Health Consultation

Soil Contamination Evaluation

UNION PACIFIC RAILROAD COMPANY
POCATELLO, BANNOCK COUNTY, IDAHO

Prepared by
Idaho Department of Health and Welfare

APRIL 24, 2013

Prepared under a Cooperative Agreement with the
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Community Health Investigations
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

Soil Contamination Evaluation

UNION PACIFIC RAILROAD COMPANY
POCATELLO, BANNOCK COUNTY, IDAHO

Prepared By:

Idaho Department of Health and Welfare
Division of Public Health
Bureau of Community and Environmental Health
Under a Cooperative Agreement with
U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

Contents

Foreword

This public health consultation was supported in part by funds from the Comprehensive Environmental Response, Compensation, and Liability Act through a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR), U.S. Department of Health and Human Services. It was completed in accordance with approved methodologies and procedures existing at the time the public health consultation was initiated. Editorial review was completed by the cooperative agreement partner.

The public health consultation is an approach used by the ATSDR and the Idaho Division of Public Health's Bureau of Community and Environmental Health (BCEH) to respond to requests from concerned residents for health information on hazardous substances in the environment. The public health consultation process evaluates environmental sampling data collected from a hazardous waste site, determines whether exposures have occurred or could occur, reports any potential harmful effects, and recommends actions to protect public health.

For more information about ATSDR, contact their Information Center at:
1-800-232-4636 or visit the agency's Home Page: http://www.atsdr.cdc.gov.

Summary

INTRODUCTION

In Idaho, the Bureau of Community and Environmental Health (BCEH) serves the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent people from coming into contact with harmful toxic substances. The Union Pacific Railroad (UPRR) has operated a rail yard with maintenance facilities in Pocatello, Idaho for over 120 years. In 1983, UPRR property outside the UPRR rail yard was placed on the National Priority List (Superfund list) for contamination associated with a railroad tie treatment facility and an unlined sludge pit which leached contaminants into the groundwater. The soil and groundwater were cleaned up, and the site was delisted from the National Priorities List in 1997. In 2002, following up on residents' complaints of spilled and buried waste, the U.S Environmental Protection Agency (EPA) issued a Preliminary Assessment Report of the Pocatello rail yard, that identified an approximate 310-acre area of concern in need of further assessment. In response, the Idaho Department of Environmental Quality (IDEQ) issued a Compliance Schedule Order to the Union Pacific Railroad for a Site Investigation of the rail yard in August of 2003. As part of the Site Investigation, on-site soil samples from seven areas of interest (AOI) encompassing the rail yard were analyzed in 2010 to determine if the levels represented a human health risk. This report examines if the levels of the contaminants found in surface soil in the AOI pose a health risk.

CONCLUSION

BCEH concludes that touching or incidentally eating the contaminants found in the surface soil at the AOI from the Union Pacific Railroad yard in Pocatello is not expected to harm people's health because the amount of the contaminants are below levels of health concern.

BASIS FOR DECISION

The levels of contaminants in surface soil at the Union Pacific Railroad yard are considered low and any contact with the surface soil or incidental ingestion (eating) of the soil is not expected to harm people's health. Also, since the exposure to surface soils through accidental ingestion would not occur on a regular basis, risks from exposure are further reduced. Although the levels of exposure represent a very low increased risk of cancer, the increased risk would not be discernible from the background or normal rates of cancer in the community.

NEXT STEPS

BCEH will communicate these findings to IDEQ and EPA upon completion of this Public Health Consultation. BCEH will coordinate with IDEQ on dissemination of report findings, will

remain in contact with IDEQ and EPA, and will evaluate new data for soil contamination near the UPRR if more sampling is conducted in the future. BCEH will provide educational outreach to communities adjacent to the UPRR site to inform them about childhood lead poisoning and how to get children screened.

FOR MORE INFORMATION

If you have concerns about your health, you should contact your health care provider. You can also contact BCEH at 1-208-334-5929 or email bceh@dhw.idaho.gov and ask for information on soils near the Union Pacific Rail Yard.

Purpose and Statement of Issues

The Bureau of Community and Environmental Health (BCEH), Division of Public Health, Idaho Department of Health and Welfare has a cooperative agreement with the Federal Agency for Toxic Substances and Disease Registry (ATSDR) to conduct public health assessments and consultations for sites in Idaho. This health consultation was done as part of this cooperative agreement. The public health consultation was initiated during discussions with the Idaho Department of Environmental Quality (IDEQ) when it was found that there had been community questions about the possible drift of contaminated dust from the Union Pacific Railroad site in Pocatello, Idaho (UPRR) onto adjacent properties. BCEH agreed to review the environmental sampling data provided by IDEQ and write a public health consultation for the site. This report evaluates the levels of contaminants in surface soils on the site, their concentrations, and the health risk they could pose.

Background

Site Description

Pocatello is located in the Portneuf Valley in southeast Idaho (see Figures 1 and 2). The population of the metropolitan area is approximately 76,000. In addition to the UPRR, the area also includes a portion of the Eastern Michaud Flats (EMF), McCarty/Pacific Hide and Fur, and the UPRR Sludge pit hazardous waste sites. Since the UPRR site was started in 1882, the city of Pocatello has grown and spread around the site. The yard occupies 502 acres and is approximately five and one-half miles long. The central point of the site is Center Street between South Main and South First Avenue; the northwest corner of the site is located at North Main Street between Garrett Way and North Arthur Avenue; and the southeastern end point of the site is located at the southern end of Ross Park at the Cheyenne street crossing.

Sources of Contamination

Rail yards have played an important role in the movement of goods and commodities for almost two centuries in this country. Rail yards provide areas where locomotives and cars are stored and maintained; where cars are added and removed; and where cargo may enter or exit the rail system. Historic use of solvents and metal machining processes, as well as combustion from locomotives and other sources, all contribute to the profile of contaminants usually found at a rail yard. Contaminants often bind or combine with dust and are blown off-site into soils of neighboring properties. Pocatello, being an urban center and historic site of industry, has had many contributing sources of contamination over the years. In addition to the UPRR, a number of other potential sources of soil contaminants exist in Pocatello. These include vehicle emissions, emissions from fixed sources such as home and commercial furnaces, wood burning, and industrial combustion, naturally occurring metals in regional soils that are transported via wind as dust, and several industrial facilities located in or near Pocatello.

Environmental Data

Data available for this health consultation include forty-three surface soil samples collected in August 2010 by CH2MHill at seven areas of interest (AOI) within the Union Pacific property [1] (See Appendix A1 for details about sampling locations). The seven AOI were originally defined to geographically divide the site in order to facilitate the environmental investigation of the site. In each AOI, soil samples were collected at a depth of 0 to 6 inches below the ground surface. Each sample was analyzed for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), metals, polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs). Appendix B contains a list of detected contaminants, the number of samples collected, percentage of contaminants detected, maximum detects, minimum detects, average concentrations, and cancer and non-cancer comparison values (CV). For this consultation, BCEH relied on the information provided in the report prepared for Union Pacific by the Center for Toxicological and Environmental Health [1] and assumed adequate quality assurance/quality control procedures were followed with regard to data collection, chain-of custody, laboratory procedures, and data reporting.

