

Letter Health Consultation

PALMERTON SOIL SAMPLING
PALMERTON BOROUGH,
CARBON COUNTY, PENNSYLVANIA

Public Health Evaluation of Surface Soil Data
at the Palmerton Borough Park and a Palmerton-Area Daycare Facility

July 2020



Bureau of Epidemiology, Division of Environmental Health Epidemiology
625 Forster Street | Room 933 | Health and Welfare Building
Harrisburg, PA 17120-0701

Disclaimer

This report was supported in part by funds provided through a cooperative agreement with ATSDR. The findings and conclusions in this report are those of the authors and do not necessarily represent the official views of ATSDR or the U.S. Department of Health and Human Services. This document has not been revised or edited to conform to ATSDR standards.

Contact Information

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Division of Environmental Health Epidemiology
Harrisburg, PA
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07/22/2020

Robert K. Lewis
Environmental Group Manager
Pennsylvania Department of Environmental Protection,
Wilkes Barre, PA

Re: Review of DEP 2019 surface soil sampling at the Palmerton Borough Park and a Palmerton-Area Daycare Facility

Dear Mr. Lewis,

The Pennsylvania Department of Health (DOH) prepared this letter health consultation to evaluate surface soil sampling data at the Palmerton Borough Park (“the Park”) and a daycare facility in the Palmerton area (the “Daycare”). The data available for review were collected between August 14, 2019, and August 20, 2019, by the Pennsylvania Department of Environmental Protection (DEP). DOH worked on this evaluation under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). Elevated concentrations of lead, copper, zinc, and cadmium were detected at the Park, and elevated concentrations of lead, cadmium, and zinc were detected at the Daycare. Samples were collected by first removing the vegetation at the surface. Exposure to elevated concentrations of contaminants detected at the Park and Daycare is of concern mainly where bare soil is consistently present. Bare soil increases the potential for contact with the contaminants. DOH continues to recommend the following best practices: prevent children from playing in bare soil, remove shoes before entering buildings, wash children’s hands after they come in contact with soil, and cover any bare playground soil (e.g., with mulch, sod, or physical barrier).

BACKGROUND

In 2018, ATSDR recommended X-ray fluorescence (XRF) soil screening and surface soil sampling within the Palmerton community based on modeled emissions from the nearby American Zinc Recycling LLC (AZR) facility. The AZR facility operates as an electric arc furnace dust recycling facility emitting criteria pollutants and heavy metals. In October 2018, DEP, ATSDR and the Environmental Protection Agency (EPA) conducted initial soil screening and sampling at ten locations in the Palmerton area—including the Park and the Daycare. Elevated concentrations of lead and cadmium were detected in both soil samples collected at the Park and elevated

concentrations of lead, cadmium and zinc detected in the single soil sample collected at the Daycare.

Following the 2018 screening and sampling event, additional surface soil sampling was conducted by DEP in August 2019 to further characterize the select metals exceedances in surface soils throughout the Park and Daycare properties and to evaluate the potential risks posed by metals in soil.

SURFACE SOIL SAMPLING

Surface soil sampling at the Park and Daycare was conducted by DEP between August 14, 2019, and August 20, 2019. Grab soil samples were collected from 71 surface soil sampling locations (SS-1 through SS-71) at the Park (Figure 1) and 12 surface soil sampling locations (SS-72 through SS-83) at the Daycare (Figure 2). Surface soil samples were collected by removing the vegetation at the surface and collecting the underlying soil (or mulch) between 0-3 inches below the ground surface. Surface soil samples were analyzed by the DEP Bureau of Laboratories for select total metals, including total cadmium, total chromium, chromium VI, total copper, total lead, total nickel, and total zinc.

EXPOSURE PATHWAY

This public health evaluation assesses if exposure to heavy metals in surface soils at the Park and Daycare at the concentrations detected, could harm people's health. The exposure pathways of concern that would occur while recreating in areas of contaminated soil are dermal contact with contaminated soil and inhalation or ingestion of contaminated dust. Ingestion of contaminated soil by people exhibiting pica behavior is also considered. Soil-pica is the intentional recurrent ingestion of unusually high amounts of soil. Soil consumption can be as high as 5,000 mg/day (ATSDR, 2005). Groups at risk of soil-pica behaviors include children aged six years and younger and developmentally delayed individuals.

