Health Consultation

Surface Soil

SCOTT HOMES SECTOR II
MIAMI-DADE COUNTY, FLORIDA

Prepared by the
Florida Department of Health

APRIL 29, 2009

Prepared under a Cooperative Agreement with the
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

A health consultation is a verbal or written response from ATSDR or ATSDR's Cooperative Agreement Partners 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 or ATSDR's Cooperative Agreement Partner which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

You May Contact ATSDR Toll Free at
1-800-CDC-INFO
or
Visit our Home Page at: http://www.atsdr.cdc.gov

HEALTH CONSULTATION

Surface Soil

SCOTT HOMES SECTOR II

MIAMI-DADE COUNTY, FLORIDA

Prepared By:

Florida Department of Health
Division of Environmental Health
Under a cooperative agreement with the
U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

Foreword

This document summarizes the Florida Department of Health's assessment from exposure to the contaminants in the environment on the former Scott Homes Sector II site. The Florida Department of Health (DOH) evaluates site-related public health issues through the following processes:

- Evaluating exposure: Florida DOH scientists begin by reviewing available information about environmental conditions at the site. The first task is to find out how much contamination is present, where it is on the site, and how human exposures might occur. Usually, the Florida DOH does not collect its own environmental sampling data. The Miami-Dade Department of Environmental Resource Management (DERM) provided the information for this public health assessment.
- Evaluating health effects: If we find evidence that exposures to hazardous substances are occurring or might occur, Florida DOH scientists will determine whether that exposure could be harmful to human health. We focus this report on public health; that is, the health impact on the community as a whole, and base it on existing scientific information.
- Developing recommendations: In this report, the Florida DOH outlines its conclusions regarding any potential health threat posed by the Scott Homes Sector II site, and offers recommendations for reducing or eliminating human exposure to contaminants. The role of the Florida DOH in dealing with hazardous waste sites is primarily advisory. For that reason, the evaluation report will typically recommend actions for other agencies, including the US Environmental Protection Agency (EPA) and the Florida DEP. If, however, an immediate health threat exists or is imminent, the Florida 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. The Florida 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 we prepare an evaluation report, the Florida DOH seeks feedback from the public.

If you have questions or comments about this report, we encourage you to contact us.

Please write to: Hazardous Waste Site Health Assessment Team
Bureau of Environmental Public Health Medicine
Florida Department Health
4052 Bald Cypress Way, Bin # A-08
Tallahassee, FL 32399-1712

Or call us at: 850 245-4299 or toll-free 1-877-798-2772

Summary and Statement of Issues

In October 2008, both the Miami-Dade County Health Department (CHD) and Miami-Dade County Department of Environmental Resource Management (DERM) requested the Florida Department of Health (DOH) assess the public health threat from surface soil at the Scott Homes Sector II site. This site includes a day care center, a community/health care center, a former dump area, and former housing area.

Florida DOH reviewed the existing data and categorizes surface soil (0-6 inches deep) as "no apparent" public health hazard. Past exposure to surface soil is not likely to cause illness. Florida DOH recommends that if soil deeper than 6 inches is brought to the surface, the responsible party should evaluate the health risk.

Background

The Scott Homes Sector II site is at 7200 NW 22nd Avenue in the Liberty City area of Miami-Dade County, Florida (Figure 1). In 1955, 21multi-family subsidized houses (136 units), a daycare center, a community center, and a health care center were built on this flat, 16-acre sandy site (Figure 2). All buildings were supplied with municipal water.

In 1997, the Florida Department of Health (DOH) found the levels of metals, pesticides, and polychlorinated biphenyls (PCBs) in fish from the nearby Wryals Pit site (Gwen Cherry Park) were not a public health hazard (ATSDR 1998).

In 2000, consultants for the Miami-Dade Housing Agency visited the site, reviewed existing reports, and talked with knowledgeable individuals. They identified the former Wryals Pit landfill just west of the site, a former dump area in the northwest corner of the site, and evidence of car maintenance throughout the site. They recommended soil and ground water testing (ERM 2000).

Between 2002 and 2005, the Miami-Dade Housing Agency demolished the multi-family houses for neighborhood revitalization. In the northeast quadrant of the site, they left standing the daycare center, the community center, and community health care center. The community center closed between 2002 and 2005. The day care ceased operations in December 2008. The community health care center is still active (Figure 3).

Between 2001 and January 2009, consultants for and Miami-Dade Department of Environmental Resource Management (DERM) tested soil and groundwater at this site. In 2008, they also dug test pits to locate areas of buried debris.

Community Health Concerns

Some former residents are concerned that exposure to contaminants in the soil may have affected their health.

Discussion

Environmental Contamination

In 2006 and 2009, consultants for Miami-Dade County DERM collected 41 surface soil samples (0-6 inches deep) across the site including the daycare center, community center, and former dump area (Figure 3). They analyzed these samples for arsenic, lead, and polycyclic aromatic hydrocarbons (PAHs) (Shaw 2006b, Mayorga 2009). For the purpose of this report, surface soil quality at this site has been adequately characterized.

Since people do not routinely contact soil deeper than six inches, this assessment only considered the top six inches of soil. Since all site buildings had municipal water, Florida DOH did not evaluate ground water quality data.

The Florida DOH used the following screening guidelines in order of priority to select contaminants of concern:

1. Cancer Risk Evaluation Guide (CREG). A CREG is the contaminant concentration estimated to result in no more than one excess cancer per 1 million persons exposed during a lifetime (i.e., 70 years). ATSDR calculates CREGs from EPA-established cancer slope factors (ATSDR 1992).

2. Environmental Media Evaluation Guide (EMEG). ATSDR derives an EMEG from a Minimal Risk Level (MRL), using standard exposure assumptions (e.g., ingestion of 200 milligrams of soil per day and body weight of 30 kilograms (kg) for children). ATSDR establishes MRLs: levels of daily human exposure to a chemical for a period of 1 year or longer which is likely to be without any appreciable risk of noncancerous illnesses.

The screening guidelines are conservative estimates of levels at which no health effects would be expected. The Florida DOH utilizes the above criteria to screen all data. Any sample results that exceed the levels established by the guidelines are then selected for further evaluation. The next step in the process for toxicological review is to compare an estimated dose or concentration that has been calculated from known concentrations to health studies in ATSDR's toxicological profiles. The health studies establish no observable adverse effect levels (NOAELs) and lowest observable adverse effect levels (LOAELs) that can be compared to estimated doses and concentrations.