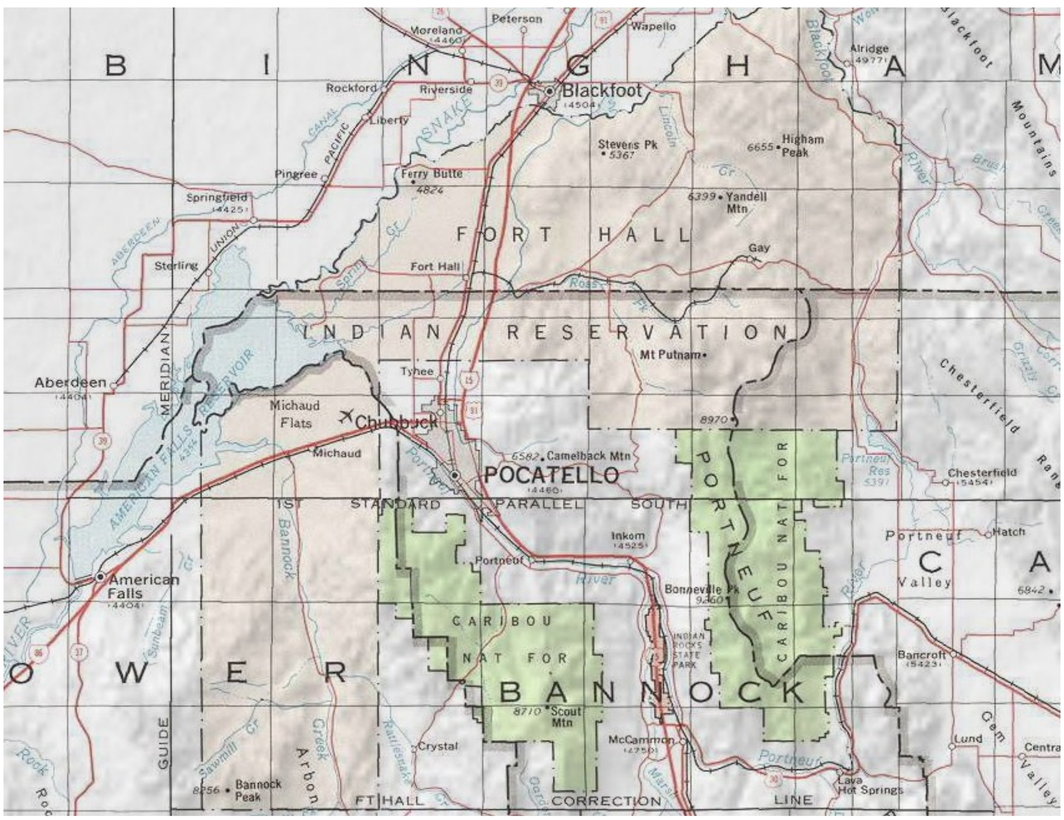


Figure 1: Map of Pocatello in relation to the entire Portneuf Valley

Discussion

Pathway Analysis

To determine whether people are, were, or could be exposed in the future to the contaminants listed in Appendix B, the environmental and human components that lead to exposure were evaluated. Exposure is said to exist if the five elements of an exposure pathway exist, have existed, or may exist in the future. An exposure pathway is composed of: 1) a source of contamination; 2) a movement of the contamination through air, water, and/or soil; 3) human activity, such as working, playing in yards and gardening where the contamination exists; 4) human contact with contaminants through touching, breathing, swallowing and/or drinking; and, 5) a population that can potentially be exposed. If all five elements are present, an exposure pathway is said to exist.

The exposure pathway of concern for this site is incidental ingestion of contaminants found in surface soil. Because of the proximity of the rail yard to some residential and commercial areas, it is likely that dust from the site is blown onto nearby residential, commercial and recreational areas. Residents, local commercial business workers and park users could accidently ingest soil or dust; thus, the exposure pathways are considered complete and are discussed below.

For the analysis of exposure pathways in each AOI, BCEH used an overlay of AOI on the city of Pocatello zoning map (Appendix A2). BCEH created the overlay to gain a better understanding of the proximity of the AOI to residential areas. Based on this information, there is potential exposure to residents living near all the AOI except for AOI B where exposure to soil is eliminated by an asphalt and cement covering of the area. AOI A, C, D, E and F are adjacent to areas zoned for medium-density, multifamily residences. AOI E, F and G are adjacent to areas zoned for high-density residences and AOI G and H are adjacent to areas zoned medium-density, single-family residences. For those living near the railroad yard, potential exposure to dust from the rail yard exits when adults and children are outside in their yards. This exposure could be from inhaling dust and contact with dust and soil and then eating food before washing hands. Young children could be exposed through inhalation of dust and hand to mouth activities when they play in their yards. AOI G has several grass covered public areas: Lower Ross Park, the aquatic complex, Pocatello Zoo, and a golf course, where adults and children may be exposed by playing outdoors and inhaling contaminated dust and getting soils and dust on their hands and then eating without washing first. However; this exposure is reduced because of the gravel covering the rail yard and grass covering the recreational areas. It is important to note some observations during BCEH's staff site visit such as lack of fencing along the boundaries of the UPRR rail yard; however, signs are in place to restrict public access to the rail yard, and gravel covers surface soils along the rail yard. Thus, it is unlikely that direct contact with the soils on the Union Pacific property by residents will occur on a regular basis.

Determination of Contaminants of Concern

For this consultation, BCEH analyzed on-site surface soil sampling data to determine if surface soils from the site may pose a health risk to those who work near or live near the site. To determine the potential human health risk from exposure to contaminated surface soil, the first step was to identify which contaminants exceed the comparison value (CV). BCEH used health-based comparison values (CVs) for non-cancer and cancer endpoints. The CVs specify levels of chemicals in particular media (air, soil, and water) that are considered to be safe for human health contact with respect to identified health effects. If contaminant levels are below their CVs, then it is unlikely that exposure would result in harm.

If a contaminant is above its non-cancer health-based CV, then BCEH determines an estimated daily exposure dose. The estimated exposure dose is then compared to ATSDR's Minimal Risk

Levels (MRLs). If a MRL is not available, EPA's oral reference doses (RfDs) or other health-based standards are used. Both the MRLs and RfDs are based on the assumption that there is an identifiable exposure threshold (both for the individual and for populations) below which there are no observable adverse effects. Therefore, MRLs and RfDs are estimates of daily exposures to contaminants that are unlikely to cause adverse non-cancer health effects. If estimated exposure doses are below the MRL or RfD, then it is unlikely that exposure would result in harm.

If the estimated daily exposure is above an MRL or an RfD, further investigation is required. The estimated daily exposure is compared to published literature showing at what dose a no observed adverse effect level (NOAEL) and a lowest observed adverse effect level (LOAEL) have been found. The NOAEL signifies an exposure dose at which no adverse health effects has been seen in animal or human exposure studies; thus, if the estimated exposure dose is below the NOAEL, the exposure is unlikely to be a health concern. However, because NOAELs are sometimes derived from animal studies, it is possible that values below the NOAEL might have some health effects on sensitive populations. If the estimated exposure dose is above the NOAEL but below the LOAEL, a review of the medical literature is completed to determine if the estimated exposure dose is a valid health concern. If an estimated exposure dose is above a LOAEL, the exposure represents a health hazard to those exposed.

For contaminants that are considered to be known human carcinogens, probable human carcinogens, or possible human carcinogens, ATSDR's cancer risk evaluation guides (CREGs) and EPA Regions 3, 6, and 9 Regional Screening Levels (RSLs) for cancer are used to determine if the contaminant level poses an increased risk of cancer in the exposed population. If the contaminant level is above the CREG or cancer-RSL, then EPA's chemical-specific cancer slope factors (CSFs) are used to estimate possible additional cancer risk in a population exposed for a lifetime. These estimates predict how many additional cancers may be caused from exposure to the contaminants in addition to the cancers that are normally expected to occur in an unexposed population.

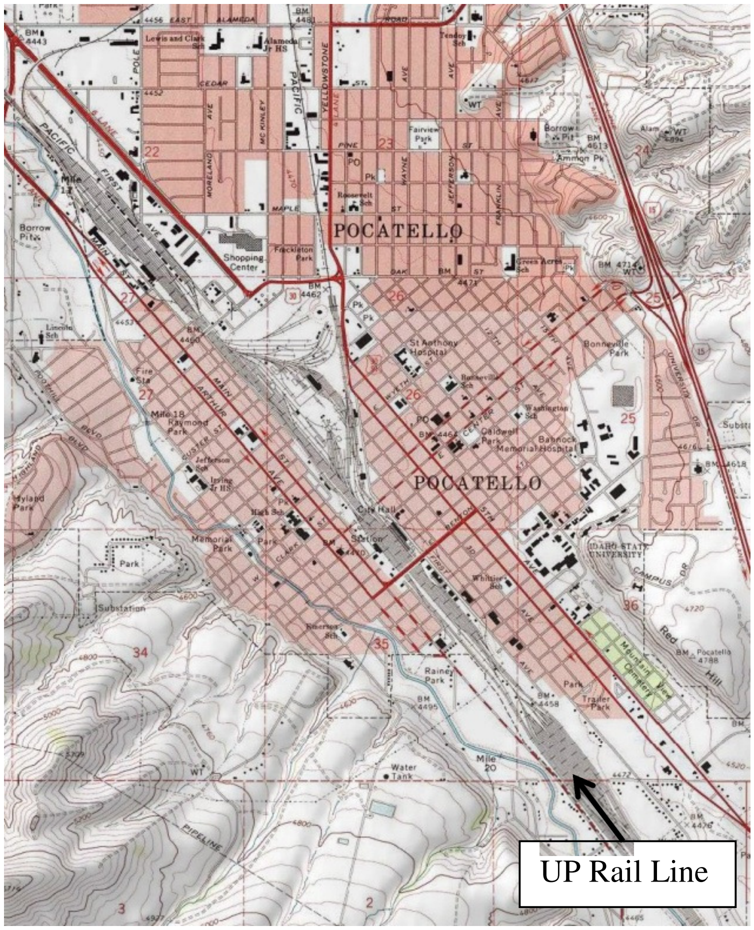


Figure 2: Downtown Pocatello area showing rail line

BCEH used the ATSDR default values of 70 kilogram (kg) for an adult and 16 kg for a child body weight and soil ingestion values of 100 milligrams per day (mg/day) for adults and 200 mg/day for a child to calculate both non-cancer and cancer risk [2].

