Letter Health Consultation

DANIA DISTRIBUTION CENTER SITE

DANIA BEACH, FLORIDA

Prepared by:
Florida Department of Health

OCTOBER 28, 2010

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.

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LETTER HEALTH CONSULTATION

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DANIA BEACH, FLORIDA

Prepared By:

Florida Department of Health
Bureau of Environmental Public Health Medicine
Under Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

Charlie Crist
Governor

Ana M. Viamonte Ros, M.D., M.P.H.
State Surgeon General

October 25, 2010

Norman Arrazola, P.E.
Broward County of Florida Department of Health Environmental Protection and Growth Management Division
1 North University Drive, Suite 203
Plantation, FL 33324

RE: Dania Distribution Center site

Dear Mr. Arrazola:

The Florida Department of Health (DOH) examined possible health risks associated with incidental ingestion (swallowing) and inhalation (breathing dust) of contaminated soil near the Dania Distribution Center (DDC) site in Dania Beach. Florida DOH evaluates the public health significance of Florida hazardous waste sites through a cooperative agreement with the US Agency for Toxic Substances and Disease Registry (ATSDR).

A former nearby resident expressed concern about health effects they thought might be related to historic dumping on the property and subsequent construction of DDC. In this health consultation, Florida DOH examined the health risk from incidental soil ingestion and inhalation of dust coming from this site in the past.

Background and Statement of Issues

The DDC site is at 71 SW 12th Avenue in Dania Beach, Florida (Figures 1 and 2). The site was reportedly used as an illegal dump from 1990 to 1995. It is reported the area was filled with construction and demolition debris. During this period it is reported that medical waste, fuel tanks, gasoline and other petroleum products and chemicals were dumped on the property (personal communication, Debra Wallace, November 2009).

Florida DOH reviewed the available environmental data from 2001-2005 and identified incidental soil ingestion and inhalation of soil dust as possible past exposure pathways (Table 1), [UA 2001; SEEC 2001a; SEEC 2001b; EES 2001; SEEC 2002; BC 2004; TCG 2004; TCG 2005].

In 2005, Tierra Consulting Group, Inc. found low levels of polycyclic aromatic hydrocarbons, arsenic, and organics in soil under the DDC site [TCG 2005].

Florida DOH determined incidental soil ingestion and soil dust inhalation as potential, past exposure pathways from 1990-2004. In 2004, construction of DDC was completed

and the property was capped by an asphalt parking lot. Since the property was capped, soil ingestion and dust inhalation has not been a health threat and is not expected to be in the future as long as the asphalt parking lot is maintained.

Discussion

Incidental ingestion and inhalation are two possible past exposure pathways from contaminated soil or dust. In order to determine the risk of illness from contaminated soil, Florida DOH used exposure models and risk factors developed by ATSDR and the United States Environmental Protection Agency (US EPA).

Models consider the potential intake of contaminants from incidental soil ingestion and dust inhalation. If the concentration of a contaminant meets or exceeds a health related Comparison Value (CV), then it is considered for further analysis. This process is called screening. If a contaminant chemical does *not* meet or exceed its appropriate CV, it is 'screened out' and is not subjected to further analysis because it does not pose a health risk at that concentration. If a chemical 'screens in', Florida DOH then considers the risk associated with 1) non-cancer illness and 2) cancer. Some chemicals have no relevant CVs because of a lack of health data. Contamination found in the soil at DDC was screened and no contaminants of concern exceeded non-cancer CVs.

For cancer causing chemicals, we evaluate the theoretical cancer risk regardless of the contaminant concentration. This is the case for two chemicals found in soil samples at DDC, arsenic and benzo(a)pyrene (BaP). BaP belongs to a larger family of chemicals called Polycyclic Aromatic Hydrocarbons (PAHs).

Arsenic

Arsenic is a naturally occurring element that is widely distributed in the Earth's crust. Arsenic is classified chemically as a metalloid, having both properties of a metal and a nonmetal; however, it is frequently referred to as a metal. Elemental arsenic (sometimes referred to as metallic arsenic) is a steel grey solid material. However, arsenic is usually found in the environment combined with other elements such as oxygen, chlorine, and sulfur [ATSDR 2007].

