Letter Health Consultation

Lead and Arsenic in Soil Samples from Taft Elementary Playground Boise, Idaho

October 26, 2012

Prepared by

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Division of Public Health
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July 23, 2013

Mr. Ed Niehay
Boise School District
400 W Fort St
Boise, ID 83702

Dear Mr. Niehay:

At your request, the Bureau of Community and Environmental Health (BCEH) assessed possible health risks associated with incidental ingestion of soil at a playground at William Howard Taft Elementary in Boise, Idaho. The BCEH evaluates the public health risk of contaminated sites through a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). The Idaho Department of Health and Welfare's (IDHW) BCEH's priority is to ensure that Idahoans have the best information possible to protect their health. Details of this information are included in the following paragraphs.

Background and Statement of Issues

Taft Elementary, located near West State Street and 36th Street in Boise, was recently awarded a grant from KaBOOM!, a national non-profit dedicated to construct innovative kid-inspired play spaces. Because of the wide distribution of heavy metals in soils, it is required that KaBOOM!'s grantees test soils for at least two contaminants, lead and arsenic, before installation of the playground equipment. On September 10, 2012, the Boise School District requested BCEH technical support for sampling and interpreting soil sampling results from Taft Elementary.

This health consultation letter estimates the possible health effects associated with the lead and arsenic concentrations found in the September 28, 2012 soil sampling at one of the playgrounds at Taft Elementary. For the purpose of this assessment, BCEH only considered the two heavy metals tested and soil sampling testing from one of the two playground areas. The exposure considered in this health consultation includes incidental ingestion (swallowing) of very small amounts of surface soil to children using the playground for recreational purposes.

Environmental Sampling

On September 28, 2012, BCEH staff collected four soil samples from the Taft Elementary playground. Random samples, 0-4 inches in depth, were taken from the four different locations within the playground area (approximately 2,500 square feet) to get a good representation of the entire area.

Standard operating procedures for soil toxicity testing and chain of custody procedures from the IDHW Bureau of Laboratories were followed.

Soil Sampling Results

On October 3, 2012 the IDHW Bureau of Laboratories completed the analysis for lead and arsenic concentrations in soil samples. Results of the soil sampling are in Table 1. All lead soil samples were well below the EPA's screening level for lead in residential soil value of 400 mg/kg. Arsenic levels were found at less than 25 mg/kg in all the soil samples tested. The laboratory analytical method used on the samples could only measure arsenic levels at or above 25 mg/kg. Thus, for comparison purposes we used 25 mg/kg as the highest arsenic soil concentration. This value was slightly above the Agency for Toxic Substances and Disease Registry (ATSDR) Environmental Media Evaluation Guide (EMEG) value of 15 mg/kg, based on chronic (long-term) exposure to arsenic in soil for a child.

Table 1. 2012 Sampling Results of Lead and Arsenic in soil from Taft Elementary Playground

Contaminants	Sample 1	Sample 2	Sample 3	Sample 4	Comparison Value mg/kg
Lead (mg/kg)	15	18	14	14	400[a]
Arsenic (mg/kg)	< 25	< 25	< 25	< 25	15[b] 5[c]

a = EPA's screening level for lead in residential soil
b = ATSDR child's chronic Environmental Media Evaluation Guide (EMEG)
c = ATSDR Cancer Risk Evaluation Guides CREG

Exceeding a comparison value does not mean that a contaminant represents a public health threat; rather, it suggests that the contaminant warrants further consideration. When a contaminant exceeds a comparison value, BCEH calculates an exposure dose – the quantity of a substance a person likely to eat, drink, inhale, or absorb through the skin given the concentration found and the length and duration of an exposure. The estimated exposure dose is then compared to ATSDR's minimal risk level (MRL). MRLs are estimates of daily exposures to contaminants that are unlikely to cause adverse non-cancer health effects even if exposure occurs for a lifetime.

Health Risk Assessment

Since the level of arsenic in the playground soil was estimated to be above the screening level, BCEH calculated an exposure dose for a child. BCEH used the ATSDR's standard values of daily soil intake of 200 mg/day and body weight of 16 kg (35 pounds) [1]. The exposure time scenario for a child was calculated based on the number of days spent at the playground in one year. We assumed that the children participated in recess activities on the playground five days a week for 7 months per year (See Appendix A for details). Using these assumptions, the estimated dose was calculated to be 0.0001 mg/kg/day, which is 3 times lower than the ATSDR chronic minimal risk level (MRL) of 0.0003 mg/kg/day [2] and 50 times lower than the ATSDR's acute oral MRL of 0.005 mg/kg/day [2]. Thus, BCEH does not expect exposure to arsenic in the soil to result in adverse non-cancerous health effects in children.