Using these criteria, Florida DOH selected arsenic, lead, and polycyclic aromatic hydrocarbons (PAHs) as contaminants of concern (Tables 1 through 4). Identification of a contaminant of concern does not necessarily mean that exposure to the contaminant will cause illness. To be protective of health, ATSDR screening guidelines are usually set hundreds or thousands of times below levels that actually cause illness. Identification of contaminants of concern helps narrow the focus to those contaminants that require further evaluation.

Arsenic

Arsenic is a naturally occurring element widely distributed in soil. It is a metal usually found combined with oxygen, chlorine, and sulfur. Most arsenic compounds have no smell or special taste. In the past arsenic compounds were used as pesticides on cotton fields and in orchards. Before 2003, arsenic was also used as a preservative for wood to make it resistant to rotting and decay ("pressure treated" wood). Manufactures still use arsenic in automotive batteries. Arsenic occurs in urban soils at concentrations from 0.3 to 110 milligrams per kilogram (mg/kg), with a

mean concentration of 3 mg/kg (ATSDR 2007a). Florida soils naturally contain arsenic at concentrations of 1 mg/kg or higher.

Lead

Lead is a heavy metal that occurs naturally in soil, usually combined with two or more elements. The largest use of lead is in automobile batteries. The second largest use is in gun ammunition. Before the 1980's, lead was added to gasoline as an octane booster. Before the 1950s, lead was also used in pesticides applied to fruit orchards. Most of the lead in inner city soils comes from old houses with leaded paint and automotive exhaust from leaded gasoline. The highest levels are usually found in soils near walls with lead-based paint and in soils along highways. Most lead sticks to soil particles but some dissolves in water. Median soil lead concentrations at 67 public housing projects nationwide were 145 mg/kg in the yard, 177 mg/kg near the sidewalks, and 194 mg/kg near the foundations (ATSDR 2007b).

Polycyclic Aromatic Hydrocarbons (PAHs)

Polycyclic aromatic hydrocarbons (PAHs) are a group of chemicals formed during the incomplete burning of coal, oil, gas, wood, garbage, tobacco, and charbroiled meat. More than 100 different PAHs exist. PAHs generally occur as complex mixtures. PAHs are contained in asphalt used in road construction, crude oil, coal, coal tar pitch, creosote, and roofing tar. They are found throughout the environment in air, soil, and water. Other sources include cigarette smoke, vehicle exhaust, wildfires, agriculture burning, and residential wood burning. PAHs do not easily dissolve in water but stick tightly to soil particles. Concentrations of PAHs (reported as benzo(a)pyrene toxicity equivalents) in urban soils are about 0.2 mg/kg (ATSDR 1995).

To assess the toxicity of a mixture of PAHs, Florida DOH used ATSDR toxicity equivalence factors (ATSDR 1995). Florida DOH used these factors to estimate the toxicity of each PAH in terms of benzo(a)pyrene, one of the most studied PAHs. Thus, Florida DOH estimate the toxicity of all measured PAHs in terms of benzo(a)pyrene toxicity equivalents (BaP TEQ). In calculating a BaP TEQ, Florida DOH assumed a concentration of one-half the laboratory detection limit for those PAHs with concentrations below the laboratory detection limits.

Pathway Analysis

Chemical contaminants in the environment can harm people's health, but only if people have contact with those contaminants at a high enough concentration (dose) to cause a health effect. Knowing or estimating the frequency with which people could have contact with hazardous substances is essential to assessing the public health importance of these contaminants. To decide if people can contact contaminants at or near a site, Florida DOH looks at the human exposure pathways. An exposure pathway has five parts. These parts are:

1. A source of contaminants, like a hazardous waste site,

2. An environmental medium like air, water or soil that can hold or move the contamination,

3. A point where people come in contact with a contaminated medium, like drinking water or soil in a garden,

4. An exposure route like drinking contaminated water from a well or eating contaminated soil on homegrown vegetables, and

5. A population who could be exposed to the contaminants.

Florida DOH eliminates an exposure pathway if at least one of the five parts referenced above is missing and will not occur in the future. Exposure pathways not eliminated are either completed or potential. For completed pathways, all five pathway parts exist and exposure to a contaminant has occurred, is occurring, or will occur. For potential pathways, at least one of the five parts is missing, but could exist. Also for potential pathways, exposure to a contaminant could have occurred, could be occurring, or could occur in the future.

Florida DOH identified past incidental (accidental) ingestion of surface soil (0-6 inches deep) as a completed exposure pathway. Since people do not routinely contact soil deeper than 6 inches, Florida DOH did not assess the health risk from exposure to deeper soil.

Florida DOH assessed the health risk at four areas of the site:

1. Past health risk from incidental ingestion of surface soil (0-6"deep) by 2 to 6-year old children 5 days-a-week for 4 years at the Jesca Olive B. Alexander Day Care Center playground. Also past health risk from incidental ingestion of surface soil (0-6" deep) at the daycare playground by adults 5 days a week for 53 years (1955-2008).

2. Past health risk from incidental ingestion of surface soil (0-6" deep) by children and adults 7 days-a-week for 53 years (1955 to 2008) around the community center and health care center.

3. Past health risk from incidental ingestion of surface soil (0-6" deep) by children and adults 7 days-a-week for 50 years (1955 to 2005) in the former dump area in the northwest corner of the site.

4. Past health risk from incidental ingestion of surface soil (0-6" deep) by children and adults 7 days-a-week for 50 years (1955 to 2005) around the former multi-family houses on the remainder of the site.

To be health protective and not underestimate the risk, this assessment assumes exposure to the highest measured soil contaminant concentration for the maximum time.

Public Health Implications

The Florida DOH evaluates exposures by estimating daily doses for children and adults. Kamrin (1988) explains the concept of dose in the following manner:

> . . .all chemicals, no matter what their characteristics, are toxic in large enough quantities. Thus, the amount of a chemical a person is exposed to is crucial in deciding the extent of toxicity that will occur. In attempting to place an exact number on the amount of a particular compound that is harmful, scientists recognize they must consider the size of an organism. It is unlikely, for example, that the same amount of a particular chemical that will cause toxic effects in a 1-pound rat will also cause toxicity in a 1-ton elephant.

> Thus instead of using the amount that is administered or to which an organism is exposed, it is more realistic to use the amount per weight of the organism. Thus, 1 ounce administered to a 1-pound rat is equivalent to 2,000 ounces to a 2,000-pound (1-ton) elephant. In each case, the amount per weight is the same; i.e., 1 ounce for each pound of animal.

This amount per weight is the *dose*. Toxicology uses dose to compare the toxicity of different chemicals in different animals. We use the units of milligrams (mg) of contaminant per kilogram (kg) of body weight per day (mg/kg/day) to express doses in this public health assessment. A milligram is 1/1,000 of a gram; a kilogram is approximately 2 pounds.