Surface soil samples were analyzed for 13 metals (antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, and zinc). CVs were available for each of these metals. For total chromium, BCEH considered the CV of hexavalent chromium (chromium VI) as a surrogate value. For thallium, BCEH used the CV that corresponded to thallium sulfate because it is generally believed that thallium is present as thallium (I) or thallium sulfate in soils and is transferred to solution in this form [3]. For each of the seven AOI (A, C, D, E, F, G and H), an average of each metal concentration was calculated. Area of interest B is covered by an impermeable surface (asphalt, concrete); thus, the impacts to surface soil are negligible [1]. The highest average of each metal was then compared to health-based CVs.

Volatile and semi-volatile organic compounds are a class of chemicals that are volatile (evaporate easily) and are organic compounds (contain carbon atoms). All analytical results for the VOCs and SVOCs came back below the analytical method reporting limit. The method reporting limits were below the available CVs. Thus, these compounds were excluded from further inquiry.

PCBs belong to a broad family of man-made organic chemicals known as chlorinated hydrocarbons. Aroclor is commonly used as trade name for PCB mixtures. There are many types of Aroclors and each has a distinguishing suffix number that indicates the degree of chlorination. The first two digits generally refer to the number of carbon atoms in the phenyl rings (for PCBs this is 12). The second two numbers indicate the percentage of chlorine by mass in the mixture. For example, the name Aroclor 1254 means that the mixture contains approximately 54% chlorine by weight. Surface soil samples were tested for seven Aroclors (1016, 1221, 1232, 1242, 1248, 1254, and 1260). The majority of these Aroclors were below the analytical method reporting limit. The method reporting limits were below the available CVs. Aroclor 1254 and 1260 were the only PCBs detected.

Polycyclic aromatic hydrocarbons (PAHs) are a group of over 100 different chemicals that are formed during the incomplete burning of coal, oil, gas, garbage, or other organic substances. PAHs are usually found as a mixture containing two or more compounds. The level of toxicity to humans in PAHs is directly correlated to a PAH's molecular weight. For example, high molecular weight PAHs may cause cancer in humans while low molecular weight PAHs are not carcinogenic. Benzo(a)pyrene (BaP) has been well characterized as the most carcinogenic of the group [4]. In this report, BaP was used as a surrogate to assess potential human risks associated with PAHs in soils. To address the total effect of PAHs, individual PAH concentrations were converted to a BaP toxic equivalent (TEQ) value using established toxic equivalency factors (TEFs) [4] (Appendix C). Total BaPs for each AOI were compared to the available cancer comparison value for BaP.

Public Health Implications

Non-cancer Exposure Analysis

Metals

The contaminants that were found to be greater than their non-cancer CVs are included in Table 1. Details of the averages of all the metals detected in each AOI are included in Appendix B. The metals cadmium and chromium were higher than their health-based CVs. The average value for cadmium in soil was higher than the chronic CV for children in AOI A, C, D, E, and H. The average value for chromium exceeded the chronic CV for children in AOI A, C, D, E, F and G. Cadmium and chromium average concentrations at each AOI exceeded the background values of 27.5 milligram per kilogram (mg/kg) for chromium, and 1.9 mg/kg for cadmium established for soils at Eastern Michaud Flats [5], a site located approximately 4 miles northwest of UPRR railyard. However, cadmium and chromium average concentrations did not exceed the adult chronic CVs.

To determine if the average concentrations of cadmium and chromium pose a possible health risk, BCEH calculated an exposure dose and compared the estimated exposure dose to exposure doses considered to be safe. Using our standard scenarios (16 kg child ingesting 200 mg of soil/day and 70 kg adult ingesting 100 mg of soil/day) and the highest average cadmium soil concentration of 9.21 mg/kg, found in AOI A which is adjacent to residential areas, the estimated dose was 0.00011 mg/kg/day for a child and 0.000013 mg/kg/day for an adult. Both the estimated dose for a child and an adult are lower than the reference dose (RfD) of 0.001 mg/kg/day in food established by EPA [6]. An exposure dose calculation was done for total chromium (chromium VI and chromium III) using our standard exposure scenarios and the highest average concentration of 121.02 mg/kg found in AOI E. The estimated dose for a child is 0.0015 mg/kg/day, and the estimated dose for an adult is 0.00017 mg/kg/day (Appendix D). Both of these values are below the chromium VI RfD of 0.003 mg/kg/day [7]. Because the dose calculations are below the RfDs, and it is likely that the real exposure to hexavalent chromium is much lower, BCEH does not expect that exposure to chromium or cadmium is likely to cause harm to anyone exposed to the on-site soils at the UPRR.

Table 1: Contaminants that exceeded the non-cancer comparison values (CVs) in on-site surface soil samples at Union Pacific Rail Yard, Pocatello, Idaho

Area of Interest (AOI)	Metals	Concentration range (mg/kg)	Average Concentration mg/kg	Comparison Value (CV) (Child)[a]	Comparison Value (CV) (Adult)[c]
A	Cadmium	0.52-34.40	**9.21**	5	70
	Chromium[d]	14.50-141	59.57	50	700
	Lead	11.6-2,970	**382.49**	140[b]	
C	Cadmium	0.81-23.85	8.83	5	70
	Chromium	22.20-268.85	108.10	50	700
	Lead	230-462	371.33	140[b]	
D	Cadmium	0.75-29.4	8.01	5	70
	Chromium	15-239	88.94	50	700
E	Cadmium	3.6-9.99	6.14	5	70
	Chromium	26.2-284	**121.02**	50	700
	Lead	44.90-610	237.78	140[b]	
F	Chromium	13.5-294	110.46	50	700
G	Chromium	23.30-49.10	32.38	50	700
	Lead	38.40-351	153.54	140[b]	
H	Cadmium	0.62-42	9.03	5	70
	Chromium	13.50-246	61.77	50	700

a = ATSDR Chronic Environmental Media Evaluation Guides (EMEGs) for child
b = BCEH provisional lead screening value
c = ATSDR Chronic Environmental Media Evaluation Guides (EMEGs) for adult
d = Hexavalent chromium used as a surrogate for total chromium
mg/kg = milligrams per kilogram
Values in bold represent highest average concentrations

The current EPA Regional Screening Level (RSL) for lead in residential soil is 400 mg/kg. However, the recent recommendation from the advisory committee on childhood lead poisoning prevention to the Centers for Disease Control and Prevention (CDC) is to use a value of 5 µg/dL instead of 10 µg/dL to identify children with elevated blood lead levels. Thus, to match the

5 µg/dL blood lead value, BCEH considered soils that are above 140 mg/kg to need further investigation and consideration. AOI A, C, E, G had lead levels above 140 mg/kg (Table 1). To assist in understanding if the lead presents a health hazard for children, the EPA's Integrated Exposure Uptake Biokinetic (IEUBK) model was used to predict children's exposure as measured by the amount of lead in blood [8]. The on-site lead values were used in the model. The IEUBK model default values were used for all other variables. BCEH found that the highest average lead concentration of 383 mg/kg (AOI A) in surface soils would equate to blood lead levels ranging from 3 to 5.5 µg/dL for children aged seven and younger. These estimated blood lead levels are below or slightly above the proposed blood lead reference value of 5µg/dL (Table 2). However, it is important to consider that the lead concentrations used in the model are from samples taken from the rail yard and not the residential yards or nearby parks. Also, other sources of lead exposure may be present. For example, lead-based paint was not banned from residential home use until 1978, so homes built before this time are likely have lead-based paint and this exposure could result in higher blood lead levels in children living in older homes. While the estimated blood lead level for children is greater than the current recommended level for identifying children with lead poisoning, BCEH believes it is unlikely that children (ages of 6 months to 7 years) are regularly and continually exposed to the soils on the site because it is an industrial site and monitored by Union Pacific employees.