Exposure to contaminants of concern is determined by examining human exposure pathways. An exposure pathway has five parts:

1. A source of contamination (e.g., industrial facilities utilizing hazardous materials);
2. An environmental medium that can hold or move the contamination (e.g., water, soil, or air);
3. An exposure point at which people could come into contact with a contaminated medium (e.g., private residential well water);
4. An exposure route (e.g., ingestion or inhalation); and
5. A population that could come in contact with the contaminants.

For a completed pathway, all five parts must exist, and exposure to a contaminant must have occurred, is occurring, or will occur (ATSDR, 2005). For this evaluation, dermal contact,

inhalation, and ingestion are the exposure pathways of concern. The five parts of the exposure pathway that are present or could be present at the site are as follows:

1. Source: Elevated concentrations of lead, cadmium, zinc, and copper have been detected in surface soil at the Park and Daycare.
2. Environmental medium: Surface soil is a medium that can hold and transport the contaminants.
3. Exposure point: A person could become exposed while recreating at the Park or while playing in the Daycare's back yard.
4. Exposure route: A person could get contaminated soil on their skin or inhale or inadvertently ingest contaminated soil or dust. A child exhibiting pica behavior could intentionally ingest contaminated soil.
5. Population: Residents living near the Park and who visit the Park or spend time playing in the Daycare's back yard. The most vulnerable population would be young children under the age of six, spending time in these locations.

Inhalation of detected metals adhered to soil particles and absorption of detected metals via soil particles on the skin are negligible sources of exposure for people and were not evaluated. The inadvertent ingestion of contaminated soil or dust by mouthing objects or eating without proper handwashing would result in a far lower exposure dose when compared to soil-pica exposure and was not evaluated. Therefore, the only completed exposure pathway of concern for this evaluation is soil ingestion by pica behavior, especially in areas where bare soil is consistently present.

DATA EVALUATION METHODS

After identifying the completed ingestion exposure pathway, DOH screened the sampling data against appropriate ATSDR comparison values (CV), which are health-based guidelines. ATSDR CVs are conservative estimates of contaminant levels below which no health effects would be expected. Concentrations found to be above a CV do not necessarily mean they are harmful but that they require further evaluation to determine if adverse health effects are likely. Contaminants that exceed a CV are further evaluated using other standards and or scientific studies, where appropriate, to determine whether adverse health effects are likely.

DOH used ATSDR's Public Health Assessment Site Tool (PHAST) to screen the contaminants. The screening results using the maximum detected levels for all contaminants detected in the surface soil are presented in the Appendix.

DOH used ATSDR's recommended CVs for childhood exposure because children are frequently present in the areas of concern—the Park and the Daycare—and children are more vulnerable to environmental exposures than adults. Children are shorter than are adults, which means they breathe dust, soil, and vapors close to the ground. Additionally, a child's lower body weight and higher intake rate result in a greater dose of hazardous substance per unit of body weight. Children may also exhibit pica behavior (eating or mouthing non-food items such as dirt and paint flakes), which increases their exposure in comparison to adults.

No ATSDR health-based CV exists for screening lead in surface soil because there is no clear threshold for some of the more sensitive health effects associated with lead exposures. For this evaluation, the EPA's Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK model) was used to screen the lead results. The IEUBK model calculates exposure from lead in air, water, soil, dust, diet, paint, and other sources using site-specific data and default values and predicts the risk of elevated blood lead levels in children six months to seven years of age. As it is true for all models, the accuracy of the results obtained using the IEUBK model is highly dependent on the selection of the various coefficients and default values that are used (EPA 1994).

SURFACE SOIL SAMPLING RESULTS

The Park and Daycare surface soils samples were analyzed for total cadmium, total chromium, chromium VI, total copper, total lead, total nickel, and total zinc. Elevated concentrations of lead, cadmium, zinc, and copper were detected at the Park and Daycare.