To calculate the daily dose of each contaminant, the Florida DOH uses standard assumptions about body weight, ingestion rates, duration of exposure (length of time), and other factors needed for dose calculation (ATSDR 2005c, EPA 1997). We assume that people are exposed daily to the maximum concentration measured. The general formula for estimating a dose is:

Dose = (soil concentration X soil ingestion rate) / body weight

ATSDR groups health effects by duration (length) of exposure. Acute exposures are those with duration of 14 days or less; intermediate exposures are those with duration of 15 - 364 days; and chronic exposures are those that occur for 365 days or more (or an equivalent period for animal exposures). ATSDR Toxicological Profiles also provide information on the environmental transport and regulatory status of contaminants.

To estimate exposure from incidental ingestion of contaminated surface soil, Florida DOH used the following assumptions:

1) children 2 - 6 years of age ingest an average of 200 milligrams (mg) of soil per day,
2) adults ingest an average of 100 mg of soil per day,
3) children 2 - 6 years of age weigh an average of 16 kilograms (kg),
4) adults weigh an average of 70 kg,
5) children and adults ingest contaminated surface soil at the maximum concentration measured for each contaminant.

Day Care Center

Arsenic

Incidental ingestion of the highest concentration of inorganic arsenic measured in the surface soil at the Jesca Olive B. Alexander day care center is not expected to cause illness in children or adults. This assessment assumes arsenic is in the more toxic inorganic form.

The highest estimated average daily doses of arsenic from incidental soil ingestion for children (0.00004 milligrams per kilogram per day - mg/kg/day) and adults (0.000007 mg/kg/day) at the day care center (Table 5) are less than the ATSDR chronic oral minimal risk level (0.0003 mg/kg/day). For children and adults, these doses are 30 and 170 times, respectively, lower than the lowest dose (0.0012 mg/kg/day) that increases the risk of premalignant skin changes or arsenical dermatosis (ATSDR 2007a).

The US Department of Health and Human Services has determined that inorganic arsenic causes cancer. To evaluate a theoretical cancer risk from incidental ingestion of inorganic arsenic, U.S. Environmental Protection Agency (EPA) developed a cancer slope factor based on a human study where subjects developed skin cancer. We multiply this cancer slope factor (1.5 per mg/kg-day) by the lifetime average daily dose (0.000004 mg/kg/day). We adjust the highest estimated ingestion dose at this daycare center to create the lifetime average daily dose for a 70-year life expectancy. The maximum theoretical excess cancer risk for lifetime exposure of incidental ingestion of inorganic arsenic at this daycare is 6 in 1,000,000, which is a very low increased risk.

We base this theoretical calculation on the assumption there is no safe level of exposure to a chemical that causes cancer. However, the theoretical calculated risk is not exact and tends to overestimate the actual risk associated with exposures that may have occurred.

Lead

The highest concentration of lead in surface soil at the Jesca Olive B. Alexander day care center (290 mg/kg) is less than the EPA residential screening value (400 mg/kg) and thus is not likely to cause illness in children or adults (Table 1).

Polycyclic Aromatic Hydrocarbons (PAHs)

Incidental ingestion of the highest concentration of polycyclic aromatic hydrocarbons (PAHs) measured in the surface soil at the Jesca Olive B. Alexander day care center is not expected to cause illness in children or adults.

The US Department of Health and Human Services has determined that some PAHs cause cancer in animals. Using toxicity equivalency factors from the ATSDR PAH toxicological profile (ATSDR 1995), this assessment compares the toxicity of the sum of the individual PAHs (benzo(a)pyrene toxicity equivalents, or BaP TEQ) to that of the well studied PAH benzo(a)pyrene (Table 1).

To evaluate a theoretical cancer risk from incidental ingestion of PAHs, represented by benzo(a)pyrene, EPA developed a cancer slope factor based on upper digestive track tumors in mice, rats, and hamsters. We multiply this cancer slope factor (7.3 per mg/kg-day) by the adult lifetime average daily dose (0.0000005 mg/kg/day) (Table 5). We adjust the highest estimated adult ingestion dose at this daycare center to create the lifetime average daily dose for a 70-year life expectancy. The maximum theoretical excess cancer risk for lifetime incidental ingestion of PAHs in surface soil at this daycare is 4 in 1,000,000, which is a very low increased risk.

We base this theoretical calculation on the assumption there is no safe level of exposure to a chemical that causes cancer. However, the theoretical calculated risk is not exact and tends to overestimate the actual risk associated with exposures that may have occurred. The actual increased cancer risk may be as low as zero.

Community and Health Care Center Area

Arsenic

Incidental ingestion of the highest concentration of inorganic arsenic measured in the surface soil around the community and health care center area is not expected to cause illness in children or adults. This assessment assumes arsenic is in the more toxic inorganic form.

The highest estimated average daily doses of arsenic from incidental soil ingestion for children (0.00008 mg/kg/day) and adults (0.000009 mg/kg/day) in the community and health care center area (Table 6) are less than the ATSDR chronic oral minimal risk level (0.0003 mg/kg/day). For children and adults, these doses are 15 and 133 times, respectively, lower than the lowest dose (0.0012 mg/kg/day) that increases the risk of premalignant skin changes or arsenical dermatosis (ATSDR 2007a).

The US Department of Health and Human Services has determined that inorganic arsenic causes cancer. To evaluate a theoretical cancer risk from incidental ingestion of inorganic arsenic, EPA developed a cancer slope factor based on a human study where subjects developed skin cancer. We multiply this cancer slope factor (1.5 per mg/kg-day) by the lifetime average daily dose (0.000009 mg/kg/day). We adjust the highest estimated ingestion dose at this community and health care center to create the lifetime average daily dose for a 70-year life expectancy. The maximum theoretical excess cancer risk from lifetime incidental ingestion of inorganic arsenic in the community and health care center area is 1.4 in 100,000, which is a very low increased risk.

We base this theoretical calculation on the assumption there is no safe level of exposure to a chemical that causes cancer. However, the theoretical calculated risk is not exact and tends to overestimate the actual risk associated with exposures that may have occurred. The actual increased cancer risk may be as low as zero.

Lead

The highest concentration of lead in surface soil around the community and health care center (148 mg/kg) is less than the EPA residential screening value (400 mg/kg) and thus is not likely to cause illness in children or adults (Table 2).