Increased risk of lung cancer, respiratory irritation, nausea, skin effects, and neurological effects have been reported following inhalation exposure. The available data from humans identify the skin as the most sensitive non-cancer target following long-term oral arsenic exposure. Other reported cardiovascular effects of oral exposure to arsenic include increased incidences of high blood pressure and circulatory problems [ATSDR 2007].

Polycyclic Aromatic Hydrocarbons (PAHs) and Benzo[a]pyrene (BaP)

PAHs are a group of chemicals that are formed during the incomplete burning of coal, oil, gas, wood, garbage, or other organic substances, such as tobacco and charbroiled meat. There are more than 100 different PAHs. PAHs generally occur as complex mixtures (for example, as part of combustion products such as soot), not as single compounds. PAHs usually occur naturally, but they can be manufactured as individual compounds for research purposes. They are found throughout the environment in the air, water, and soil. They can occur in the air, either attached to dust particles or as solids in soil or sediment [ATSDR 1995]. As pure chemicals, PAHs generally exist as colorless, white, or pale yellow-green solids. They can have a faint, pleasant odor. A few PAHs are used in medicines and to make dyes, plastics, and pesticides. Others are contained in asphalt used in road construction. They can also be found in substances such as crude oil, coal, coal tar pitch, creosote, and roofing tar.

PAHs can be harmful to your health under some circumstances. Several of the PAHs, including BaP, have caused tumors in laboratory animals when they breathed these substances in the air, when they ate them, or when they had long periods of skin contact with them. Studies of people show that individuals exposed by breathing or skin contact for long periods to mixtures that contain PAHs and other compounds can also develop cancer [ATSDR 1995].

When performing calculations involving PAHs and BaP, a mathematical Toxic Equivalency Factor (TEF) is used to sum the relative toxicities of various PAHs. BaP is given a nominal value of 1.0 TEF and the other PAHs are given comparable toxicity values (Tables 2 and 3). Table 2 is specific to oral ingestion. Table 3 is specific to inhalation. Finally, the products of each PAH concentration with its TEF (concentration x TEF) are added together to give a total PAH value which is then used for risk analysis comparisons involving 1) non-cancer illness and also 2) cancer related illness [ATSDR 1995].

Health Risk Analysis

Florida DOH's analysis showed that all chemicals analyzed did not exceed relevant comparison values for non-cancer illness. Therefore, there is no apparent non-cancer risk associated with incidentally ingesting or inhaling DDC related soils.

At the maximum soil arsenic level (3.1 mg/kg), there is an extremely low theoretical increased cancer risk for either ingestion or dust inhalation (Tables 2 and 3). The additional theoretical cancer risk for arsenic ingestion is approximately 4 in 10 million (4 in 10,000,000). The increased risk for arsenic dust inhalation is 2 in 10 million (2 in 10,000,000). These risks are a factor of ten lower than what is considered an 'extremely low' risk.

At the maximum level of BaP and related PAHs detected (2.2 mg/kg), there is almost no theoretical increased risk of cancer illness for ingestion (Table 2). The additional cancer risk for PAH ingestion is only about 1 in 1 million (1 in 1,000,000). This is considered an 'extremely low' increased risk of cancer. The increased risk for PAH inhalation could not be determined because inhalation data related to cancer is unavailable.

Conclusions

In the past, incidental ingestion of soil or breathing dust from the Dania Distribution Center site is not likely to have harmed people's health.

- Past incidental ingestion of soils on the Dania Distribution Center site is unlikely to have caused cancer or other illnesses.
- Breathing soil dust from the Dania Distribution Center in the past is unlikely to have caused cancer or other illnesses.

Recommendations

- No recommendations.

Public Health Action Plan

If requested, Florida DOH will consider evaluation of other environmental data.

Please call me (850-245-4444, ext 2316) if you have any questions about this health consultation.