Results for the 2019 surface soil samples are summarized in Tables 1 and 2. Maps depicting the sampling locations at the Park and Daycare are presented in Figures 1 and 2. Elevated concentrations of contaminants were detected around the perimeter of the Park and near the main building and garage of the Daycare.

METALS EXPOSURE AND PUBLIC HEALTH IMPLICATIONS

Lead, cadmium, zinc, and copper are elements that occur naturally in the earth's crust and can be found throughout our environment in the air, water, and soil. These metals are also present in the environment as pollution, particularly in urban areas, from sources related to human activity such as traffic emissions, industrial emissions, weathering of buildings, and pavement surfaces. Background levels of these metals (meaning the ambient levels present in the environment from natural sources and human activity) can vary greatly depending on the surrounding landscape. The individual contaminants detected during the 2019 sampling event, their background levels, and their potential effect on human health at the concentrations detected are discussed below.

Lead

Lead was detected in the Park samples at concentrations ranging from <61.6 to 1,218 ppm and in the Daycare samples at concentrations ranging from <150 to 628 ppm. Soils in developed areas such as urban soils often have lead concentrations much greater than naturally occurring background levels. These concentrations frequently range from 150 ppm to as high as 10,000 ppm at the base of structures painted with lead-based paint (<https://extension.psu.edu/lead-in-residential-soils-sources-testing-and-reducing-exposure>). While the concentrations of lead

detected in the Park and Daycare soil are high, they are similar to typical urban levels of lead in soil.

Using the IEUBK model, PADOH determined that exposure to lead in soil at 330 ppm could result in a blood lead level (BLL) of 5.0 µg/dL in children aged one to two years (Table 3). The screening value of 330 ppm was identified for this evaluation by running the model with incrementally increasing concentrations of soil lead along with the model's default variables for exposure to lead in air and drinking water until the resulting BLL reached a minimum of 5.0 µg/dL. While no safe BLL in children has been identified, a BLL of 5.0 µg/dL is considered "elevated." Low levels of lead in blood have been shown to affect IQ, ability to pay attention, and academic achievement as the nervous system is the main target for lead toxicity in adults and children.

Cadmium

Cadmium was detected in the Park samples at concentrations ranging from 0.68 to 165 ppm and in the Daycare samples at concentrations ranging from 2.08 to 106 ppm. ASTDR's recommended CV for evaluating exposure to cadmium in the soil is the chronic environmental media evaluation guide (EMEG) for children of 5.2 ppm. Additionally, the pica EMEG for cadmium is 2.7 ppm. The ingestion and/or inhalation of lower levels of cadmium over a long period of time can lead to a toxic build-up of cadmium in the kidneys (the organ most affected by chronic cadmium exposure) and have been associated with progressive impairment in kidney function. Data from human studies suggest a latency period of approximately 10 years before kidney damage is diagnosable, depending on intensity of exposure. Chronic low-level ingestion of cadmium can also cause bones to become fragile and break easily. Cadmium has not been found to be carcinogenic via the oral route of exposure, and virtually no cadmium enters the body through the skin.

Zinc

Zinc was detected in the Park samples at concentrations ranging from 254 to 18,773 ppm and in the Daycare samples at concentrations ranging from 503 to 22,994 ppm. ASTDR's recommended CV for evaluating exposure to zinc in the soil is the chronic EMEG for children of 16,000 ppm. Additionally, the pica EMEG for zinc is 1,600 ppm. While trace amounts of zinc are essential to healthy biological function, ingesting high levels of zinc can cause stomach cramps, nausea, and vomiting.

Copper

Copper was detected in the Park samples at concentrations ranging from 17.6 to 620 ppm and in the Daycare samples at concentrations ranging from 12.7 to 316 ppm. ASTDR's recommended CV for evaluating exposure to copper in the soil is the intermediate EMEG for children of 520 ppm. Additionally, the pica EMEG for copper is 53 ppm. While trace amounts of copper are essential to healthy biological function, ingesting high levels of copper can also cause nausea, vomiting, and diarrhea.