Table 2: Modeled ranges of blood lead levels of children

AOI	Average lead concentration in surface soil (mg/kg)	Estimated range of children's blood lead levels (µg/dL)[a]
A	382.49	3.0 – 5.5
C	371.33	2.9 – 5.4
E	237.78	2.1 – 3.9
G	153.54	1.6 – 2.9

a = children aged from 6 months to 7 years of age

PCBs

Only Aroclor 1254 and Aroclor 1260 were detected in the surface soil. Aroclor 1254 was detected in only one soil sample from AOI H at a level below its chronic CV of 1 mg/kg (ATSDR's Reference Media Evaluation Guide for children). Thus, BCEH disregarded Aroclor 1254 for further analysis. Aroclor 1260 was detected in 15 of the 43 samples and in each AOI, except for AOI F; however, neither EPA nor ATSDR have a chronic CV for Aroclor 1260. There currently are no studies in the scientific literature regarding non-cancer chronic exposures to Aroclor 1260. A cancer CV is available, and it is discussed below in the Cancer Exposure Analysis section.

PAHs

Benzo(a)pyrene (BaP) was used as a surrogate to assess the relative toxicity of PAHs in surface soil. BaP values were calculated for each AOI except for AOI C, where no PAHs were detected. No RfD is available for BaP; however, NOAEL and LOAEL values exist that are based on mice exposed to BaP and the appearance of gastric tumors. The NOAEL is 1.3 mg/kg/day and the LOAEL is 2.6 mg/kg/day [9]. There currently are no studies available that evaluate chronic exposures [9]. Using our standard exposure scenarios (16 kg child ingesting 200 mg of soil/ day and 70 kg adult ingesting 100 mg of soil/day) and the soil sample with the highest BaP TEQ of

19.14 mg/kg, detected in AOI H, adjacent to a medium-density, single-family residence area, the estimated exposure dose was 0.00024 mg/kg/day for a child and 0.000027 mg/kg/day for an adult. The estimated doses for exposure to BaP in soil to children and adults are several orders of magnitude below the NOAEL (1.3 mg/kg/day) and LOAEL (2.6 mg/kg/day) values detected in mice. The highest BaP TEQ of 19.14 mg/kg is below background levels of PAHs in urban soils [9]

Cancer Exposure Analysis

Metals
Arsenic has been classified by EPA as a "known human carcinogen" [10]. 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. The highest average (13.57 mg/kg) concentration of arsenic in surface soils exceed the CREG value of 0.5 mg/kg (Table 3 and Appendix B Table B4) and the background value of 7.7 mg/kg established for soils at Eastern Michaud Flats [5]. Using our standard exposure scenarios (16 kg child ingesting 200 mg of soil/day and 70 kg adult ingesting 100 mg of soil/day) and the highest average arsenic concentration of 13.57 mg/kg, the calculated exposure doses are 0.00017 mg/kg/day for a child and 0.000019 mg/kg/day for an adult. Estimates of cancer risk from long term exposures (30 years) to these doses indicate a low risk of developing cancer in each type of population (children and adults). The cancer risk estimates from exposure to arsenic in soil are 1 additional cancer in a population of 100,000 adults and 1 additional cancer in a population of 10,000 children (Table 3 and Appendix D). These estimated cancer risk calculations are considered to be low. Thus, BCEH does not expect exposure to soil contaminated with arsenic at the UPRR to result in increases in the risk of developing cancer above what is normally seen in U.S. populations.

Total chromium was reported in the analytical results. Total chromium can include both Chromium III and Chromium VI since both exist in nature and from industrial sources. Chromium VI is more toxic than Chromium III, and EPA has classified Chromium VI as a "human carcinogen". The highest average chromium concentration (121 mg/kg) was above the EPA cancer-RSL of 0.29 mg/kg (Table 3 and Appendix B Table B4). Dose calculations were calculated using our standard exposure scenarios (16 kg child ingesting 200 mg of soil per day and 70 kg adult ingesting 100 mg of soil/day). The exposure dose for a child was calculated at 0.0015 mg/kg/day and the exposure dose for an adult was 0.00017 mg/kg/day. Estimated cancer risk calculations using these exposure doses and 30-year exposure time indicate a moderate risk of developing cancer for both children and adults. The cancer risks resulting from exposure to chromium in soil using the highest average Chromium VI concentration results in 4 additional cancers in a population of 100,000 adults and 3 additional cancers in a population of 10,000 children (Table 3 and Appendix D). EPA considers cancer risk less than one additional cancer among one million people exposed (i.e., 1 in 1,000,000) to be insignificant. Also, EPA uses a target range (1 in 10,000 to 1 in 1'000,000) within which the Agency determines whether or not action is warranted [11]. Although few additional cancers were calculated, it is possible that the cancer risk calculations are overestimated because the chromium value is considered to be Chromium VI, the most toxic form of chromium, and not a combination of Chromium VI and Chromium III. EPA considers a ratio of 6:1 for Chromium III compared to Chromium VI for risk calculations [7]. Thus, when using the total chromium divided by 7 (121mg/kg/7) or 17.28 mg/kg the calculated estimated cancer risks is much lower. For example, the highest average detected would equate to 5 additional cancers in a population of 1 million adults and 5 additional cancers in 100,000 children (Appendix D). These estimated cancer risk calculations are considered to be moderate. This determination is very conservative and probably overestimates any actual carcinogenic risk because the on-site contaminated soil is not accessible (i.e., site is restricted to public access) and exposure is greatly reduced by the presence of gravel covering surface soils along the yard. Consequently, the estimated lifetime cancer risk is probably lower than the calculations reported in this health consultation.Thus, BCEH does not expect exposure to soil contaminated with chromium at the UPRR to result in increases in the risk of developing cancer above what is normally seen in U.S. populations.

PCBs

PCBs have been classified as "probable human carcinogens" by the EPA [12]. The highest average concentration of Aroclor 1260 (0.85 mg/kg) exceeded the cancer CV of 0.22 (Table 3 and Appendix B Table B8). Using our standard exposure scenarios (16 kg child ingesting 200 mg of soil/day and 70 kg adult ingesting 100 mg of soil/day) to calculate exposure doses and the highest average concentration of 0.85 mg/kg, the estimated exposure dose was 0.00001 mg/kg/day for a child and 0.000001 mg/kg/day for an adult. Estimated cancer risk calculations using these exposure doses and 30-year exposure time yielded low cancer risk of developing cancer in both adults and children. The cancer risk for an adult exposed to the highest average concentration is 1 additional cancer in 1 million adults and 9 additional cancers in 1 million children (Table 3 and Appendix D). These estimated cancer risk values are low to moderate. Therefore, accidental ingestion to soils contaminated with Aroclor 1260 is unlikely to cause an increase in cancers in children or adults above the background rates found in U.S. populations.

Table 3: Contaminants that exceeded the cancer comparison values (CVs) in surface on-site soil samples at Union Pacific Rail Yard, Pocatello, Idaho

Contaminant	Area of Interest (AOI)	Concentration range (mg/kg)	Highest Average Concentration mg/kg	Cancer Comparison Value (CV)	Estimated additional life time cancer risk
Metals					
Arsenic	E	2.94-48.5	13.57	0.5[a]	1×10^{-5} (adult) 1×10^{-4} (children)
Chromium	E	13.5-294	121.02	0.29[b]	4×10^{-5} (adult) 3×10^{-4} (children)
PCBs					
Aroclor 1260	C	ND-0.85	0.85	0.22[b]	1×10^{-6} (adult) 9×10^{-6} (children)
PAHs					
BaP-TEQ	H	ND-19.14	19.14	0.1[a]	9×10^{-5} (adult) 8×10^{-4} (children)

BaP-TEQ = Benzo(a)pyrene toxicity equivalence value
ND = below the analytical method reporting limit
a = ATSDR Cancer Risk Evaluation Guide (CREG)
b = EPA Regional Screening Level (RSL) Resident Soil Carcinogenic value
mg/kg = milligram per kilogram