Polycyclic Aromatic Hydrocarbons (PAHs)

Incidental ingestion of the highest concentration of polycyclic aromatic hydrocarbons (PAHs) measured in the surface soil around the community and health care center area is not expected to cause illness in children or adults.

The US Department of Health and Human Services has determined that some PAHs cause cancer in animals. Using toxicity equivalency factors from the ATSDR PAH toxicological profile (ATSDR 1995), this assessment compares the toxicity of the sum of the individual PAHs (benzo(a)pyrene toxicity equivalents, or BaP TEQ) to that of the well studied PAH benzo(a)pyrene (Table 2).

To evaluate a theoretical cancer risk from incidental ingestion of PAHs, represented by benzo(a)pyrene, EPA developed a cancer slope factor based on upper digestive track tumors in

mice, rats, and hamsters. We multiply this cancer slope factor (7.3 per mg/kg-day) by the adult lifetime average daily dose (0.000008 mg/kg/day) (Table 6). We adjust the highest estimated adult ingestion dose at this daycare center to create the lifetime average daily dose for a 70-year life expectancy. The maximum theoretical excess cancer risk for lifetime incidental ingestion of PAHs in the community and health care center area is 6 in 100,000, which is a low increased risk.

To put this "low increased" risk of cancer into perspective, the American Cancer Society estimates the background cancer rate in the US is 1 in 3. That is, for every 100,000 people, on average about 33,333 will get some form of cancer during their lifetime. Exposure to PAHs around the community and health care centers would, at most, increase the lifetime cancer risk from 33,333 in 100,000 to 33,339 in 100,000. Therefore, it is unlikely that any additional cases of cancer would have resulted from exposure to PAHs at the community and health care center.

We base this theoretical calculation on the assumption there is no safe level of exposure to a chemical that causes cancer. However, the theoretical calculated risk is not exact and tends to overestimate the actual risk associated with exposures that may have occurred. The actual increased cancer risk may be as low as zero.

Former Dump Area (Northwest Corner)

Arsenic

Incidental ingestion of the highest concentration of inorganic arsenic measured in the surface soil in the former dump area in the northwest corner of the site is not expected to cause illness in children or adults. This assessment assumes arsenic is in the more toxic inorganic form.

The highest estimated average daily doses of arsenic from incidental soil ingestion for children (0.00007 mg/kg/day) and adults (0.000008 mg/kg/day) in the former dump area (Table 7) are less than the ATSDR chronic oral minimal risk level (0.0003 mg/kg/day). For children and adults, these doses are 17 and 150 times, respectively, lower than the lowest dose (0.0012 mg/kg/day) that increases the risk of premalignant skin changes or arsenical dermatosis (ATSDR 2007a).

The US Department of Health and Human Services has determined that inorganic arsenic causes cancer. To evaluate a theoretical cancer risk from incidental ingestion of inorganic arsenic, EPA developed a cancer slope factor based on a human study where subjects developed skin cancer. We multiply this cancer slope factor (1.5 per mg/kg-day) by the lifetime average daily dose (0.000008 mg/kg/day). We adjust the highest estimated ingestion dose at this daycare center to create the lifetime average daily dose for a 70-year life expectancy. The maximum theoretical excess cancer risk for lifetime exposure of incidental ingestion of inorganic arsenic in the former dump area is 1.2 in 100,000, which is a very low increased risk.

We base this theoretical calculation on the assumption there is no safe level of exposure to a chemical that causes cancer. However, the theoretical calculated risk is not exact and tends to overestimate the actual risk associated with exposures that may have occurred. The actual increased cancer risk may be as low as zero.

Lead

The highest concentration of lead in surface soil in the former dump area (74 mg/kg) is less than the EPA residential screening value (400 mg/kg) and thus is not likely to cause illness in children or adults (Table 3).

Polycyclic Aromatic Hydrocarbons (PAHs)

Incidental ingestion of the highest concentration of polycyclic aromatic hydrocarbons (PAHs) measured in the surface soil in the former dump area in the northwest quadrant of the site are not expected to cause illness in children or adults.

The US Department of Health and Human Services has determined that some PAHs cause cancer in animals. Using toxicity equivalency factors from the ATSDR PAH toxicological profile (ATSDR 1995), this assessment compares the toxicity of the sum of the individual PAHs (benzo(a)pyrene toxicity equivalents, or BaP TEQ) to that of the well studied PAH benzo(a)pyrene (Table 3).

To evaluate a theoretical cancer risk from incidental ingestion of PAHs, represented by benzo(a)pyrene, EPA developed a cancer slope factor based on upper digestive track tumors in mice, rats, and hamsters. We multiply this cancer slope factor (7.3 per mg/kg-day) by the adult lifetime average daily dose (0.0000008 mg/kg/day) (Table 7). We adjust the highest estimated adult ingestion dose at this daycare center to create the lifetime average daily dose for a 70-year life expectancy. The maximum theoretical excess cancer risk for lifetime incidental ingestion of PAHs in the former dump area is 6 in 1,000,000, which is a very low increased risk.

We base this theoretical calculation on the assumption there is no safe level of exposure to a chemical that causes cancer. However, the theoretical calculated risk is not exact and tends to overestimate the actual risk associated with exposures that may have occurred. The actual increased cancer risk may be as low as zero.

Former Housing Area

Arsenic

Incidental ingestion of the highest concentration of inorganic arsenic measured in the surface soil in the former housing area of the site is not expected to cause illness in children or adults. This assessment assumes arsenic is in the more toxic inorganic form.

The highest estimated average daily doses of arsenic from incidental soil ingestion for both children and adults (0.0001 mg/kg/day) in the former housing area (Table 8) are less than the ATSDR chronic oral minimal risk level (0.0003 mg/kg/day). For children and adults, these doses are 12 times lower than the lowest dose (0.0012 mg/kg/day) that increases the risk of premalignant skin changes or arsenical dermatosis (ATSDR 2007a).

The US Department of Health and Human Services has determined that inorganic arsenic causes cancer. To evaluate a theoretical cancer risk from incidental ingestion of inorganic arsenic, EPA developed a cancer slope factor based on a human study where subjects developed skin cancer. We multiply this cancer slope factor (1.5 per mg/kg-day) by the lifetime average daily dose

(0.0001 mg/kg/day). We adjust the highest estimated ingestion dose at the former housing area to create the lifetime average daily dose for a 70-year life expectancy. The maximum theoretical excess cancer risk for lifetime exposure of incidental ingestion of inorganic arsenic in the former housing area is 1.5 in 10,000, which is a low increased risk.

