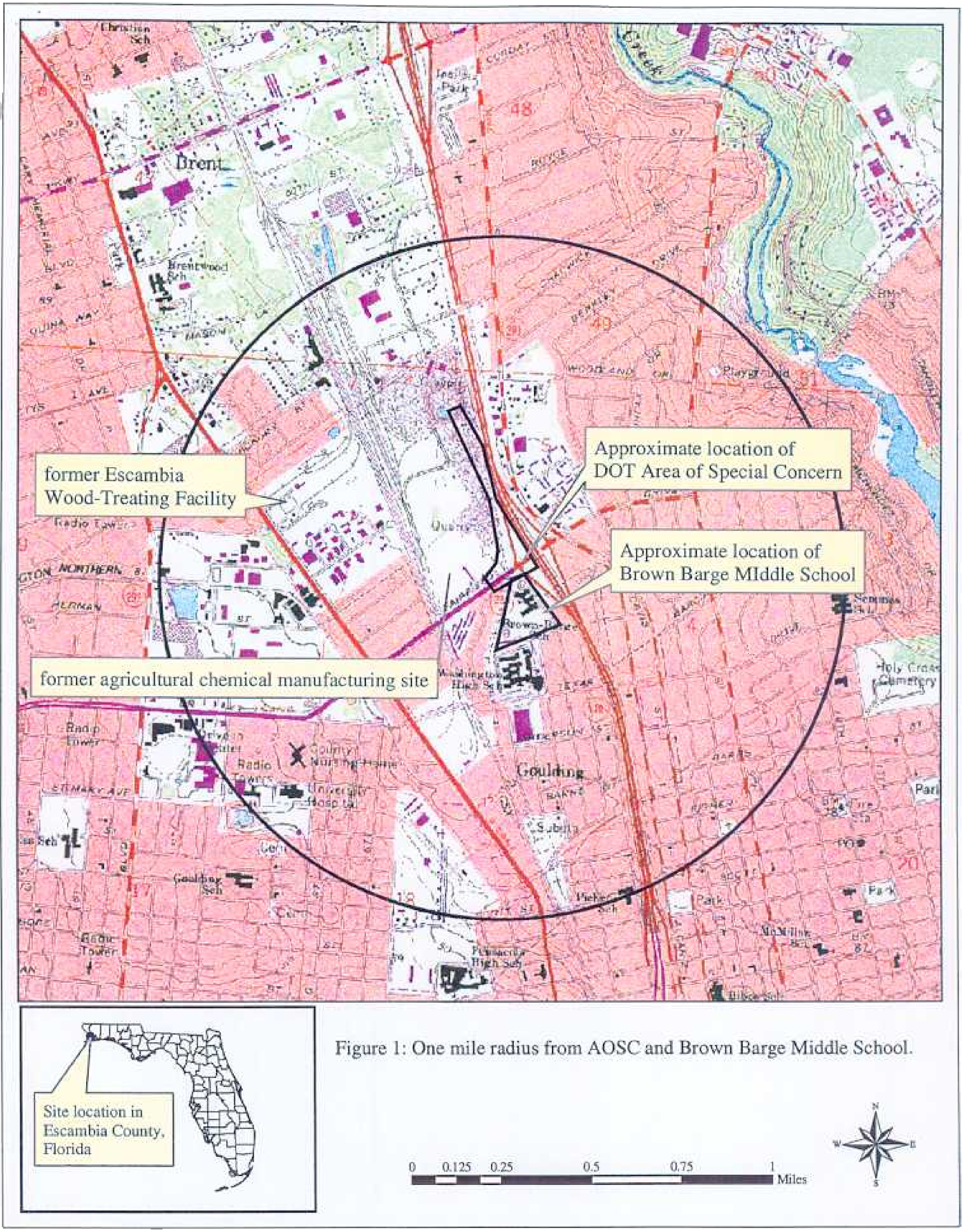

Figure 1: One mile radius from AOSC and Brown Barge Middle School.