PAHs
Benzo(a)pyrene (BaP), along with several other PAHs, has been classified by the EPA as a "probable human carcinogen" [9]. BaP was used as a surrogate to assess the relative toxicity of PAHs in surface soil. It is important to emphasize that the percentage of detected PAHs was low, ranging from 2 to 16% in each AOI (Table B9). The BaP maximum concentration of 19.14 mg/kg was above the CV of 0.1 (Table 3 and Appendix B Table B9). Using our standard exposure scenarios (16 kg child ingesting 200 mg of soil/day and 70 kg adult ingesting 100 mg of soil/day) and the soil sample with the highest BaP TEQ of 19.14 mg/kg, the estimated exposure was 0.00024 mg/kg/day for a child and 0.000027 mg/kg/day for an adult. The cancer risk calculations using the highest average value indicate the risk of an adult exposed to BaP from accidental ingestion is 9 additional cancers in a population of 100,000 adults and 8 additional cancers in a population of 10,000 children (Table 3 and Appendix D). Although these highest values pose a moderate to high risk of cancer, it is important to emphasize that direct exposure to contaminated soils is highly minimized by the presence of gravel along the rail yard and regular exposure is unlikely. In addition, people (non-workers) are not likely to visit the site every day for 30 years because of access restrictions employed by the rail road. The assumptions in these estimates are health protective and tend to overestimate the risk. Moreover, the classification of BaP as "probable human carcinogen" is based on animal studies where repeated BaP administration has been associated with increased incidence tumors [9]. Human data specifically linking BaP, or any of the other PAHs, to a carcinogenic effect, particularly lung cancer, are inconclusive [9]. Consequently, BCEH does not expect exposure to PAHs at the UPRR will result in an increased risk of cancer greater than background levels found in the U.S. population.

Uncertainties
The on-site samples may not be representative of the levels of contaminants in soils on land (residential and parks) adjacent to or near the site. Environmental, climatic, and other factors (e.g. wind speed, rain, amount of time people spend outdoors, presence of urban contaminants off-site, etc.) could increase or decrease the exposure to contaminants transported off-site. No air monitoring was conducted on site; so, it is not known to what degree breathing dust from the site may harm the health of those exposed. Uncertainty is also associated with the use of the IEUBK model with the use of default values and on-site surface soil lead values. Exposure scenarios considered standard exposures and 30 years of exposure, which is the time that a family may spend in a residence; these assumptions are very conservative and may not truly represent exposure risk to those living and recreating in the area. Some of the laboratory results were flagged as below the laboratory reporting limit. This analysis did not include any contaminant below the laboratory reporting limit. Values below the laboratory reporting limit do not indicate whether the contaminant is present at a concentration just below the detection limit, present at a concentration just above zero, or absent from the sample. Therefore, contaminants that are evaluated as non-detects can lead to an overestimation of risk if the actual concentrations are just above zero, or absent from the sample.

Children's Health Considerations

ATSDR and BCEH recognize that children may be more sensitive to contaminant exposures than adults. This sensitivity is a result of several factors: 1) children may have greater exposures to environmental toxicants than adults because, pound for pound of body weight, children drink more water, eat more food, and breathe more air than adults; 2) children play outdoors close to the ground, increasing their exposure to toxicants in dust, soil, water, and air; 3) children have a tendency to put their hands in their mouths while playing, thereby exposing them to potentially contaminated soil particles at higher rates than adults; 4) children are shorter than adults, meaning that they can breathe dust, soil, and any vapors close to the ground; and 5) children grow and develop rapidly; they can sustain permanent damage if toxic exposures occur during critical growth stages. BCEH considered all these factors when determining health risks at the UPRR site.

Conclusions

Although a few metals found in surface soils exceeded screening values and background concentrations established for this part of the United States, concentrations of these metals were below levels that have been shown to cause harmful health effects. The estimated lead blood levels in children using on-site values and the IEUBK model indicate lead blood levels that are in the range that could prompt a public health response. It is unlikely that children would be exposed to soils on the site on a regular basis, and BCEH does not believe that the on-site lead is a health concern for residents living nearby. Since lead is ubiquitous element in urban areas and other sources besides the rail yard may be of concern (i.e., lead-based paint from old housing), BCEH will provide health education to the communities near the site to raise awareness of lead hazards. The estimated exposure doses of Aroclor 1260 and PAHs were below levels shown to cause harmful health effects. While the levels of chromium, arsenic, Aroclor 1260 and total PAHs (measured as BaP TEQ) were above their cancer screening CVs, the estimated risk of developing cancer is low and not considered a public health threat for those living in the area. With these findings BCEH concludes that touching or incidentally eating the contaminants found in the surface soil at the Union Pacific Railroad maintenance yard in Pocatello is not expected to harm people's health because the amount of the contaminants are below levels of health concern.

Recommendations

1. For future soil sampling efforts BCEH recommends collecting soil samples (0-2 inches deep) from residential and recreational areas.

2. To prevent lead exposure BCEH will provide educational outreach program to provide information to the families living in the areas where lead levels in an AOI is above 140 mg/kg. These efforts will be coordinated with the local health district, IDEQ and EPA.

Public Health Action Plan

Actions planned

- BCEH will communicate these findings to EPA and IDEQ upon completion of this PHC.
- BCEH will coordinate with IDEQ on dissemination of this report's findings.
- BCEH will coordinate with the Southeast Idaho Public Health District officials to distribute childhood lead poisoning prevention information to families living near the UPRR.

- BCEH will remain in contact with EPA and IDEQ and will evaluate new environmental monitoring data for contamination near the UPRR if more sampling is conducted in the future.

Report Preparation

This Public Health Consultation for the Union Pacific Railroad Company site was prepared by the Idaho Department of Health and Welfare under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with the approved agency methods, policies, and procedures existing at the date of publication. Editorial review was completed by the cooperative agreement partner. ATSDR has reviewed this document and concurs with its findings based on the information presented.

Authors
Norka Paden, Ph.D., Idaho Division of Public Health
Health Assessor

Jim Vannoy, MPH, Idaho Division of Public Health
Program Manager

State Reviewers
Kara Stevens, BS, Idaho Division of Public Health
Bureau of Community and Environmental Health Section Manager

Elke Shaw-Tulloch, MHS, Idaho Division of Public Health
Chief, Bureau of Community and Environmental Health

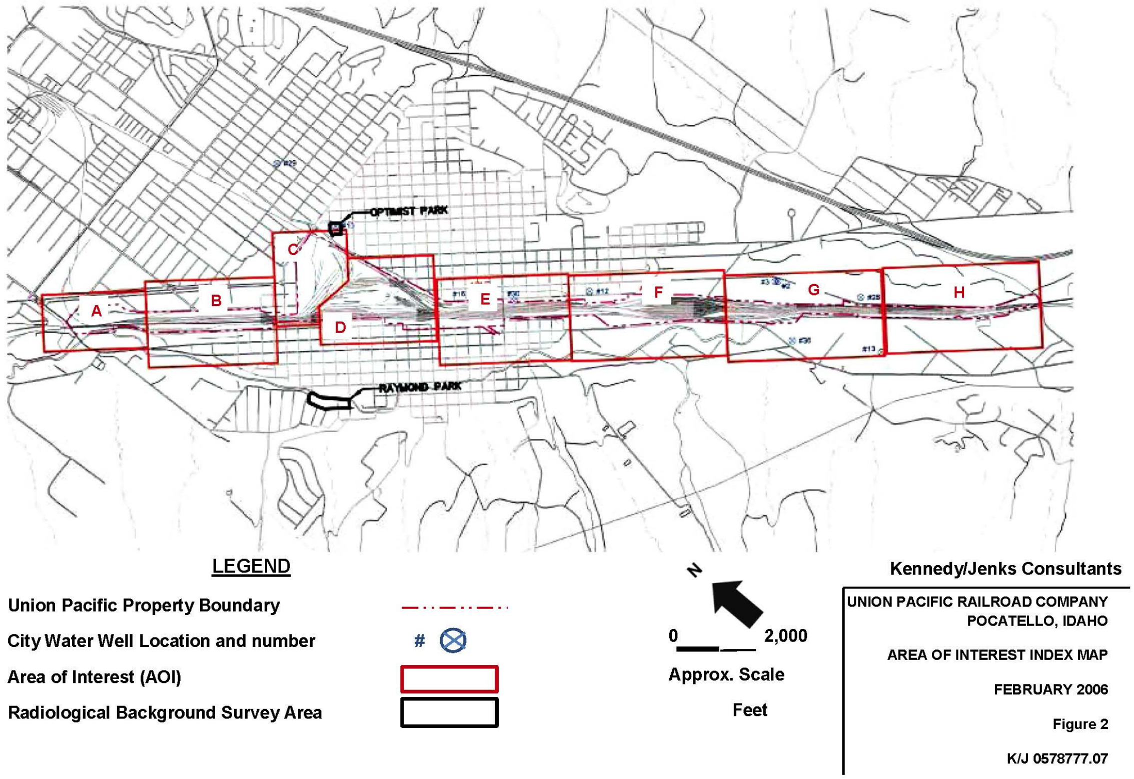
Jeffrey E. Fromm, PhD., Idaho Department of Environmental Quality
Technical Services