To put this "low increased" risk of cancer into perspective, the American Cancer Society estimates the background cancer rate in the US is 1 in 3. That is, for every 10,000 people, on average about 3,333 will get some form of cancer during their lifetime. Exposure to arsenic around the former housing area would, at most, increase the lifetime cancer risk from 3,333 in 10,000 to 3,334.5 in 10,000. Therefore, it is unlikely that any additional cases of cancer would have resulted from exposure to arsenic around the former housing area.

We base this theoretical calculation on the assumption there is no safe level of exposure to a chemical that causes cancer. However, the theoretical calculated risk is not exact and tends to overestimate the actual risk associated with exposures that may have occurred. The actual increased cancer risk may be as low as zero.

Lead

Incidental ingestion of the highest concentrations of lead measured in the surface soil in the former housing area is not expected to cause illness in children or adults.

Only one surface soil sample out of 30 had a lead concentration (553 mg/kg) greater than the EPA guideline for residential exposure (400 mg/kg) (Table 4). Neither ATSDR nor EPA has developed health guidelines for human exposure to lead. Therefore, we cannot use the usual approach of estimating a human dose and then comparing this dose to a health guideline. Instead, we evaluate exposure to lead by using a biological model that predicts a blood lead concentration that would result from exposure to environmental lead contamination. We then compare the modeled blood lead concentration to the level of concern for blood lead concentrations in children (ATSDR 2007b).

Using the lead level in the one surface soil with more than 400 mg/kg (553 mg/kg), the EPA Integrated Exposure Uptake Biokinetic Model (IEUBK) predicts a corresponding blood lead level of between 5 and 8 micrograms per deciliter (ug/dL) in children 2 to 6 years old (EPA 2007). The Centers for Disease Control and Prevention (CDC) action level for children < 7 years of age is 10 ug/dL.

Blood lead levels in the US have been decreasing over the past 3 decades as regulations regarding lead paint, leaded fuels, and lead-containing plumbing materials have reduced exposures. Blood lead levels measured in the National Health and Nutrition Examination Surveys (NHANES) indicate from 1976 to 1991, the mean blood level in the US dropped from 12.8 to 2.8 ug/dL. NHANES III, phase II (1991-1994) found the mean blood levels in children (1-5 years old) were 2.7 ug/dL. From 1999 to 2002, the level dropped further to 1.9 ug/dL (ATDR 2007b).

Although the evidence is not conclusive, the US Department of Health and Human Services has determined that lead can reasonably be anticipated to cause cancer in humans. Quantifying lead's cancer risk involves many uncertainties, some of which may be unique to lead. Age, health, nutritional state, body burden, and exposure duration influence the absorption, release, and excretion of lead. In addition, current knowledge of lead pharmacokinetics indicates that an

estimate derived by standard procedures would not truly describe the potential risk. Therefore, EPA has not developed a cancer risk slope factor for lead and a numerical estimate of the caner risk is not possible.

Polycyclic Aromatic Hydrocarbons (PAHs)

Incidental ingestion of the highest concentration of polycyclic aromatic hydrocarbons (PAHs) measured in the surface soil around the former housing area are not expected to cause illness in children or adults.

The US Department of Health and Human Services has determined that some PAHs cause cancer in animals. Using toxicity equivalency factors from the ATSDR PAH toxicological profile (ATSDR 1995), this assessment compares the toxicity of the sum of the individual PAHs (benzo(a)pyrene toxicity equivalents, or BaP TEQ) to that of the well studied PAH benzo(a)pyrene (Table 4).

To evaluate a theoretical cancer risk from incidental ingestion of PAHs, represented by benzo(a)pyrene, EPA developed a cancer slope factor based on upper digestive track tumors in mice, rats, and hamsters. We multiply this cancer slope factor (7.3 per mg/kg-day) by the adult lifetime average daily dose (0.0000017 mg/kg/day) (Table 8). We adjust the highest estimated adult ingestion dose at this daycare center to create the lifetime average daily dose for a 70-year life expectancy. The maximum theoretical excess cancer risk for lifetime incidental ingestion of PAHs in the former housing area is 1 in 100,000, which is a ver low increased risk.

We base this theoretical calculation on the assumption there is no safe level of exposure to a chemical that causes cancer. However, the theoretical calculated risk is not exact and tends to overestimate the actual risk associated with exposures that may have occurred. The actual increased cancer risk may be as low as zero.

Child Health Considerations

In communities faced with air, water, or food contamination, the many physical differences between children and adults demand special emphasis. Children could be at greater risk than are adults from certain kinds of exposure to hazardous substances. Children play outdoors and sometimes engage in hand-to-mouth behaviors that increase their exposure potential. Children are shorter than are adults; this means they breathe dust, soil, and vapors close to the ground. A child's lower body weight and higher intake rate results in a greater dose of hazardous substance per unit of body weight. If toxic exposure levels are high enough during critical growth stages, the developing body systems of children can sustain permanent damage. Finally, children are dependent on adults for access to housing, for access to medical care, and for risk identification. Thus, adults need as much information as possible to make informed decisions regarding their children's health.

This assessment takes into account the special vulnerabilities of children. It specifically assesses the health risk for children attending the daycare center as well as children living in the former housing area.

Conclusions

The Florida Department of Health categorizes surface soil at the Scott Homes Sector II site as "no apparent" public health hazard. Past exposure to surface soil (0-6 inches deep) is not likely to cause illness.

Day Care Center – The maximum theoretical excess cancer risk for lifetime incidental ingestion of the highest levels of arsenic and PAHs in the daycare surface soil is very low. The highest concentration of lead is less than the EPA residential screening value and thus is not likely to cause illness.

Community and Health Care Center Area - The maximum theoretical excess cancer risk for lifetime incidental ingestion of the highest levels of arsenic and PAHs in the community and health care center area surface soil is low. The highest concentration of lead is less than the EPA residential screening value and thus is not likely to cause illness.

Former Dump Area (Northwest Corner) - The maximum theoretical excess cancer risk for lifetime incidental ingestion of the highest levels of arsenic and PAHs in the former dump area surface soil is very low. The highest concentration of lead is less than the EPA residential screening value and thus is not likely to cause illness.

Former Housing Area - The maximum theoretical excess cancer risk for lifetime incidental ingestion of the highest levels of arsenic and PAHs in the former housing area surface soil is low. The highest surface soil concentration of lead is not likely to cause a blood lead concentration above the CDC action level for children

This assessment did not consider exposures to soils deeper than six inches deep. In addition, this assessment did not consider exposures to ground water because buildings at this site used municipal water.

Recommendations

If future land use brings subsurface soil (> 6 inches deep) to the surface, the responsible party should evaluate the health risk.