Arsenic has been classified by EPA as a "human carcinogen" (cancer-causing agent), Group A [2]. This classification is used only when there is sufficient evidence from epidemiologic studies to support a causal association between exposure to the agents and cancer. Cancer risk estimates are generally

expressed in a value over a 70 year lifetime. For this assessment an age adjusted cancer risk was calculated. The concentration of arsenic in surface soil (25 mg/L) exceeded the ATSDR Cancer Risk Evaluation Guide (CREG) value of 0.5 mg/kg. It is also greater than the arsenic background range of 5 to 10 mg/kg for soils in the Boise valley area (Jeff Fromm, Idaho Department of Environmental Quality, personal communication). Children incidentally ingesting (swallowing) very small amounts of surface soil with the highest arsenic level from the playground area indicate "no apparent" increased risk of cancer. The cancer risks resulting from exposure to arsenic in soil using the arsenic concentration results in 1 additional excess cancer in a population of 100,000 children (Appendix B). This is considered by BCEH to be a "very low" increased risk for cancer. Thus, BCEH does not expect exposure to soil contaminated with arsenic at Taft Elementary playground to result in increases in the risk of developing cancer above what is normally seen in U.S. populations.

Conclusions

Based upon our analysis of the September 28, 2012 sampling data, BCEH does not expect to see any harmful health effects in children associated with exposure to lead or arsenic in soil at the Taft elementary school playground. Additionally, it is our understanding that new wood composite materials will be placed over the surface soils. This new layer will prevent or reduce direct soil contact and further minimize any exposure. Thus, because of the low levels of lead and arsenic found in soils and the minimal exposure potentials, BCEH concludes that the lead and arsenic in the surface soil at the playground where the new equipment will be installed in Taft Elementary is not expected to harm people's health, including children.

Recommendations

- To minimize exposures, adequate maintenance on the new playground equipment (i.e., wood composite cover) should be implemented to avoid direct contact with surface soils.

- Although BCEH does not foresee any direct exposure to soils from the playground, it would be advisable to reinforce good hygiene practices such as washing hands after using the playground and before meals to avoid exposure to soil contaminants.

If you have any questions, please do not hesitate to contact me at 208-334-5862 or at padenn@dhw.idaho.gov

Best regards,

Norka E. Paden, PhD.
Toxicologist/Public Health Assessor
Environmental Health Education and Assessment Program

Cc: Jim Vannoy
Kara Stevens

References

1. Agency for Toxic Substances and Disease Registry (ATSDR). 2005. Public Health Assessment Guidance Manual.

2. Agency for Toxic Substances and Disease Registry (ATSDR). 2007. Arsenic Toxicological Profile. Available on line at: http://www.atsdr.cdc.gov/toxprofiles/tp.asp?id=22&tid=3

3. Environmental Protection Agency (EPA) Integrated Risk Information System and Chemical-Specific Factors Data Base. Arsenic. Available on line at: http://www.epa.gov/iris/subst/0278.htm

Appendix A: Calculation Formulas

Dose Calculation Formula
Non-cancer

$$D = \frac{C \ x \ IR \ x \ BF \ x \ CF \ x \ EF}{BW}$$

Where:
D = Dose in milligram per kilogram of body weight per day (mg/kg-day)
C = Contaminant concentration in milligrams per kilogram (mg/kg)
IR[1] = Ingestion rate in mg/kg
BF = Bioavailability Factor (default used 1)
CF = Conversion Factor $1x10^{-6}$
EF[2] = Exposure Factor in days per year exposed/365
BW = Body Weight (16 kg for children)

Sources:
[1] = ATSDR default values (200 mg/day children average) [1]
[2] = Exposure factor: ([5days/week x 28 weeks/year] x 6 years/ 6 years x 365 days/year)
28 weeks per year (number of weeks during the school year spend at playground, 2 months of winter were considered to be spent indoors).
Exposure Factor = 0.38 [1]

Additional Cancer Risk Formula

$$Cancer\ Risk = [Dose\ x\ Cancer\ Slope\ Factor\ x\ Exposure\ Years/70]$$

Dose = mg/kg-day
Cancer Slope Factor = EPA cancer slope factors from IRIS [3]
Exposure years = 6, maximum number of years spent in school

Appendix B: Dose and Additional Cancer Risk Calculations

Dose Calculation for Arsenic in soil (25 mg/kg)

Children

$$\text{Dose (mg/kg per day)} = \frac{\text{C (mg/kg soil) x IR (kg soil ingested per day) x CF } (10^{-6}) \text{ x EF}}{\text{BW (kg)}}$$

$$= \frac{25 \times 200 \times 10^{-6} \times 0.38}{16}$$

$= 1.19 \times 10^{-4}$ or 0.0001 mg/kg body weight per day (Exposure Dose)

Additional Cancer Risk Calculations for exposure to Arsenic in Soil (25 mg/kg)

Children

Cancer Slope Factor = 1.5 mg/kg-day^{-1}

Risk = Dose (mg/kg-day) x CSF (mg/kg-day^{-1}) x (Exposure years/70)

Risk = $1.19 \times 10^{-4} \times 1.5 \times 6/70 = 1.53 \times 10^{-5}$ (Approximately 1 cancer excess in 100,000 children)