Sincerely,

Joseph Mark Higginbotham
Health Assessor
Florida Department of Health
Bureau of Environmental Public Health Medicine

Cc: Concerned citizen
Noel Johnson, Clyne & Associates

References

[ATSDR 1995] Agency for Toxic Substances and Disease Registry. 1995. Toxicological profile for polycyclic aromatic hydrocarbons. Atlanta: U.S. Department of Health and Human Services.

[ATSDR 2007] Agency for Toxic Substances and Disease Registry. 2007. Toxicological profile for arsenic. Atlanta: U.S. Department of Health and Human Services.

[BC 2004] Broward County DPEP. Environmental assessment & remediation report. August 12, 2004.

[EES 2001] Engineered Environmental Solutions, Inc. Soil sample results. November 26, 2001.

[RA 1995] Risk Assistant for Windows 1.1, Hampshire Research Institute, Washington DC, Thistle Publishing Group.

[SEEC 2002] Southeastern Environmental Consultants, Inc. Environmental audit report. April 23, 2002.

[SEEC 2001a] Southeastern Environmental Consultants, Inc. Proposed fill material study & correspondence. October 10, 2001.

[SEEC 2001b] Southeastern Environmental Consultants, Inc. Analysis of fill material. October 10, 2001.

[TCG 2005] Tierra Consulting Group, Inc. Addendum. March 3, 2005.

[TCG 2004] Tierra Consulting Group, Inc. Confirmatory soil & groundwater evaluation. November 15, 2004.

[UA 2001] Unknown Author, possibly CRB Geologic and Environmental Services, Inc. Environmental Report. February 9, 2001.