Public Health Action Plan

Because past exposure to surface soil is not likely to cause illness, we do not recommend additional health investigations, cancer cluster analysis, or medical monitoring at this time.

Authors, Technical Advisors

Florida Department of Health Author
Randy Merchant
Bureau of Environmental Public Health Medicine
Division of Environmental Health
Florida Department of Health
850 245-4299

ATSDR Reviewer
Jennifer Freed
Technical Project Officer
Division of Health Assessment and Consultation

References

ATSDR 1995. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Polycyclic Aromatic Hydrocarbons (PAHs) (Update). August. US Department of Health and Human Services. Atlanta, GA.

ATSDR 1998. Agency for Toxic Substances and Disease Registry. Health Consultation, Wryals Pit (Gwen Cherry Park), Miami, Dade County, Florida. CERCLIS No. FLD9801015712. February 9, 1998. US Department of Health and Human Services. Atlanta, GA.

ATSDR 2005. Agency for Toxic Substances and Disease Registry. Public Health Assessment Guidance Manual (Update). U.S. Department of Health and Human Services, Atlanta, GA. January 2005.

ATSDR 2007a. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Arsenic (Update). August. US Department of Health and Human Services. Atlanta, GA.

ATSDR 2007b. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Lead (Update). August. US Department of Health and Human Services. Atlanta, GA.

BFA 2001. Barnes, Ferland, and Associates, Inc. Scott/Carver Homes, Phase II Site Assessment, Sectors I through V. August.

BFA 2002a. Barnes, Ferland, and Associates, Inc. Site Assessment Report Addendum, Scott/Carver Homes, Sectors I-V. January.

BFA 2002b. Barnes, Ferland, and Associates, Inc. Site Assessment Report Addendum, Scott/Carver Homes, Sectors I-V. March.

BFA 2002c. Barnes, Ferland, and Associates, Inc. Site Assessment Report Addendum, Scott/Carver Homes, Sectors I-V. July.

CEI 2008a. Cherokee Enterprises, Inc. Scott Homes Sector II, Historical Analytical Results, Figures, and Soil Lithology Logs, Miami, Florida. May.

CEI 2008b. Cherokee Enterprises, Inc. Supplemental Site Assessment Report. Miami-Dade Housing Authority, Scott Homes – Sector II, 7200 NW 22nd Avenue, Miami, Florida, DERM File No. 17571. October.

EPA 1997. US Environmental Protection Agency, Office of Research and Development. Exposure Factors Handbook. Volumes I, II, and III. EPA/600/P-95/002F (a, b, and c).

EPA 2007. US Environmental Protection Agency. Integrated Exposure Uptake Biokinetic Model (IEUBKwin32, Lead Model Version 1.0, Build 264). http://www.epa.gov/superfund/lead.

ERM 2000. Environmental Resources Management. Phase I Environmental Site Assessment, Scott Homes-Sector II, Hope VI Revitalization Program, Miami, Florida. April

Kamrin 1988. Toxicology – A Primer on Toxicology Principles and Applications. Lewis Publishers. Chelsea MI.

Mayorga 2009. Wilbur Mayorga, Miami-Dade County Department of Environmental Resource Management, personal communication, February.

Shaw 2005. Shaw Environmental, Inc. Soil Assessment Report for Scott Homes Sector II, Miami, Florida. September.

Shaw 2006a Shaw Environmental, Inc. Soil Assessment Report Addendum for Scott Homes Sector II, Miami, Florida. January.

Shaw 2006b. Shaw Environmental, Inc. Soil Assessment Report Addendum for Scott Homes Sector II, Miami, Florida. October.

Table 1: Surface Soil (0-6"deep) Contaminant Concentrations at the Jesca Olive B. Alexander Day Care Center Playground

Contaminant	Concentration Range (mg/kg)	Screening Guideline* (mg/kg)	# Above Screening Guideline/ Total #	Urban Soil Background (mg/kg)
Arsenic	0.63 – 4.55	0.5 (CREG)	11 / 11	3 (mean) 0.3 – 110 (range)
Lead	30 – 290	400 (EPA)	0 / 4	145 – 194 (median)
PAHs	0.058 – 0.53	0.1 (CREG)	6/ 9	0.2

Soil Data Source: Mayorga 2009
mg/kg = milligrams of contaminant per kilograms soil
PAHs = polycyclic aromatic hydrocarbons, expressed as benzo(a)pyrene toxicity equivalents
CREG = ATSDR Cancer Risk Evaluation Guide for 1 X 10^{-6} excess cancer risk
* Screening guidelines only used to select chemicals for further scrutiny, not to judge risk of illness.

Table 2: Surface Soil (0-6"deep) Contaminant Concentrations around Community/Health Care Center

Contaminant	Concentration Range (mg/kg)	Screening Guideline* (mg/kg)	# Above Screening Guideline/ Total #	Urban Soil Background (mg/kg)
Arsenic	< 0.2 – 6.2	0.5 (CREG)	6 / 8	3 (mean) 0.3 – 110 (range)
Lead	18 – 148	400 (EPA)	0 / 8	145 – 194 (median)
PAHs	0.29– 7.4	0.1 (CREG)	8 / 8	0.2

Soil Data Source: Mayorga 2009
mg/kg = milligrams of contaminant per kilograms soil
PAHs = polycyclic aromatic hydrocarbons, expressed as benzo(a)pyrene toxicity equivalents
CREG = ATSDR Cancer Risk Evaluation Guide for 1 X 10^{-6} excess cancer risk
* Screening guidelines only used to select chemicals for further scrutiny, not to judge risk of illness.

Table 3: Surface Soil (0-6"deep) Contaminant Concentrations in Former Dump Area (Northwest Corner)

Contaminant	Concentration Range (mg/kg)	Screening Guideline* (mg/kg)	# Above Screening Guideline/ Total #	Urban Soil Background (mg/kg)
Arsenic	0.5 – 5.3	0.5 (CREG)	3 / 3	3 (mean) 0.3 – 110 (range)
Lead	6.7 - 74	400 (EPA)	0 / 3	145 – 194 (median)
PAHs	0.36 - 0.92	0.1 (CREG)	3 / 3	0.2

Soil Data Source: Mayorga 2009
mg/kg = milligrams of contaminant per kilograms soil
PAHs = polycyclic aromatic hydrocarbons, expressed as benzo(a)pyrene toxicity equivalents
CREG = ATSDR Cancer Risk Evaluation Guide for 1 X 10^{-6} excess cancer risk
* Screening guidelines only used to select chemicals for further scrutiny, not to judge risk of illness.