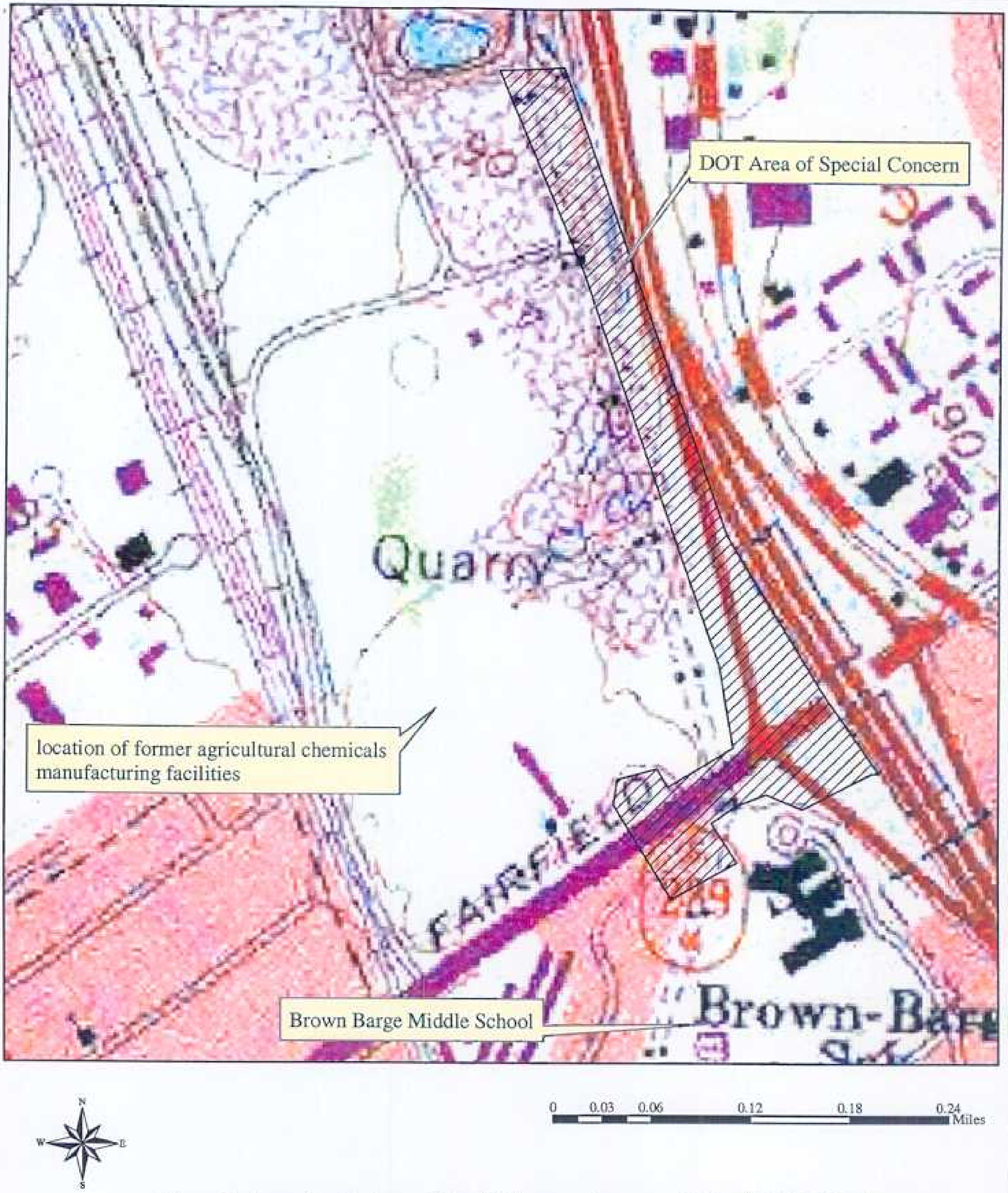

Figure 2: Approximate Area of Special Concern, Interstate-110 and Fairfield Drive

Figure 3. Approximate WRS sample points with arsenic values measured (in mg/kg) above the residential Soil Target Cleanup Level of 2.1 mg/kg. SB-4, SB-5, SB-9, and SB-12 also have arsenic values above the industrial Soil Target Cleanup Level of 12 mg/kg.