CONCLUSIONS AND RECOMMENDATIONS

Samples were collected by first removing the vegetation at the surface. As such, exposure to the elevated concentrations of contaminants detected at the Park and Daycare is of concern mainly where bare soil is consistently present.

The samples with elevated concentrations of lead, cadmium, zinc, and copper were collected mainly around the perimeter of the Park and near the buildings on the Daycare property (see Tables and Figures).

Recommendations for Palmerton Borough Park:

- Place sod, mulch, or physical barrier to cover any areas of bare soil around the perimeter of the Park where elevated concentrations of contaminants were detected (e.g., around the bases of trees).
- Inform the schools adjacent to the Park about the elevated levels, including soil sample results maps, so faculty and staff can ensure that children do not frequent these areas.

Recommendations for the Daycare:

- Due to the increased prevalence of soil pica behaviors in children, protecting children from access to contaminated soil should be the primary goal.
- Before giving children access to play in the areas where elevated concentrations of contaminants were detected, the exteriors of the main building and garage should be tested for lead, and other metals as that may be a source of contamination, and resurface the buildings (e.g., with paint or vinyl siding) if necessary.
- Re-sod around the main building and garage wherever children will play.
- With regards to the remaining areas of the property where elevated levels of metals were not detected, DOH continues to recommend the following best practices: prevent children from playing in bare soil, remove shoes before entering buildings, wash children's hands after they come in contact with soil, and cover any bare playground soil (e.g., with mulch, sod or physical barrier).

Please contact me with any questions you may have regarding this letter health consultation.

Sincerely,

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Cc: Anil Nair, PhD, MPH; DOH

REFERENCES

[ATSDR] Agency for Toxic Substances and Disease Registry, 2005. Public Health Assessment Guidance Manual. Available at: https://www.atsdr.cdc.gov/hac/phamanual/pdfs/phagm_final1-27-05.pdf.

[ATSDR] Agency for Toxic Substances and Disease Registry, 2001. Summary report for the soil/pica conference. https://www.atsdr.cdc.gov/child/2_0.html

[EPA] U.S. Environmental Protection Agency, 1994. Guidance manual for the IEUBK model for lead in children. Available at: <https://www.epa.gov/superfund/lead-superfund-sites-software-and-users-manuals#guidance>

Table 1: Palmerton Borough Park Surface Soil Sampling Results and Screening Values (ppm)
 Sample date: 8/14/2019–8/20/2019, Sample depth: 0–3 inches

Sample ID	Lead IEUBK Screen: 330	Cadmium ATSDR chronic EMEG: 5.2 ATSDR Int. EMEG Pica: 2.7*	Zinc ATSDR chronic EMEG:16,000 ATSDR Int. EMEG Pica: 1,600	Copper ATSDR Int. EMEG: 520 ATSDR Acute/Int. EMEG Pica: 520/53
SS-1	684	94.8	14,970.00	237
SS-2	284	31.5	5,995.00	266
SS-3	128	26.3	5,385.00	77.3
SS-4	289	38.5	7,073.00	74.1
SS-5	181	19.9	5,525.00	75.3
SS-6	205	25.3	4,575.00	98.6
SS-7	512	52.3	9,937.00	244
SS-8	162	29.5	3,626.00	96.4
SS-9	<61.60	0.68	254	86.2
SS-10	120	8.99	2,296.00	98.9
SS-11	69.5	6.46	1,360.00	50.1
SS-12	<125.00	5.14*	980	18.2
SS-13	<189.00	4.36*	888	20.3
SS-14	<187.00	6.36	1,410.00	36.3
SS-15	449	35.3	5,444.00	131
SS-16	105	11.9	1,994.00	42.5
SS-17	233	22.9	3,174.00	69.7
SS-18	<190.00	2.85*	653	18.8
SS-19	93.4	15.3	3,132.00	38.1
SS-20	<162.00	3.24*	709	17.6
SS-21	<61.10	1.53	486	43.5
SS-22	242	43	10,175.00	63.7
SS-23	121	12.2	2,911.00	56.2
SS-24	84.1	11.3	1,526.00	41.1
SS-25	1,025.00	87.1	13,527.00	387
SS-26	406	50.6	6,064.00	439
SS-27	281	34.6	4,486.00	118
SS-28	268	37.5	4,551.00	108
SS-29	113	16.3	2,350.00	52.6
SS-30	208	36.3	4,146.00	68.1
SS-31	233	45.7	5,981.00	58.2
SS-32	<65.00	18.9	1,878.00	43.6
SS-33	377	62.7	8,249.00	155