ATSDR Reviewers

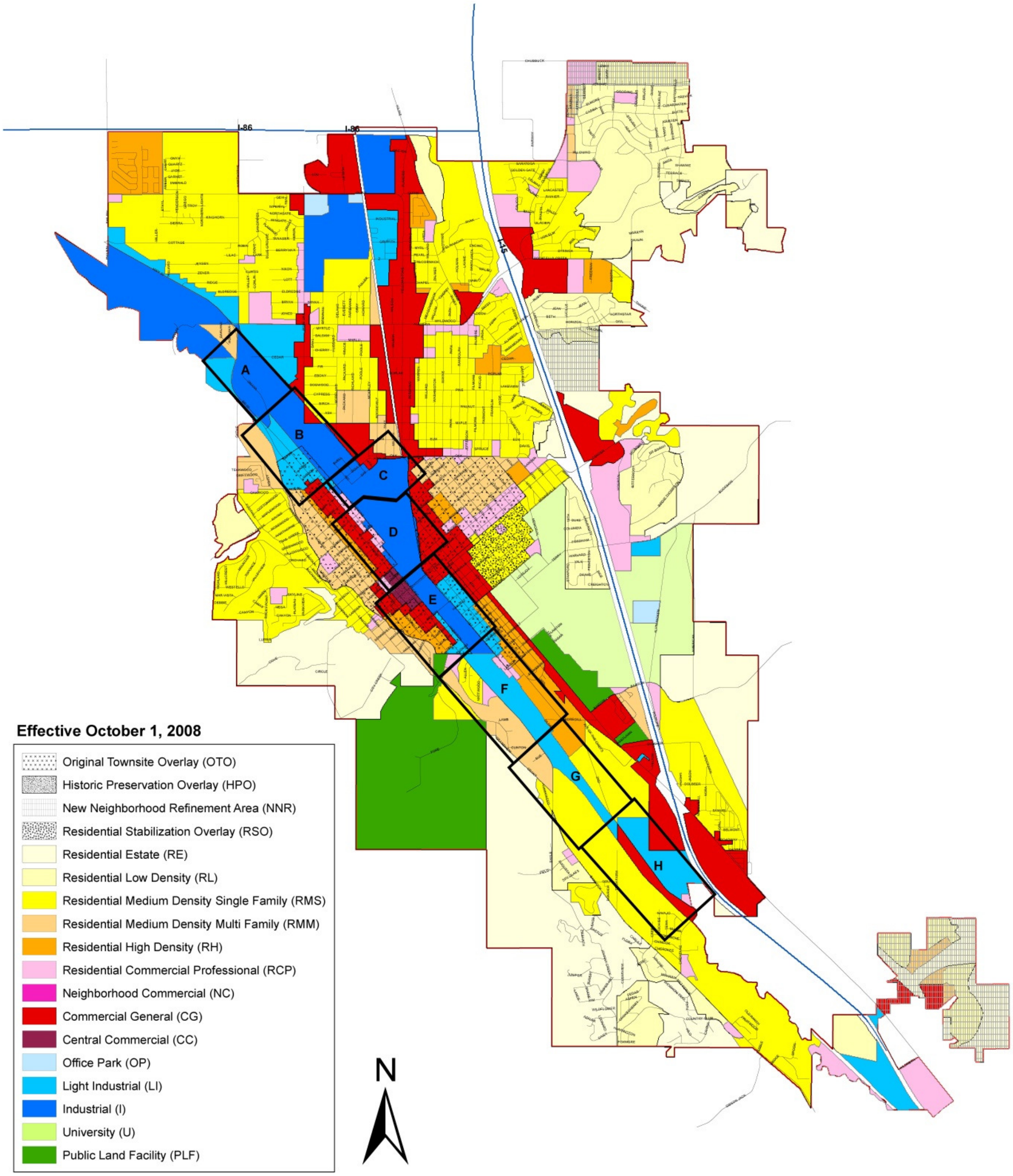
Division of Community Health Investigations

Audra Henry, Technical Project Officer
Alan Yarbrough, State Cooperative Agreement Coordinator
Cassandra Smith, Western Branch Chief
Lynn Wilder, Acting Associate Director for Science
Tina Forrester, Acting Division Director

Appendix A1: Areas of Interest or Sampling Locations Map [1]



Appendix A2: Overlay of AOI on Pocatello City Zoning Map



Appendix B: Minimum, maximum, and average concentrations of metals in soil and human health comparison values found on-site at Area of Interests A, C, D, E, F, G, and H

Table B1. Metals in on-site soil at Area of Interest A, Union Pacific Rail Yard, Pocatello, ID

Metals	Number of samples	Percentage of detects	Minimum Detected Value (mg/kg)	Maximum Detected Value (mg/kg)	Average Value (mg/kg)	Non-Cancer Comparison Value (CV) (Child)	Non-Cancer Comparison Value (CV) (Adult)	Cancer Comparison Value (CV)
Antimony	10	70	0.62	92	16.83	20[a]	300[a]	
Arsenic	10	100	3.75	48.50	**10.26**	20[b]	200[b]	0.5[e]
Beryllium	10	10	1.02	1.02	1.02	100[a]	1000[a]	
Cadmium	10	90	0.52	34.40	**9.21**	5[b]	70[b]	
Chromium	10	100	14.50	141	**59.57**	50[b]	700[b]	0.29[d]
Copper	10	100	10.30	662	95.25	500[c]	7,000[c]	
Lead	10	100	11.60	2970	**382.49**	140[d]		
Mercury	10	30	0.11	0.45	0.27		10[d]	
Nickel	10	100	10.90	68.30	22.19	1,000[a]	10,000[a]	
Selenium	10	40	1.34	3.70	2.38	300[b]	4,000[b]	
Silver	10	40	0.63	10.30	3.96	300[a]	4,000[a]	
Thallium	10	10	0.52	0.52	0.52	4[a]	60[a]	
Zinc	10	100	42.1	1410	332.93	20,000[b]	200,000[b]	

a = ATSDR Intermediate Reference Media Evaluation Guide (RMEG) for child and adult
b = ATSDR Chronic Environmental Media Evaluation Guides (EMEGs) for child and adult
c = ATSDR Intermediate Environmental Media Evaluation Guides (EMEGs) for child and adult
d = BCEH provisional lead screening value
e = ATSDR Cancer Risk Evaluation Guide (CREG)
mg/kg = milligrams per kilogram
Values in bold represent concentrations above the comparison values

Table B2. Metals in on-site at Area of Interest C, Union Pacific Rail Yard, Pocatello, ID

Metals	Number of samples	Percentage of detects	Minimum Detected Value (mg/kg)	Maximum Detected Value (mg/kg)	Average Value (mg/kg)	Non-Cancer Comparison Value (CV) (Child)	Non-Cancer Comparison Value (CV) (Adult)	Cancer Comparison Value (CV)
Antimony	3	100	9.99	27.90	17.26	20[a]	300[a]	
Arsenic	3	100	7.46	13.66	**11.44**	20[b]	200[b]	0.5[e]
Beryllium	3	33.33	1.24	1.24	1.24	100[a]	1000[a]	
Cadmium	3	100	0.81	23.85	**8.83**	5[b]	70[b]	
Chromium	3	100	22.20	268.50	**108.10**	50[b]	700[b]	0.29[d]
Copper	3	100	62.30	208	111.80	500[c]	7,000[c]	
Lead	3	100	230	462	**371.33**	140[d]		
Mercury	3	33.33	0.22	0.22	0.22		10[d]	
Nickel	3	100	22.90	46.75	30.98	1,000[a]	10,000[a]	
Selenium	3	66.67	0.59	4.99	2.79	300[b]	4,000[b]	
Silver	3	66.67	0.63	2.97	1.80	300[a]	4,000[a]	
Thallium	3	33.33	0.53	0.53	0.53	4[a]	60[a]	
Zinc	3	100.00	110	530.50	273.50	20,000[b]	200,000[b]	

a = ATSDR Intermediate Reference Media Evaluation Guide (RMEG) for child and adult
b = ATSDR Chronic Environmental Media Evaluation Guides (EMEGs) for child and adult
c = ATSDR Intermediate Environmental Media Evaluation Guides (EMEGs) for child and adult
d = BCEH provisional lead screening value
e = ATSDR Cancer Risk Evaluation Guide (CREG)
mg/kg = milligrams per kilogram
Values in bold represent concentrations above the comparison value