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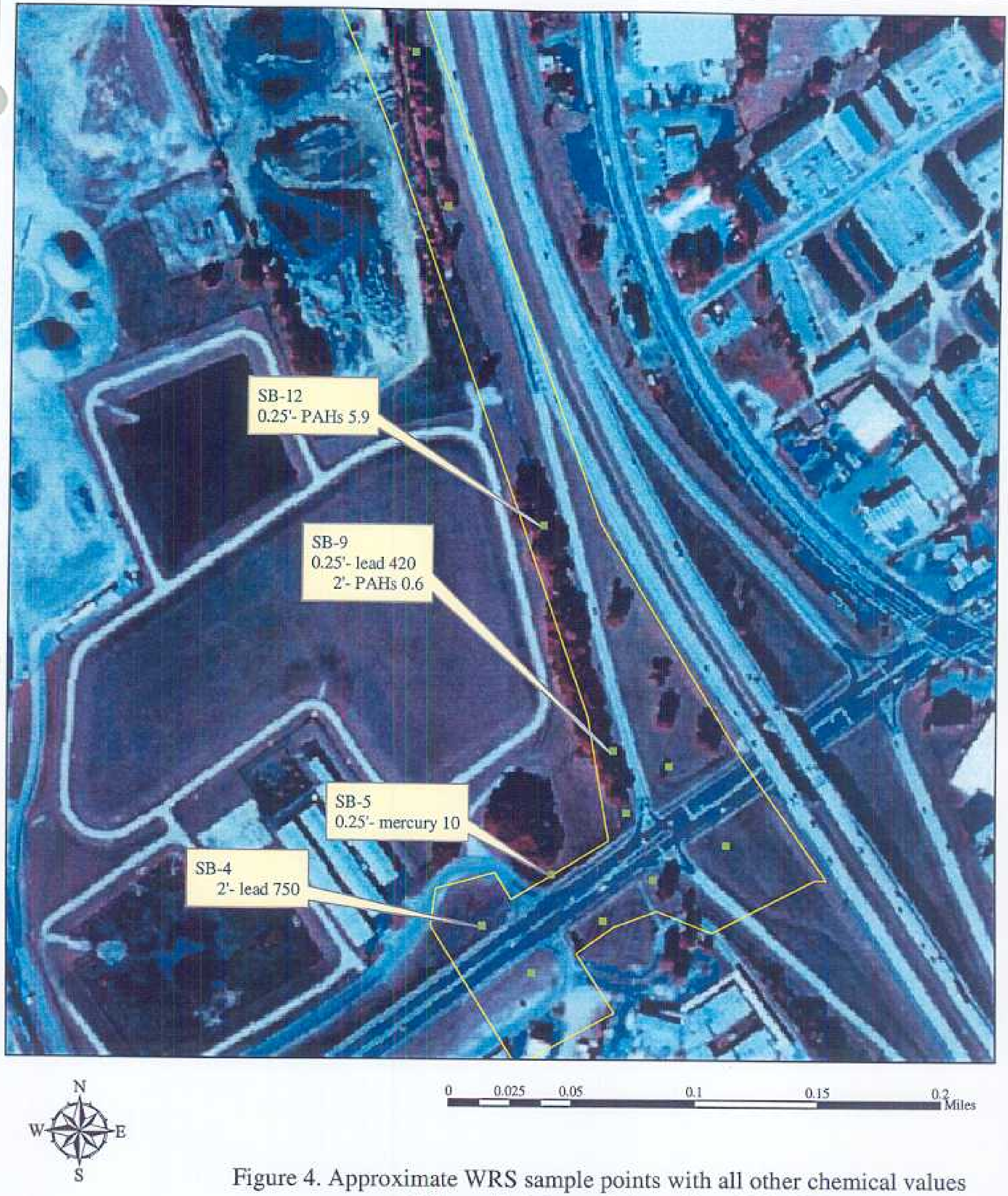

Figure 4. Approximate WRS sample points with all other chemical values measured (in mg/kg) above their residential Soil Target Cleanup Levels. Chemicals include lead, mercury, polycyclic aromatic hydrocarbons (PAHs).