SS-34	189	30.7	5,195.00	57.3
SS-35	463	77.3	7,527.00	100
SS-36	377	72.7	7,030.00	118
SS-37	108	13.4	2,808.00	37.8
SS-38	380	75.5	7,118.00	94.5
SS-39	213	28.7	3,452.00	71
SS-40	280	69.8	5,835.00	94.1
SS-41	135	13	12,081.00	75
SS-42	382	38.2	10,802.00	87.5
SS-43	423	54.7	6,291.00	99
SS-44	134	10.7	1,854.00	60.3
SS-45	92.8	56.3	4,264.00	43.2
SS-46	287	53.8	6,025.00	90.1
SS-47	632	81.6	9,837.00	232
SS-48	96.7	8.86	2,999.00	78.7
SS-49	271	44.7	7,044.00	91.4
SS-50	255	38.7	4,564.00	84.3
SS-51	<62.20	16.4	1,729.00	36.3
SS-52	437	43.7	5,619.00	144
SS-53	293	33.5	6,189.00	97
SS-54	1,103.00	165	17,091.00	313
SS-55	317	53.9	6,393.00	91.6
SS-56	165	29.1	3,985.00	63.5
SS-57	144	27.4	7,831.00	55.7
SS-58	459	62.1	6,280.00	117
SS-59	1,070.00	108	16,607.00	252
SS-60	1,073.00	127	17,945.00	289
SS-61	151	15.4	2,927.00	72.1
SS-62	229	19.3	2,972.00	75
SS-63	452	53.6	4,563.00	140
SS-64	372	35.4	3,633.00	86.2
SS-65	348	48.5	7,857.00	107
SS-66	508	91.1	8,691.00	139
SS-67	485	55.4	6,321.00	127
SS-68	97.1	7.62	1,841.00	66
SS-69	579	51.9	6,385.00	179
SS-70	267	20.2	2,809.00	80.6
SS-71	1,218.00	93	18,266.00	620

Bold = Exceeded IEUBK Screening value of 330 ppm (lead) or ATSDR's recommended CV (chronic EMEG child for cadmium and zinc; intermediate EMEG child for copper).

Table 2: Daycare Surface Soil Sampling Results and Screening Values (ppm)
 Sample date: 8/20/2019, Sample depth: 0–3 inches

Sample ID	Total Lead IEUBK Screen: 330	Total Cadmium ATSDR chronic EMEG: 5.2 ATSDR Int. EMEG Pica: 2.7*	Total Zinc ATSDR chronic EMEG: 16,000 ATSDR Int. EMEG Pica:1,600	Total Copper ATSDR Int. EMEG: 520 ATSDR Acute/Int. EMEG Pica: 53
SS-72	460	106	22,994.00	138
SS-73	471	94.6	14,980.00	103
SS-74	319	48.9	7,744.00	117
SS-75	378	86.6	13,603.00	144
SS-76	<150.00	3.44*	470	12.7
SS-77	421	75	11,770.00	118
SS-78	<222.00	3.1*	503	25.3
SS-79	<160.00	2.08	379	23
SS-80	376	68.1	12,390.00	125
SS-81	<187.00	2.99*	808	37.1
SS-82	628	77.4	13,592.00	316
SS-83	<236.00	4.01*	821	51.7

Bold = Exceeded IEUBK Screening value of 330 ppm (lead) or ATSDR’s recommended CV (chronic EMEG child for cadmium and zinc; intermediate EMEG child for copper).