Table B3. Metals in on-site at Area of Interest D, Union Pacific Rail Yard, Pocatello, ID

Metals	Number of samples	Percentage of detects	Minimum Detected Value (mg/kg)	Maximum Detected Value (mg/kg)	Average Value (mg/kg)	Non-Cancer Comparison Value (CV) (Child)	Non-Cancer Comparison Value (CV) (Adult)	Cancer Comparison Value (CV)
Antimony	5	100	0.93	6.21	3.32	20[a]	300[a]	
Arsenic	5	100	2.94	15.75	**8.07**	20[b]	200[b]	0.5[e]
Beryllium	5	40	1.05	1.07	1.06	100[a]	1000[a]	
Cadmium	5	100	0.75	29.4	**8.01**	5[b]	70[b]	
Chromium	5	100	15.00	239	**88.94**	50[b]	700[b]	0.29[d]
Copper	5	100	28.80	157.5	79.07	500[c]	7,000[c]	
Lead	5	100	36.40	215.5	111.85	140-[d]		
Mercury	5	0	0	0	0		10[d]	
Nickel	5	100	9.89	31.20	20.17	1,000[a]	10,000[a]	
Selenium	5	60.00	0.68	3.93	1.83	300[b]	4,000[b]	
Silver	5	60	0.64	3.65	1.48	300[a]	4,000[a]	
Thallium	5	0	0	0	0	4[a]	60[a]	
Zinc	5	0	89.8	440	259.47	20,000[b]	200,000[b]	

a = ATSDR Intermediate Reference Media Evaluation Guide (RMEG) for child and adult
b = ATSDR Chronic Environmental Media Evaluation Guides (EMEGs) for child and adult
c = ATSDR Intermediate Environmental Media Evaluation Guides (EMEGs) for child and adult
d =BCEH provisional lead screening value
e = ATSDR Cancer Risk Evaluation Guide (CREG)
mg/kg = milligrams per kilogram
Values in bold represent concentrations above the comparison value

Table B4. Metals in on-site at Area of Interest E, Union Pacific Rail Yard, Pocatello, ID

Metals	Number of samples	Percentage of detects	Minimum Detected Value (mg/kg)	Maximum Detected Value (mg/kg)	Average Value (mg/kg)	Non-Cancer Comparison Value (CV) (Child)	Non-Cancer Comparison Value (CV) (Adult)	Cancer Comparison Value (CV)
Antimony	5	100	1.16	22.30	6.02	20[a]	300[a]	
Arsenic	5	100	4.37	26.50	**13.57**	20[b]	200[b]	0.5[e]
Beryllium	5	40	1.12	1.42	1.27	100[a]	1000[a]	
Cadmium	5	100	3.6	9.99	**6.14**	5[b]	70[b]	
Chromium	5	100	26.2	284	**121.02**	50[b]	700[b]	0.29[d]
Copper	5	100	35	169	80.42	500[c]	7,000[c]	
Lead	5	100	44.90	610	**237.78**	140[d]		
Mercury	5	60	0.16	0.25	0.21		10[d]	
Nickel	5	100	14.00	49.80	26.24	1,000[a]	10,000[a]	
Selenium	5	100	0.52	3.84	1.75	300[b]	4,000[b]	
Silver	5	100	0.67	2.15	1.26	300[a]	4,000[a]	
Thallium	5	0	0	0	0	4[a]	60[a]	
Zinc	5	120.00	212	833	420	20,000[b]	200,000[b]	

a = ATSDR Intermediate Reference Media Evaluation Guide (RMEG) for child and adult
b = ATSDR Chronic Environmental Media Evaluation Guides (EMEGs) for child and adult
c = ATSDR Intermediate Environmental Media Evaluation Guides (EMEGs) for child and adult
d = BCEH provisional lead screening value
e = ATSDR Cancer Risk Evaluation Guide (CREG)
mg/kg = milligrams per kilogram
Values in bold represent concentrations above the comparison value

Table B5. Metals in on-site at Area of Interest F, Union Pacific Rail Yard, Pocatello, ID

Metals	Number of samples	Percentage of detects	Minimum Detected Value (mg/kg)	Maximum Detected Value (mg/kg)	Average Value (mg/kg)	Non-Cancer Comparison Value (CV) (Child)	Non-Cancer Comparison Value (CV) (Adult)	Cancer Comparison Value (CV)
Antimony	5	100	0.773	2.73	1.73	20[a]	300[a]	
Arsenic	5	100	3.09	19.6	**7.25**	20[b]	200[b]	0.5[e]
Beryllium	5	20	1.53	1.53	1.53	100[a]	1000[a]	
Cadmium	5	100	0.558	6.69	4.14	5[b]	70[b]	
Chromium	5	100	13.5	294	**110.46**	50[b]	700[b]	0.29[d]
Copper	5	100	30	180	70.84	500[c]	7,000[c]	
Lead	5	100	34.2	202	78.60	140[d]		
Mercury	5	20	0.138	0.138	0.14		10[d]	
Nickel	5	100	15.6	28.9	22.32	1,000[a]	10,000[a]	
Selenium	5	80	0.548	4.26	2.12	300[b]	4,000[b]	
Silver	5	60	1.16	2.54	1.67	300[a]	4,000[a]	
Thallium	5	0	0	0	0	4[a]	60[a]	
Zinc	5	100	46.7	477	187.54	20,000[b]	200,000[b]	

a = ATSDR Intermediate Reference Media Evaluation Guide (RMEG) for child and adult
b = ATSDR Chronic Environmental Media Evaluation Guides (EMEGs) for child and adult
c = ATSDR Intermediate Environmental Media Evaluation Guides (EMEGs) for child and adult
d = BCEH provisional lead screening value e = ATSDR Cancer Risk Evaluation Guide (CREG)
mg/kg = milligrams per kilogram
Values in bold represent concentrations above the comparison value

Table B6. Metals in on-site at Area of Interest G, Union Pacific Rail Yard, Pocatello, ID

Metals	Number of samples	Percentage of detects	Minimum Detected Value (mg/kg)	Maximum Detected Value (mg/kg)	Average Value (mg/kg)	Non-Cancer Comparison Value (CV) (Child)	Non-Cancer Comparison Value (CV) (Adult)	Cancer Comparison Value (CV)
Antimony	5	80	0.84	4.35	1.85	20[a]	300[a]	
Arsenic	5	100	4.98	11.80	**7.73**	20[b]	200[b]	0.5[e]
Beryllium	5	0	0	0	0	100[a]	1000[a]	
Cadmium	5	100	1.14	9.48	3.92	5[b]	70[b]	
Chromium	5	100	23.30	49.10	**32.38**	50[b]	700[b]	0.29[d]
Copper	5	100	22.80	164.00	60.64	500[c]	7,000[c]	
Lead	5	100	38.40	351.00	**153.54**	140[d]		
Mercury	5	20	0.12	0.12	0.12		10[d]	
Nickel	5	100	10.90	27.40	18.92	1,000[a]	10,000[a]	
Selenium	5	40	0.49	0.58	0.53	300[b]	4,000[b]	
Silver	5	40	0.94	1.12	1.03	300[a]	4,000[a]	
Thallium	5	0	0	0	0	4[a]	60[a]	
Zinc	5	100	88.6	968	313.72	20,000[b]	200,000[b]	

a = ATSDR Intermediate Reference Media Evaluation Guide (RMEG) for child and adult
b = ATSDR Chronic Environmental Media Evaluation Guides (EMEGs) for child and adult
c = ATSDR Intermediate Environmental Media Evaluation Guides (EMEGs) for child and adult
d = BCEH provisional lead screening value
e = ATSDR Cancer Risk Evaluation Guide (CREG)
mg/kg = milligrams per kilogram
Values in bold represent concentrations above the comparison value

Table B7. Metals in on-site at Area of Interest H, Union Pacific Rail Yard, Pocatello, ID