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Figure 5: Chen et al.'s Figure 2-5. Spatial Distribution of Arsenic Concentrations Based on Suborders.

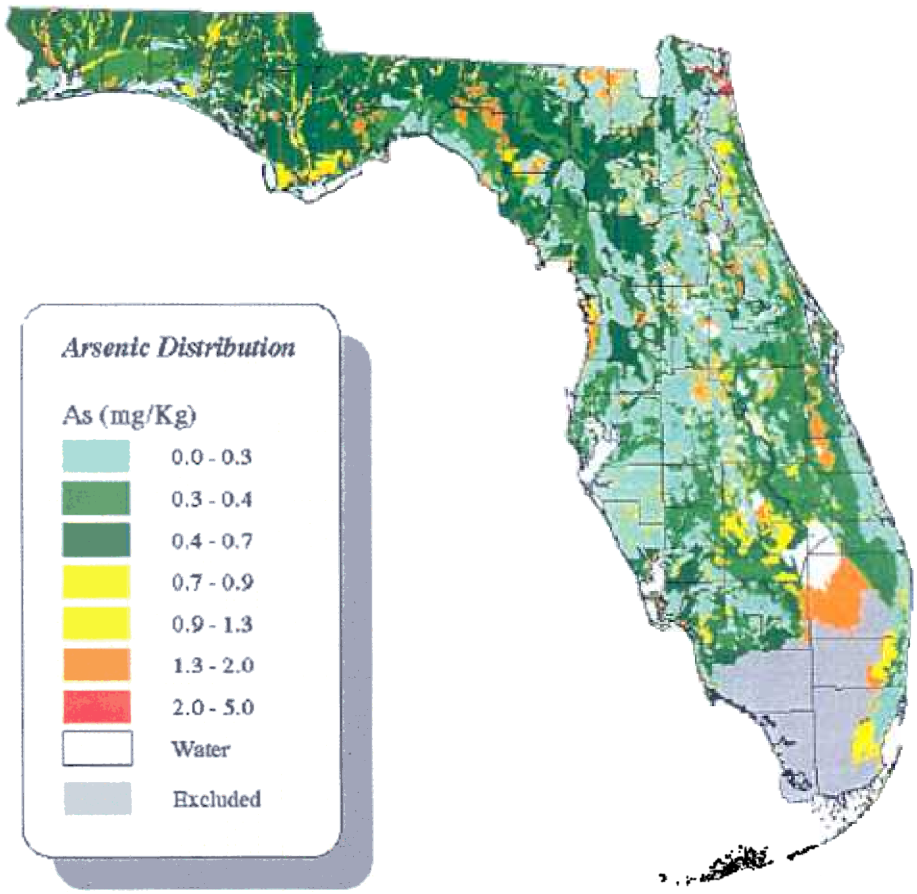

Table 1. Soil Concentrations for Contaminants of Concern

Contaminants of Concern	Screening Value (mg/kg)		Highest Soil Concentration (mg/kg)	Location of Highest Concentration	Number Soil Samples Above Screening Value
Arsenic	2.1	DEP proposed RSCTL**	28	0.25' deep, in right-of-way west of south bound off ramp (SB-9)	23/35
Arsenic	12	DEP proposed ISCTL**	28	0.25' deep, in right-of-way west of south bound off ramp (SB-9)	4/35
Lead	400	DEP RSCTL	750	2' deep, north of East Fairfield (SB-4)	2/35
Mercury	3	DEP RSCTL	10	0.25' deep, in right-of-way west of south bound off ramp (SB-5)	1/35
PAHs	0.1	ATSDR CREG*, DEP RSCTL†	5.9	0.25' deep, in right-of-way west of south bound off ramp (SB-12)	3/35