Table 3: Calculated Blood Lead and Lead Uptakes Using the IEUBK Model,
 Soil Lead Concentration: 330 ppm

Age (yrs)	Air (µg/day)	Diet (µg/day)	Alternate (µg/day)	Water (µg/day)	Soil+Dust (µg/day)	Total (µg/day)	Blood (µg/dL)
0.5-1	0.021	1.032	0.000	0.365	6.544	7.962	4.3
1-2	0.034	0.881	0.000	0.899	10.235	12.050	5.0
2-3	0.062	0.971	0.000	0.948	10.380	12.361	4.6
3-4	0.067	0.942	0.000	0.979	10.513	12.501	4.4
4-5	0.067	0.923	0.000	1.042	7.983	10.015	3.6
5-6	0.093	0.980	0.000	1.109	7.252	9.433	3.0
6-7	0.093	1.066	0.000	1.133	6.883	9.175	2.7

330 ppm resulted in BLL of 5.0 µg/dL in children aged one to two years highlighted in red

Figure 1: Palmerton Borough Park Surface Soil Sample Location Map



Figure 2: Daycare Surface Soil Sample Location Map (Exact location redacted for privacy)



APPENDIX

PHAST Results: CV Screening

Lead in soil, maximum concentration: 1,218 ppm

Contaminant Name / CASRN	Conc	Unit	Above or Equal to Rec ATSDR CV?	Above or Equal to Other CV?	CREG	Chronic EMEG Child	Chronic EMEG Adult	Int EMEG Child	Int EMEG Adult	RMEG Child	RMEG Adult	Acute EMEG Pica Child	Int EMEG Pica Child
LEAD 007439-92-1	1,218	ppm	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Cadmium in soil, maximum concentration: 165 ppm

Contaminant Name / CASRN	Conc	Unit	Above or Equal to Rec ATSDR CV?	Above or Equal to Other CV?	CREG	Chronic EMEG Child	Chronic EMEG Adult	Int EMEG Child	Int EMEG Adult	RMEG Child	RMEG Adult	Acute EMEG Pica Child	Int EMEG Pica Child
CADMIUM 007440-43-9	165	ppm	Yes [1]	Yes [2]	NA	5.2 [1]	80 [2]	26 [2]	400	26 [2]	400	NA	2.7 [3]

[1] Recommended ATSDR CV met or exceeded.
 [2] Additional ATSDR CV met or exceeded.
 [3] Acute/Intermediate pica ATSDR CV met or exceeded.

Zinc in soil, maximum concentration: 22,994 ppm

Contaminant Name / CASRN	Conc	Unit	Above or Equal to Rec ATSDR CV?	Above or Equal to Other CV?	CREG	Chronic EMEG Child	Chronic EMEG Adult	Int EMEG Child	Int EMEG Adult	RMEG Child	RMEG Adult	Acute EMEG Pica Child	Int EMEG Pica Child
ZINC 007440-66-6	22,994	ppm	Yes [1]	No	NA	16,000 [1]	240,000	16,000 [1]	240,000	16,000 [1]	240,000	NA	1,600 [3]

[1] Recommended ATSDR CV met or exceeded.
 [3] Acute/Intermediate pica ATSDR CV met or exceeded.

Copper in soil, maximum concentration: 620 ppm

Contaminant Name / CASRN	Conc	Unit	Above or Equal to Rec ATSDR CV?	Above or Equal to Other CV?	CREG	Chronic EMEG Child	Chronic EMEG Adult	Int EMEG Child	Int EMEG Adult	RMEG Child	RMEG Adult	Acute EMEG Pica Child	Int EMEG Pica Child
COPPER 007440-50-8	620	ppm	Yes [1]	No	NA	NA	NA	520 [1]	8,000	NA	NA	53 [3]	53 [3]

[1] Recommended ATSDR CV met or exceeded.
 [3] Acute/Intermediate pica ATSDR CV met or exceeded.