Figure 1. Dania Distribution Center Site

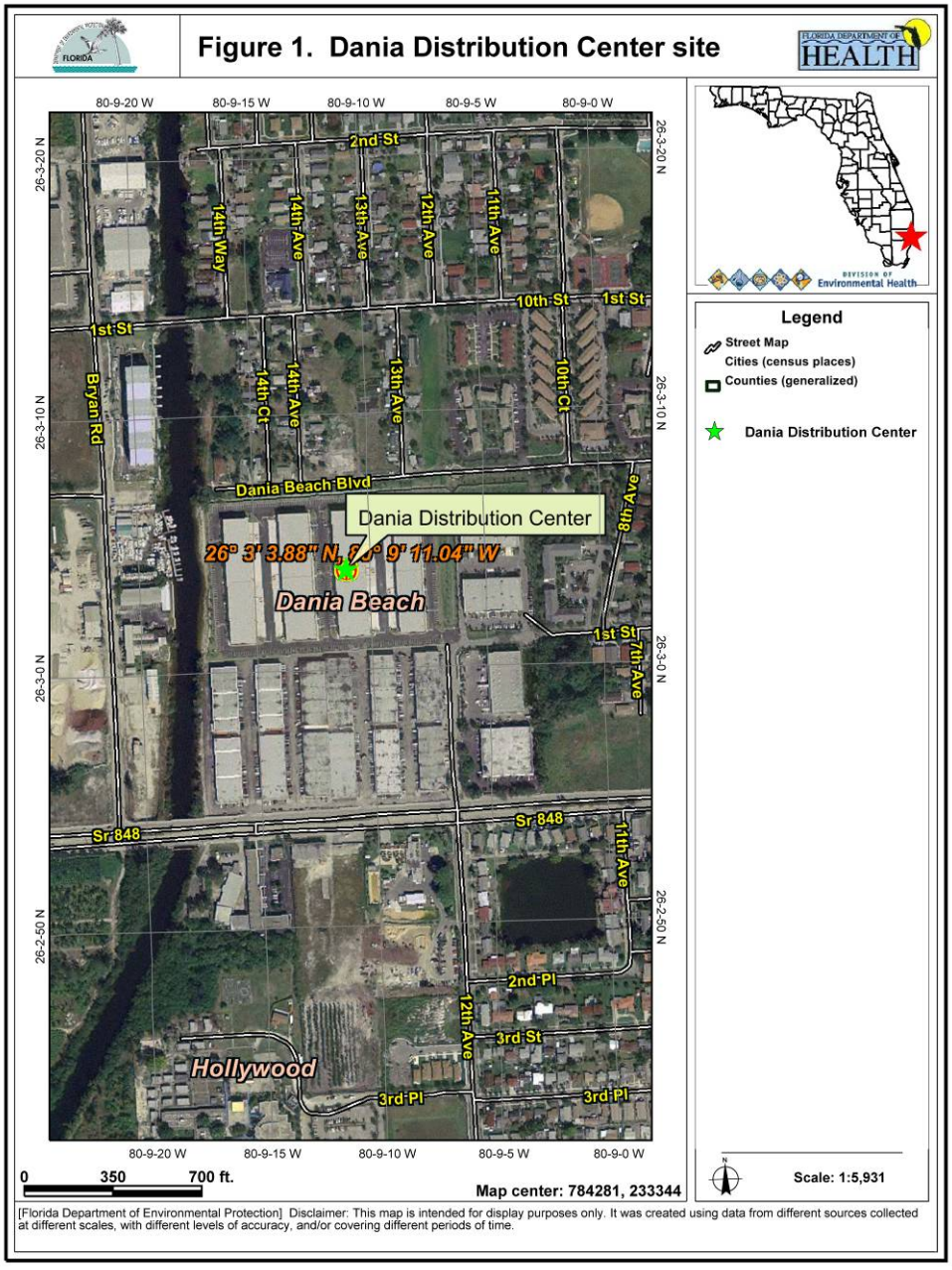

Figure 2. Dania Distribution Center Property Boundaries

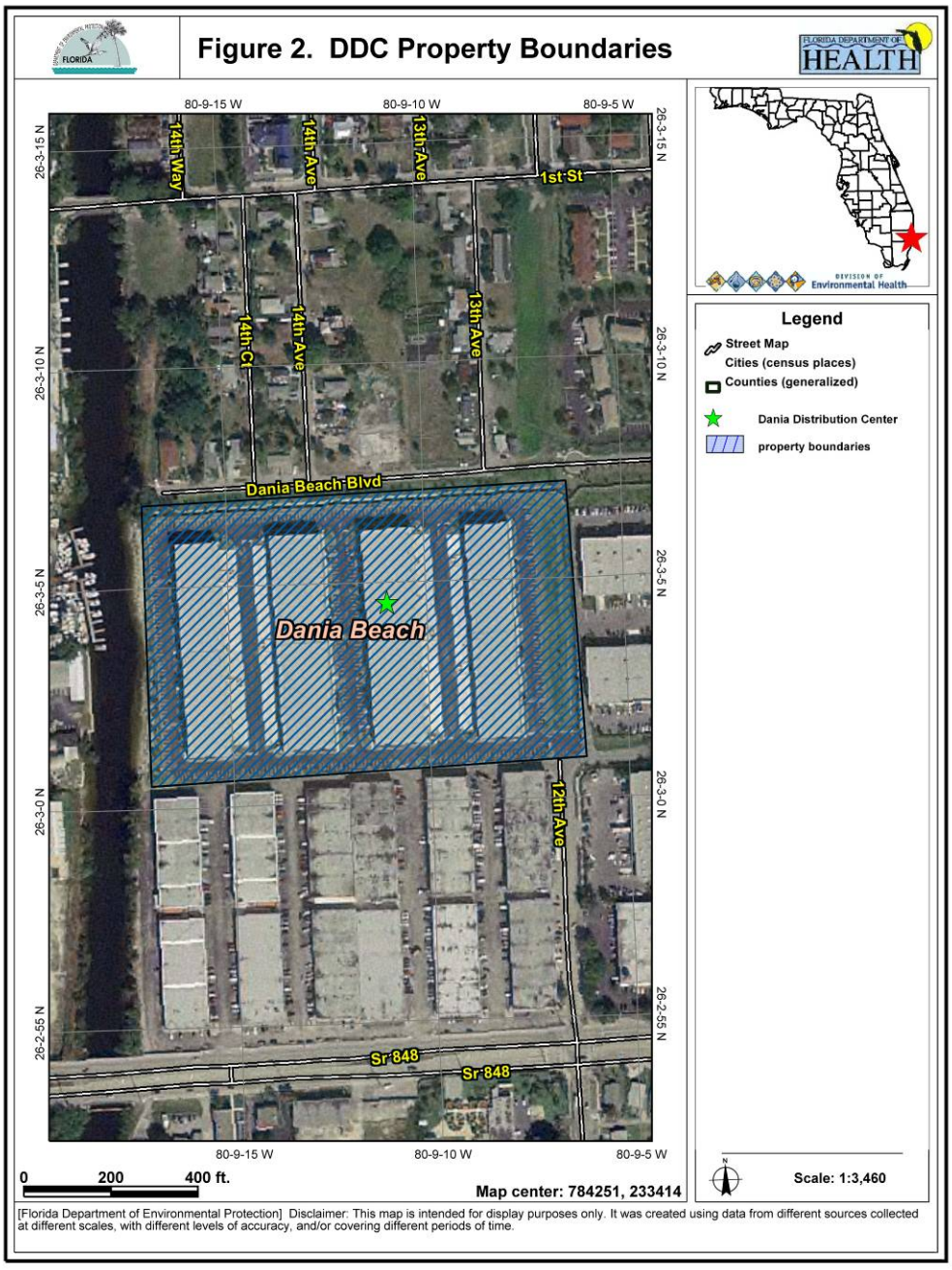

Table 1. Potential Exposure Pathways

	Exposure Pathway Elements					
Pathway Name	**Source**	**Environmental Medium**	**Point of Exposure**	**Potentially Exposed Population**	**Route of Exposure**	**Time Frame**
Incidental Soil Ingestion (Swallowing)	Contaminated On-Site Soil	Soil	On-site	Nearby Residents	Ingestion	Past (1990-2004)
Dust Inhalation	Contaminated On-Site Soil	Dust	Off-site	Nearby Residents	Inhalation	Past (1990-2004)

Table 2. Soil Concentrations, Comparison Values, and Ingestion Risk

		Hierarchy Level 1						
Contaminant of concern	Maximum Contaminant Concentration * [mg/kg = ppm]	Chronic EMEG^ for Children [ppm] for non-cancer calculations	Chronic EMEG^ for Adults [ppm] for non-cancer calculations	CREG$^{\perp}$ [ppm] for cancer calculations	# of samples above screening comparison value / total soil samples	Ingestion Exposure Dose (non-cancer) [mg/kg/d]	Ingestion Cancer Slope Factor^{ə} [$(mg/kg/d)^{-1}$]	Ingestion Cancer Risk$^{\varepsilon}$ (unitless)
Arsenic	3.1	**20**	**200**	**0.5**	1/21	0.00000124	1.5	4×10^{-7}
BaP-TEQ sum	2.2	Not Available	Not Available	**0.1**	1/21	0.00000088	7.3§	1×10^{-6}

* maximum contaminant concentration found when comparing all soils, 0-1' depth, from 11/15/04 Tierra Consulting Group Report

^ Comparison value used for screening is Chronic Environmental Media Evaluation Guide (EMEG)

$^{\perp}$ Comparison value used for screening is Cancer Risk Evaluation Guide (CREG)

ə from EPA Integrated Risk Information System (IRIS)

$^{\varepsilon}$ Ingestion Cancer Risk = (maximum non-cancer ingestion dose x ingestion cancer slope factor) x (14 years estimated exposure / 70 years)

mg = milligrams

kg = kilograms

ppm= parts per million

d = day

§ BaP oral cancer slope factor used for BaP-TEQ Sum ingestion cancer risk calculation