*ATSDR 1x 10^{-6} excess cancer risk evaluation guide (ATSDR 2001).
**DEP's 1x 10^{-6} excess cancer risk evaluation guide is currently 0.8 mg/kg. They have proposed a new guide of 2.1 mg/kg based on an ingestion bioavailability factor of 3 for residential land use and 12 for industrial land use.
†DEP's 1x 10^{-6} excess guide for cancer risk evaluation, set for residential property use.
mg/kg = milligrams per kilogram
PAHs = polycyclic aromatic hydrocarbons
EMEG - Environmental Media Evaluation Guide, child and adult values are given.

Model Parameters and Assumptions for Table 2

Exposure Medium: Soil

Exposure Point:	**On-site soil and dust**
Scenario Time frame:	Future
Land Use Conditions:	Residential

Receptor Population: Residents

We calculated these doses using Risk Assistant software and accepted values for soil consumption, dust inhalation exposure and dermal exposure parameters (EPA, 1991). We calculated the following doses using the following values:

Adult body weight-	70 kg
Child body weight-	15 kg
Adult soil consumption-	100 mg/day
Child soil consumption-	200 mg/day
Adult/Child shower time-	0.2 hours
Adult skin surface area-	23,000cm^2
Child skin surface area-	7,200cm^2

* We give the air concentration in milligrams per cubic meter because the Toxicological Profiles give the values for inhalation studies in these units. The air concentration is not a dose; therefore, it is the same for adults and children.

mg/kg = milligram per kilogram of soil

mg/kg/day = milligrams per kilogram body weight per day

Table 2. Estimated Doses from Exposure to On-site Surface Soil

Contaminant of Concern (maximum concentration) (mg/kg)	Oral MRL (mg/kg/day)	Estimated Soil Ingestion (mg/kg/day)		Inhalation MRL (mg/m³)	Estimated Dust Inhalation (mg/m³)
		Child	Adult		Child and Adult
Arsenic (28)	0.005 Prov. Acute 0.0003 Chr	0.00037	0.00004	None	0.000002
Lead (750)	None	2.4- 6.4 µg/dl (modeled)	1.8 - 6.0 µg/dl (modeled)	None	
Mercury (10)	None	.0001	.00001	None	0.0000007
PAHs (5.9)	None	0.00008	0.000008	None	0.0000003

MRL—Minimal Risk Level. An MRL is an estimate of the daily human exposure to a hazardous substance that is likely to be without appreciable risk of adverse noncancer health effects over a specified duration of exposure.
mg/kg—milligrams per kilogram
PAHs—polycyclic aromatic hydrocarbons
Chr—Chronic exposure length of more than 365 days
mg/kg/day—milligram chemical per kilogram body weight per day
mg/m3—microgram of chemical per cubic meter of air

Table 3. Comparison of doses calculated from highest measured road widening project soil values to the most sensitive effects doses (effects occurring at the lowest doses in animal and human medical studies).