Table 4: Surface Soil (0-6"deep) Contaminant Concentrations around Former Multi-Family Houses

Contaminant	Concentration Range (mg/kg)	Screening Guideline* (mg/kg)	# Above Screening Guideline/ Total #	Urban Soil Background (mg/kg)
Arsenic	< 0.05 – 7.9	0.5 (CREG)	18 / 20	3 (mean) 0.3 – 110 (range)
Lead	3.6 – 553	400 (EPA)	1 / 30	145 – 194 (median)
PAHs	0.003 – 1.7	0.1 (CREG)	22 / 26	0.2

Soil Data Source: Shaw 2006b, Mayorga 2009
mg/kg = milligrams of contaminant per kilograms soil
PAHs = polycyclic aromatic hydrocarbons, expressed as benzo(a)pyrene toxicity equivalents
CREG = ATSDR Cancer Risk Evaluation Guide for 1 X 10^{-6} excess cancer risk
BDL – below detection limits
* Screening guidelines only used to select chemicals for further scrutiny, not to judge risk of illness.

Table 5. Estimated Maximum Dose from Incidental Surface Soil Ingestion at the Jesca Olive B. Alexander Day Care Center Playground

Contaminant	Child Average Daily Dose (mg/kg/day)	Adult Average Daily Dose (mg/kg/day)	Adult Lifetime Average Daily Dose (mg/kg/day)	ATSDR Chronic Minimal Risk Level (mg/kg/day)
Arsenic	0.00004	0.000007	0.000004	0.0003
PAHs	0.000007	0.0000007	0.0000005	Not Available

mg/kg/day = milligrams of contaminant per kilograms body weight per day
PAHs = polycyclic aromatic hydrocarbons, expressed as benzo(a)pyrene toxicity equivalents

Table 6. Estimated Maximum Dose from Incidental Surface Soil Ingestion around Community/Health Care Center

Contaminant	Child Average Daily Dose (mg/kg/day)	Adult Average Daily Dose (mg/kg/day)	Adult Lifetime Average Daily Dose (mg/kg/day)	ATSDR Chronic Minimal Risk Level (mg/kg/day)
Arsenic	0.00008	0.000009	0.000009	0.0003
PAHs	0.00009	0.00001	0.000008	Not Available

mg/kg/day = milligrams of contaminant per kilograms body weight per day
PAHs = polycyclic aromatic hydrocarbons, expressed as benzo(a)pyrene toxicity equivalents

Table 7. Estimated Maximum Dose from Incidental Surface Soil Ingestion in Former Dump Area (Northwest Corner)

Contaminant	Child Average Daily Dose (mg/kg/day)	Adult Average Daily Dose (mg/kg/day)	Adult Lifetime Average Daily Dose (mg/kg/day)	ATSDR Chronic Minimal Risk Level (mg/kg/day)
Arsenic	0.00007	0.000008	0.000008	0.0003
PAHs	0.00001	0.000001	0.0000008	Not Available

mg/kg/day = milligrams of contaminant per kilograms body weight per day
PAHs = polycyclic aromatic hydrocarbons, expressed as benzo(a)pyrene toxicity equivalents

Table 8. Estimated Maximum Dose from Incidental Surface Soil Ingestion around Former Multi-Family Houses

Contaminant	Child Average Daily Dose (mg/kg/day)	Adult Average Daily Dose (mg/kg/day)	Adult Lifetime Average Daily Dose (mg/kg/day)	ATSDR Chronic Minimal Risk Level (mg/kg/day)
Arsenic	0.0001	0.0001	0.0001	0.0003
PAHs	0.00002	0.000002	0.0000017	Not

mg/kg/day = milligrams of contaminant per kilograms body weight per day
PAHs = polycyclic aromatic hydrocarbons, expressed as benzo(a)pyrene toxicity equivalents