Table 3. Estimated Dust Concentrations, Comparison Values, and Inhalation Risk

			Hierarchy Level 1			
Contaminant of concern	Maximum Soil Contaminant Concentration* [mg/kg = ppm]	Maximum Soil Dust Contaminant Concentration# [ug/m^3]	Chronic EMEG/MRL[þ] [ug/m^3] for non-cancer screening	CREG[⊥] [ug/m^3] for cancer screening	EPA's Inhalation Unit Risk[ə] [(ug/m^3)$^{-1}$] for cancer calculations	Inhalation Cancer Risk[ε] [unitless]
Arsenic	3.1	0.00027	Not Available	**0.0002**	0.0043	2 X 10^{-7}
BaP-TEQ Sum	2.2	2 X 10^{-4}	Not Available	Not Available	Not Available	

* maximum soil contaminant concentration found when comparing all soils, 0-1' depth, from 11/15/04 Tierra Consulting Group Report

Maximum soil dust contaminant concentration from EPA's Risk Assistant, sum of Indoor and Outdoor Dust

þ Comparison value used for screening is Chronic Environmental Media Evaluation Guide / ATSDR Minimal Risk Level (EMEG / MRL)

⊥ Comparison value used for screening is Cancer Risk Evaluation Guide (CREG)

ə from EPA Integrated Risk Information System (IRIS)

ε Inhalation cancer risk = [maximum soil dust contaminant concentration (ug/m^3) x EPA's inhalation unit risk (ug/m^3)$^{-1}$] x 14 years estimated exposure / 70 years

mg = milligrams

kg = kilograms

ppm = parts per million

ug = micrograms

m^3 = cubic meters

Calculations and examples

I. Exposure dose (also called the maximum daily dose)

Oral ingestion route (incidental soil ingestion)

Non-cancer

It is important to restate that no contaminants were found to exceed non-cancer comparison values. Thus, the non-cancer exposure dose is only solved in this instance as a necessary step in completing the later cancer calculation (adult). The cancer calculation and example follows the non-cancer calculations and examples.

Assumptions:

- Contaminant concentration is the maximum amount measured and does not change from day to day.
- Ingestion rate is 100 mg of soil per day.
- EF = Exposure Factor (unitless), exposure is assumed to be 2 d/wk every week of the year.
- 10^{-6} kg/mg is a necessary conversion factor for soil.
- The adult body weight is 70 kg.

Abbreviations

mg = milligram
kg = kilogram
d = day
wk = week
yr = year

D = exposure dose (mg/kg/d)
C = contaminant concentration (mg/kg)
IR = intake rate of contaminated soil (mg/d)
EF = exposure factor (unitless)
BW = body weight (kg)

We first need to solve for the specified EF:

EF = (2 d/wk) x (52 wk/yr) x (365 d/yr) = 0.28 (unitless)

Then solve for exposure dose, D:

Exposure dose = (maximum contaminant concentration x ingestion rate x exposure factor)/body weight

$D = (C \times IR \times EF \times 10^{-6}\ kg/mg) / BW$

Example:

Arsenic measured at a maximum concentration of 3.1 mg/kg

Adult:

$D = (3.1\ mg/kg \times 100\ mg/d \times 0.28 \times 10^{-6}\ kg/mg) / 70\ kg = 1.2 \times 10^{-6}\ mg/kg/d$

II. Exposure dose (also called the maximum daily dose)

Inhalation route (from soil dust)

The soil dust inhalation calculation is computed using the EPA software program Risk Assistant for Windows [RA 1995]. The program calculates both an indoor dust concentration using indoor parameters and an outdoor dust calculation using outdoor parameters. The two calculated concentrations are then summed to give a total dust inhalation concentration.