Chemical	Doses are in mg/kg/day			Soil
	children's dose	adult's dose	children's theoretical increased cancer risk	adult's theoretical increased cancer risk
Arsenic	Ing 0.0004 Inh 0.000002	Ing 0.00004 Inh 0.000002	Ing 3:100,000 Inh 2:1,000,000	Ing 3:100,000 Inh 2:1,000,000
ATSDR 2000 (Update)	<u>Child ingestion dose</u> (0.0004) is 50 times less than the Lowest Observable Adverse Effect Level dose (0.022) associated with gastrointestinal irritation, diarrhea, nausea, skin pigmentation changes, and hyperkeratosis (dark raised spots on the skin that are possibly precancerous); persons in this study continuously ingested arsenic in their drinking water. This level equals the (0.0004) No Observable Adverse Effect Level (NOAEL), for these health effects (same study) and is ¾ of the MRL (0.0003) calculated from another NOAEL (0.0008) for adverse skin effects from long-term ingestion of arsenic in drinking water. ATSDR scientists divided this second NOEL dose (0.0008) by 3 to account for human diversity in calculating the (0.0003) MRL. <u>Adult ingestion dose</u> is 10 times less than the (0.0004) dose referenced for children; therefore, we would not expect skin or gastrointestinal health effects for most adults. <u>Inhalation dose</u> (0.000002) is 350 times less than the amount associated with increased risk of stillbirth in humans (0.0007) and 3,500 times less than the dose causing dermatitis (0.007) in humans inhaling arsenic. Dermatitis is skin inflammation that may cause redness, pain, and occasionally itching. <u>Associated cancers</u>: From lowest to highest dose cancer effect levels, chronic arsenic exposures in people have been linked to lung cancer, basal and squamous cell skin cancers, liver cancer (haemangioendothelioma), urinary tract cancers (bladder, kidney, ureter, and all urethral cancers), and intraepidermal cancers. Intraepidermal is the name for the early pre-invasive form of squamous cell skin cancer. Pre-invasive cancer cells grow in the outermost layer of skin, the epidermis. At this stage, the cancer cells are unlikely to have spread to the lymph nodes, but they can spread along the skin surface. If left untreated, these cells can develop into an invasive cancer and spread into the lymphatic system.			

Chemical	Doses are in mg/kg/day			Soil
	children's dose	adult's dose	children's theoretical increased cancer risk	adult's theoretical increased cancer risk
Lead ATSDR 1999a	2.4- 6.4 µg/dl (modeled)	1.8 - 6.0 µg/dl (modeled)		
We compare the following health effects at blood lead levels between 1 and 200 micrograms per deciliter (µg/dl), in studies with the levels we modeled for exposure: 1.8 to 6.4µg/d				
	Children's Blood (µg/dl):	**Adults' Blood (µg/dl):**		
	No threshold	**3 - 56 µg/dl**	Decreased aminolevulinic acid dehydratase (ALAD) enzyme activity. ALAD is necessary for hemoglobin synthesis. A large decrease in ALAD activity can lead to anemia.	
	1 - 17 µg/dl		Alterations in visual evoked potentials[1].	
	6.5 µg/dl		(Average value at 24 months of age) - Lower cognitive function test scores in children 5 to 10 years of age.	
	6 - 200 µg/dl		Decreased neurobehavioral function; slightly decreased performance on IQ tests and other measures of neuro-psychological function.	
		5.5 µg/dl (average)	Decreased performance on neurobehavioral tests.	
Mercury	Ing 0.0001 Inh 0.0000007	Ing 0.00001 Inh 0.0000007	No slope.	No slope.
ATSDR 1999b (Update)	<u>Child ingestion dose</u> (0.0001) is 5,600 times less than the dose (0.56) associated with kidney symptoms† in mice exposed for 10 weeks ad. lib. via drinking water. <u>Adult ingestion dose</u> (0.00001) is 56,000 times less than the (0.56) sensitive dose health effects described above for children. <u>Inhalation dose</u> (0.0000007) is 20,000 times less than the dose (0.014) associated with impaired performance on neurobehavioral tests in persons exposed 0.7-24 years. <u>Cancer association:</u> Animal studies and human epidemiological studies for evaluating the carcinogenicity of mercury via inhalation or dermal exposure were not located; animal studies involving ingestion exposure were equivocal.			

1The visual evoked potential measures the electrical response of the brain's primary visual cortex to a visual stimulus.

† The mouse kidney symptoms were increased granular IgG deposits, slight glomerular endocapillary cell hyperplasia; slight tubular atrophy, inflammation, and fibrosis.