Figure 1. Scott Homes Sector II Location Map

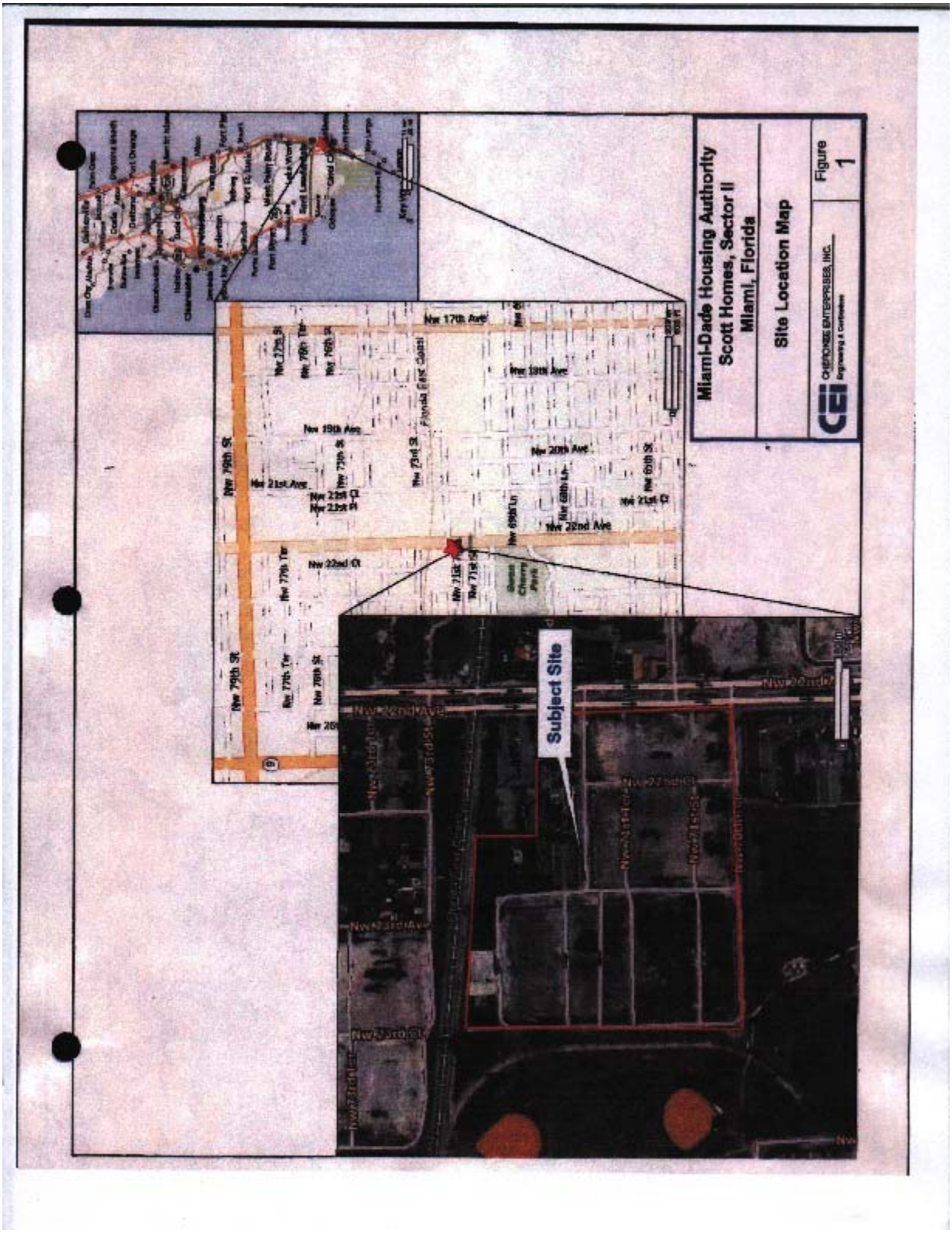

Figure 2. Scott Homes Sector II 1999

Figure 3. 2006 and 2009 Scott Homes Sector II Surface Soil Sample Locations (0-6 inches deep)

Glossary

The Agency for Toxic Substances and Disease Registry (ATSDR)

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal public health agency with headquarters in Atlanta, Georgia, and 10 regional offices in the United States. ATSDR's mission is to serve the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and diseases related to toxic substances.

Background level
An average or expected amount of a substance or radioactive material in a specific environment, or typical amounts of substances that occur naturally in an environment.

Cancer
Any one of a group of diseases that occur when cells in the body become abnormal and grow or multiply out of control.

Cancer risk
A theoretical risk for getting cancer if exposed to a substance every day for 70 years (a lifetime exposure). The true risk might be lower.

Carcinogen
A substance that causes cancer.

Chronic
Occurring over a long time [compare with acute].

Chronic exposure
Contact with a substance that occurs over a long time (more than 1 year) [compare with acute

Comparison value (CV)
Calculated concentration of a substance in air, water, food, or soil that is unlikely to cause harmful (adverse) health effects in exposed people. The CV is used as a screening level during the public health assessment process. Substances found in amounts greater than their CVs might be selected for further evaluation in the public health assessment process.

Completed exposure pathway [see exposure pathway].

Concentration
The amount of a substance present in a certain amount of soil, water, air, food, blood, hair, urine, breath, or any other media.

Contaminant
A substance that is either present in an environment where it does not belong or is present at levels that might cause harmful (adverse) health effects.

Detection limit
The lowest concentration of a chemical that can reliably be distinguished from a zero concentration.

Dose (for chemicals that are not radioactive)
The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An "exposure dose" is how much of a substance is encountered in the environment. An

"absorbed dose" is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.

Environmental media

Soil, water, air, biota (plants and animals), or any other parts of the environment that can contain contaminants.

Environmental media and transport mechanism

Environmental media include water, air, soil, and biota (plants and animals). Transport mechanisms move contaminants from the source to points where human exposure can occur. The environmental media and transport mechanism is the second part of an exposure pathway.

EPA

United States Environmental Protection Agency.

Exposure

Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term [acute exposure], of intermediate duration, or long-term [chronic exposure].

Exposure assessment

The process of finding out how people come into contact with a hazardous substance, how often and for how long they are in contact with the substance, and how much of the substance they are in contact with.

Exposure pathway

The route a substance takes from its source (where it began) to its end point (where it ends), and how people can come into contact with (or get exposed to) it. An exposure pathway has five parts: a source of contamination (such as an abandoned business); an environmental media and transport mechanism (such as movement through groundwater); a point of exposure (such as a private well); a route of exposure (eating, drinking, breathing, or touching), and a receptor population (people potentially or actually exposed). When all five parts are present, the exposure pathway is termed a completed exposure pathway.

Groundwater

Water beneath the earth's surface in the spaces between soil particles and between rock surfaces [compare with surface water].

Ingestion

The act of swallowing something through eating, drinking, or mouthing objects. A hazardous substance can enter the body this way [see route of exposure].

Intermediate duration exposure

Contact with a substance that occurs for more than 14 days and less than a year [compare with acute exposure and chronic exposure].

mg/kg

Milligram per kilogram.

Minimal risk level (MRL)

An ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects. MRLs are calculated for a route of exposure (inhalation or oral) over a specified time period (acute, intermediate, or chronic). MRLs should not be used as predictors of harmful (adverse) health effects [see reference dose].

No apparent public health hazard

A category used in ATSDR's public health assessments for sites where human exposure to

contaminated media might be occurring, might have occurred in the past, or might occur in the future, but where the exposure is not expected to cause any harmful health effects.

Point of exposure

The place where someone can come into contact with a substance present in the environment [see exposure pathway].

Population

A group or number of people living within a specified area or sharing similar characteristics (such as occupation or age).

ppm

Parts per million.

Public health hazard categories

Public health hazard categories are statements about whether people could be harmed by conditions present at the site in the past, present, or future. One or more hazard categories might be appropriate for each site. The five public health hazard categories are no public health hazard, no apparent public health hazard, indeterminate public health hazard, public health hazard, and urgent public health hazard.

Risk

The probability that something will cause injury or harm.

Route of exposure

The way people come into contact with a hazardous substance. Three routes of exposure are breathing [inhalation], eating or drinking [ingestion], or contact with the skin [dermal contact].

Sample

A portion or piece of a whole. A selected subset of a population or subset of whatever is being studied. For example, in a study of people the sample is a number of people chosen from a larger population [see population]. An environmental sample (for example, a small amount of soil or water) might be collected to measure contamination in the environment at a specific location.

Source of contamination

The place where a hazardous substance comes from, such as a landfill, waste pond, incinerator, storage tank, or drum. A source of contamination is the first part of an exposure pathway.

Substance

A chemical.

Toxicological profile

An ATSDR document that examines, summarizes, and interprets information about a hazardous substance to determine harmful levels of exposure and associated health effects. A toxicological profile also identifies significant gaps in knowledge on the substance and describes areas where further research is needed.

Certification

The Florida Department of Health, Bureau of Community Environmental Health prepared this Health Consultation under a cooperative agreement with the Agency for Toxic Substances and Disease Registry. FDOH followed approved methodologies and procedures existing at the time the health consultation was begun. The Cooperative Agreement Partner completed editorial review.

Jennifer Freed
Technical Project Officer
CAT, CAPEB, DHAC, ATSDR

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

Alan Yarbrough
Team Lead
CAT, CAPEB, DHAC, ATSDR