Non-cancer

Assumptions (indoor dust):

- Respirable fraction of dust is 73.00%
- Proportion of contaminated dust is 80%
- Dust concentration is 56 ug/m^3

Assumptions (outdoor dust):

- Respirable fraction of dust is 73.0%
- Proportion of contaminated dust is 100%
- Dust concentration is 75 ug/m^3

Abbreviations

C(i) = inhaled concentration of contaminant
C(s) = concentration in soil (also the contaminant concentration)
R = Respirable fraction of dust
f = proportion of contaminated dust
D = dust concentration
10^{-6} kg/mg is a necessary conversion factor for soil

m^3 = cubic meters
ug = microgram
mg = milligram
kg = kilogram

$C(i) = D \times R \times f \times C(s) \times 10^{-6}$ kg/mg

Example:

Arsenic measured at a maximum concentration of 3.1 mg/kg

Indoor concentration calculation:

$$C(i) = (56 \text{ ug/m}^3 \times 0.73 \times 0.8 \times 3.1 \text{ mg/kg} \times 10^{-6} \text{ kg/mg}) = 1.0 \times 10^{-4} \text{ ug/m}^3$$

Outdoor concentration calculation:

$$C(i) = (75 \text{ ug/m}^3 \times 0.73 \times 1.0 \times 3.1 \text{ mg/kg} \times 10^{-6} \text{ kg/mg}) = 1.7 \times 10^{-4} \text{ ug/m}^3$$

Summing the calculated indoor concentration and outdoor concentration gives:

Total dust inhalation concentration = 1.0×10^{-4} ug/m^3 + 1.7×10^{-4} ug/m^3 = 2.7×10^{-4} ug/m^3

III. Cancer

Oral ingestion of soil

Assumptions:

- An average lifetime is 70 years
- Estimated exposure period is 14 years (1990-2004)

Working from the calculated non-cancer concentration and with the cancer slope factor (from EPA):

(calculated non-cancer dose (mg/kg/d) x ingestion cancer slope factor (mg/kg/d)$^{-1}$) x (estimated years exposed / 70 years) = cancer risk (unitless)

Example:

Arsenic oral ingestion cancer slope factor of 1.5 (mg/kg/d)$^{-1}$

(1.2×10^{-6} mg/kg/d x 1.5 (mg/kg/d)$^{-1}$) x (14 (yr) / 70 (yr)) = 0.000000372 or approximately 4×10^{-7}

This would be interpreted as an increased risk of 4 people in every 10,000,000 (4 in 10 million). This is considered a negligible (almost no) increased risk of cancer.

Soil dust inhalation

Assumptions:

- An average lifetime is 70 years
- Estimated exposure period is 14 years (1990-2004)

Working from the calculated non-cancer concentration and with the inhalation unit risk (from EPA):

(calculated non-cancer total dust concentration x inhalation unit risk) x (estimated years exposed / 70 years) = cancer risk (unitless)

Example:

Arsenic inhalation unit risk of 0.0043 (ug/m^3) $^{-1}$

(0.00027 (ug/m^3) x 0.0043 (ug/m^3) $^{-1}$) x (14 (yr) / 70 (yr)) = 0.00000023 = 2.3×10^{-7}

This would be interpreted as an increased risk of 2 people in every 10,000,000 (2 in 10 million). This is a factor of ten lower than what is considered an 'extremely low' increased risk of cancer.

IV. Benzo[a]pyrene TEFs, calculations, and example

Non-cancer

As was the case above, it is important to restate that no contaminants were found to exceed non-cancer comparison values. Thus, the non-cancer exposure dose is only solved in this instance as a necessary step in completing the later cancer calculation (adult). The cancer calculation and example follows the non-cancer calculations and examples.

Here we have to start with a listing of the ATSDR group of polycyclic aromatic hydrocarbons (PAHs) that are given Toxic Equivalency Factors (TEFs) and their values [ATSDR 1995].

The table below shows ATSDR grouped PAHs. The highlighted column gives the product of the maximum contaminant concentration x the TEF for each TEF. At the bottom of this column is the sum of these products.