Chemical	Doses are in mg/kg/day			Soil
	children's dose	adult's dose	children's theoretical increased cancer risk	adult's theoretical increased cancer risk
PAHs TEQ	Ing 0.00008 Inh 0.0000003	Ing 0.000008 Inh 0.0000003	Ing 3:100,000 Inh <1:1,000,000	Ing 3:100,000 Inh <1:1,000,000
ATSDR 1995 (Update)	Child ingestion dose (0.00008) is 32,500 times less than the dose (2.6) associated with stomach cancer in mice exposed to benzo[a]pyrene ad lib in food for 30 to 197 days. Adult ingestion dose (0.000008) is 325,000 times less than the (2.6) sensitive dose health effects described above for children. Inhalation dose (0.0000003) is 333 times less than the dose (0.0001) associated with reduced lung function, abnormal chest x-ray, cough, bloody vomit, and throat and chest irritation, in persons exposed from 6 months to 6 years. Cancer and occupational studies: Worker exposures to high levels of PAHs show cancers (skin, bladder, lung and gastrointestinal) are the most significant endpoint of PAH toxicity. Long-term worker PAH exposures have been linked with skin and eye irritation, photosensitivity, respiratory irritation (with cough and bronchitis), leukoplakia†, precancerous skin growths enhanced by exposure to sunlight, erythema$^{\Delta}$, skin burns, acneiform lesions, mild hepatoxicity, and haematuria‡. Also several PAH compounds are immunotoxic, and some suppress selective compounds of the immune system. Workers' dermal exposure studies indicate that although direct contact may be of concern at high exposure levels, they do not suggest that lower levels are likely to cause significant irritation (Goodfellow et al. 2001).			

† Leukoplakia is a common, is a common, potentially pre-cancerous disease of the mouth that involves the formation of white spots on the mucous membranes of the tongue and inside of the mouth. Despite the increased risk associated with having leukoplakia, many people with this condition never get oral cancer
Δ Erythema nodosum is an inflammation of subcutaneous fat tissue.
‡ Haematuria is passage of blood in the urine.

Table 4. Estimated Blood Lead Concentrations In Children Ingesting On-Site Surface Soil (micrograms per deciliter - μg/dl)

Media	**Conc. ***		**Time**	**Slope'**		Low	High
	Low	High		Low	High		
Air (out) *	0.1	0.2	0.33	2.46	3.04	0.08118	0.20064
Air (in) *	0.3	0.6	0.33	2.46	3.04	0.24354	0.60192
Food*	5	5	0.33	0.24	0.24	0.396	0.396
Water*	4	4	0.33	0.16	0.16	0.2112	0.2112
Soil	750	750	0.33	0.002	0.016	0.495	3.96
Dust	750	750	0.33	0.004	0.004	0.99	0.99
Total						**2.41692**	**6.35976**

*Default Value from ATSDR 1999a, Appendix D.
'These slopes were for children from ATSDR 1999a, Appendix D.
ATSDR=s Regression Analysis with Multiple-uptake Parameters to Estimate Blood Lead from Environmental Exposures (ATSDR 1999a, Appendix D)

Table 5. Estimated Blood Lead Concentrations In Adults Ingesting On-Site Surface Soil (micrograms per deciliter - μg/dl)

Media	**Conc. ***		**Time**	**Slope'**		Low	High
	Low	High		Low	High		
Air (out) *	0.1	0.2	0.33	1.59	3.56	0.05247	0.23496
Air (in) *	0.3	0.6	0.33	1.53	3.56	0.15147	0.70488
Food*	5	5	0.33	0.016	0.0195	0.0264	0.032175
Water*	4	4	0.33	0.03	0.06	0.0396	0.0792
Soil	750	750	0.33	0.002	0.016	0.495	3.96
Dust	750	750	0.33	0.004	0.004	0.99	0.99
Total						**1.75494**	**6.001215**

*Default Value from ATSDR 1999a, Appendix D.
'These slopes were for adults from ATSDR 1999a, Appendix D.
ATSDR=s Regression Analysis with Multiple-uptake Parameters to Estimate Blood Lead from Environmental Exposures (ATSDR 1999a, Appendix D)

CERTIFICATION

The Florida Department of Health prepared this Brown Barge Middle School Health Consultation under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). The Florida Department of Health wrote it in accordance with approved methodologies and procedures that existed when they began the health assessment. Editorial review was completed by the Cooperative Agreement Partner.

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The Division of Health Assessment and Consultation, ATSDR, reviewed this health consultation, and concurred with its findings.

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