Table 4. PAH TEF calculations

Contaminant of concern	Maximum Contaminant Concentration (mg/kg = ppm)	PAH Toxicity Equivalency Factor (TEF) (unitless)	PAH Concentration Relative to B(a)P (ppm)	Ingestion Exposure Dose (non-cancer) Adults (mg/kg/d)	Ingestion Cancer Slope Factor $(mg/kg/d)^{-1}$	Ingestion Cancer Risk (unitless)
Dibenz[a,h]anthracene	0.16	5	0.8			
Benzo[a]pyrene	0.98	1	0.98			
Benz[a]anthracene	1.3	0.1	0.13			
Benzo[b]fluoranthene	1.9	0.1	0.19			
Benzo[k]fluoranthene	0.51	0.1	0.051			
Indeno[1,2,3-c,d]pyrene	0.51	0.1	0.051			
Anthracene	0.53	0.01	0.0053			
Benzo[g,h,i]perylene	0.53	0.01	0.0053			
Chrysene	1.3	0.01	0.013			
Acenaphthene	0.33	0.001	0.00033			
Fluoranthene	3.9	0.001	0.0039			
Fluorene	0.29	0.001	0.00029			
Phenanthrene	2	0.001	0.002			
Pyrene	3	0.001	0.003			
		Sum of PAH Concentrations Relative to B(a)P [ppm]	2.23512	9×10^{-7}	7.3	1×10^{-6}

It is the sum of the TEF products that is the important value to use for the non-cancer exposure dose PAH calculation. Now the calculations follow the same format as the Arsenic non-cancer ingestion example above.

Assumptions:

- Contaminant concentration is the sum of the PAH TEF products and does not change from day to day. This is the maximum PAH concentration.
- Ingestion rate is 100 milligrams of soil per day.
- EF = Exposure Factor (unitless), exposure is assumed to be 2 d/wk every week of the year.
- 10^{-6} kg/mg is a necessary conversion factor for soil
- The adult body weight is 70 kilograms.

Abbreviations

mg = milligram
kg = kilogram
d = day
wk = week
yr = year
ppm = parts per million

D = exposure dose (mg/kg/d)
C = contaminant concentration (mg/kg)
IR = intake rate of contaminated soil (mg/d)
EF = exposure factor (unitless)
BW = body weight (kg)

We first need to solve for the specified EF:

EF = (2 d/wk) x (52 wk/yr) x (365 d/yr) = 0.28 (unitless)

Then solve for exposure dose, D:

Exposure dose = (maximum PAH concentration x ingestion rate x exposure factor)/body weight

$D = (C \times IR \times EF \times 10^{-6}\ kg/mg) / BW$

Example:

PAH sum measured at a maximum concentration of 2.23512 mg/kg (or ppm)

Adult:

$D = (2.24\ mg/kg \times 100\ mg/d \times 0.28 \times 10^{-6}\ kg/mg) / 70\ kg = 8.94 \times 10^{-7}\ mg/kg/d$

From this oral ingestion non-cancer exposure dose we can now calculate the oral ingestion cancer risk.

Cancer

Oral ingestion of soil

Assumptions:

- An average lifetime is 70 years
- Estimated exposure period is 14 years (1990-2004)

Working from the calculated non-cancer concentration and with the cancer slope factor (from EPA):

(calculated non-cancer dose (mg/kg/d) x ingestion cancer slope factor $(mg/kg/d)^{-1}$) x (estimated years exposed / 70 years) = cancer risk (unitless)

Example:

The oral ingestion cancer slope factor for Benzo[a]pyrene (BaP) is used with the total PAH calculations.

BaP oral ingestion cancer slope factor of 7.3 $(mg/kg/d)^{-1}$

(8.94×10^{-7} mg/kg/d x 7.3 $(mg/kg/d)^{-1}$) x (14 (yr) / 70 (yr)) = 0.0000013053 or approximately 1×10^{-6}

This would be interpreted as an increased risk of 1 person in every 1,000,000 people (1 in 1 million). This is considered an 'extremely low' increased risk of cancer.

Certification

The Florida Department of Health, Bureau of Environmental Public Health Medicine prepared this health consultation report under a cooperative agreement with the US Agency for Toxic Substances and Disease Registry (ATSDR). Florida DOH followed approved methodologies and procedures existing at the time it began its assessment. Florida DOH completed an editorial review of this document.

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

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

Alan Yarbrough
Team Lead
CAT, CAPEB, DHAC, ATSDR