Metals	Number of samples	Percentage of detects	Minimum Detected Value (mg/kg)	Maximum Detected Value (mg/kg)	Average Value (mg/kg)	Non-Cancer Comparison Value (CV) (Child)	Non-Cancer Comparison Value (CV) (Adult)	Cancer Comparison Value (CV)
Antimony	10	80	0.59	6.49	2.35	20[a]	300[a]	
Arsenic	10	100	4.03	18.1	**6.83**	20[b]	200[b]	0.5[e]
Beryllium	10	10.00	1.35	1.35	1.35	100[a]	1000[a]	
Cadmium	10	90	0.62	42	**9.03**	5[b]	70[b]	
Chromium	10	100	13.50	246	**61.77**	50[b]	700[b]	0.29[d]
Copper	10	100	14.00	458	95.88	500[c]	7,000[c]	
Lead	10	100	12.30	334	104.94		140[d]	
Mercury	10	20	0.16	1.34	0.75		10[d]	
Nickel	10	100	11.60	53.85	21.16	1,000[a]	10,000[a]	
Selenium	10	20	4.14	4.91	4.52	300[b]	4,000[b]	
Silver	10	40	0.72	2.62	1.65	300[a]	4,000[a]	
Thallium	10	20	0.79	0.79	0.79	4[a]	60[a]	
Zinc	10	100	52.20	1220	311.31	20,000[b]	200,000[b]	

a = ATSDR Intermediate Reference Media Evaluation Guide (RMEG) for child and adult
b = ATSDR Chronic Environmental Media Evaluation Guides (EMEGs) for child and adult
c = ATSDR Intermediate Environmental Media Evaluation Guides (EMEGs) for child and adult
d = BCEH provisional lead screening value
e = ATSDR Cancer Risk Evaluation Guide (CREG)
mg/kg = milligrams per kilogram
Values in bold represent concentrations above the comparison values

Table B8. Minimum, maximum, and average concentrations of Aroclor 1260 in soil and human health comparison values found on-site by Area of Interest, Union Pacific Rail Yard, Pocatello, ID

Areas of Interest (AOI)	Number of samples	% Detects	Minimum Detected Value (mg/kg)	Maximum Detected Value (mg/kg)	Average concentration (mg/kg)	Cancer Comparison Value (CV)[a]
A	10	50	0.035	0.12	0.062	0.22
C	3	33.33	0.85	0.85	**0.85**	
D	5	40	0.10	0.26	0.18	
E	5	20	0.03	0.03	0.03	
G	5	40	0.04	0.17	0.10	
H	10	10	0.10	0.10	0.10	

a = EPA Regional Screening Level (RSL) Resident Soil Carcinogenic value
Value in bold represents concentration above the comparison value
% = percentage
mg/kg = milligram/kilogram

Table B9. Range, average concentrations of Polyaromatic hydrocarbons (PAHs) in soil and human health comparison values found on-site by Area of Interest, Union Pacific Rail Yard, Pocatello, ID

Areas of Interest	Range of detected PAH concentrations in surface soil (mg/kg)	Average concentration of detected values (mg/kg)	Percent of Detected PAHs	Total BaP	Cancer Comparison Value (CV)[a]
A	070-1.27	0.99	4	**1.26**	0.1
D	0.39-0.51	0.45	2	0.0009	
E	0.39-2.13	1.33	7	0.004	
F	1.44-3.65	2.45	11	**3.39**	
G	0.36-2.56	1.24	13	**1.46**	
H	0.94-16	4.92	16	**19.14**	

a = ATSDR Cancer Risk Evaluation Guide (CREG)
BaP = Benzo (a) pyrene
TEQ = Toxic Equivalent
Values in bold represent concentration above the comparison value

Appendix C: Toxic Equivalency Factors (TEFs) for Polycyclic aromatic hydrocarbons (PAHs)

Polyaromatic Hydrocarbons (PAHs)	**Toxicity Equivalency Factors (TEFs)**
Dibenzo(a,h)anthracene	5
Benzo(a)pyrene	1
Benzo(a)anthracene	0.1
Benzo(b)fluoranthene	0.1
Benzo(k)fluoranthene	0.1
Indeno(1,2,3-cd)pyrene	0.1
Benzo(g,h,i)perylene	0.01
Anthracene	0.01
Chrysene	0.01
Acenaphthene	0.001
Acenaphthylene	0.001
Fluoranthene	0.001
Fluorene	0.001
2-Methylnaphthalene	0.001
Naphthalene	0.001
Phenanthrene	0.001
Pyrene	0.001

Source: [4] [1] = Toxic Equivalency Factors (TEFs); It is a way to express the toxicity of a mixture of toxic compounds (e.g., polycyclic aromatic hydrocarbons) in a single number, which indicates the degree of toxicity compared to the surrogate compounds [e.g., Benzo(a)pyrene (BaP)].

Appendix D: Dose Calculations and Cancer Risk Calculations

Dose Calculation Formula
Non-cancer

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

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 (default for adult 70 kg, and 16 kg for children)

Sources:
1 = ATSDR default values (100 mg/day adult average; 200 mg/day children average) [2]
2 = Exposure factor (default value of 1.0) [2]

Additional Cancer Risk Calculation

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

Dose = mg/kg-day
Cancer Slope Factor = EPA cancer slope factors from IRIS [6,7,8,9,10,11]
Exposure years = 30, approximate time in one residence

Cadmium (9.21 mg/kg soil)

Adult

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

$$= \frac{9.21 \times 100 \times 10^{-6} \times 1.0}{70}$$

$= 1.32 \times 10^{-5}$ mg/kg body weight per day (Exposure Dose)

Children

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

$$= \frac{9.21 \times 200 \times 10^{-6} \times 1.0}{16}$$

$= 1.15 \times 10^{-4}$ mg/kg body weight per day (Exposure Dose)

Chromium (121.02 mg/kg soil)

Adult

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

$= \frac{121.02 \times 100 \times 10^{-6} \times 1.0}{70}$

$= 1.73 \times 10^{-4}$ mg/kg body weight per day (Exposure Dose)

Cancer Slope Factor = 0.5 mg/kg-day^{-1}

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

$1.73 \times 10^{-4} \times 0.5 \times 30/70 = 3.71 \times 10^{-5}$ (Approximately 4 in 100,000)

Children

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

$= \frac{121.02 \times 200 \times 10^{-6} \times 1.0}{16}$

$= 1.51 \times 10^{-3}$ mg/kg body weight per day (Exposure Dose)

Cancer Slope Factor = 0.5 mg/kg-day^{-1}

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

$1.51 \times 10^{-3} \times 0.5 \times 30/70 = 3.24 \times 10^{-4}$ (Approximately 3 in 10,000)

Chromium (17.28 mg/kg soil)

Adult

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

$= 17.28 \times 100 \times 10^{-6} \times 1.0$

70

= 2.5 x 10^{-5} mg/kg body weight per day (Exposure Dose)

Cancer Slope Factor = 0.5 mg/kg-day^{-1}

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

2.5 x 10^{-5} x 0.5 x 30/70 = 5 x 10^{-6} (Approximately 5 in 1 million)

Children

Dose (mg/kg per day) = <u>C (mg/kg soil) x IR (mg soil ingested per day) x CF (10^{-6}) x EF</u>

BW (kg)

= 17.28 <u>x 200 x 10^{-6} x 1.0</u>

16

= 2.2 x 10^{-4} mg/kg body weight per day (Exposure Dose)

Cancer Slope Factor = 0.5 mg/kg-day^{-1}

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

2.2 x 10^{-45} x 0.5 x 30/70 = 5 x 10^{-5} (Approximately 5 in 100,000)

Arsenic (13.57 mg/kg soil)

Adult

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

$$= \frac{13.57 \text{ x } 100 \text{ x } 10^{-6} \text{ x } 1.0}{70}$$

$= 1.94 \text{ x } 10^{-5}$ mg/kg body weight per day (Exposure Dose)

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

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

$1.94 \text{ x } 10^{-5} \text{ x } 1.5 \text{ x } 30/70 = 1.25 \text{ x } 10^{-5}$ (Approximately 1 in 100,000)

Children

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

$$= \frac{13.57 \text{ x } 200 \text{ x } 10^{-6} \text{ x } 1.0}{16}$$

$= 1.7 \text{ x } 10^{-4}$ mg/kg body weight per day (Exposure Dose)

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

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

$1.7 \text{ x } 10^{-4} \text{ x } 1.5 \text{ x } 30/70 = 1.09 \text{ x } 10^{-4}$ (Approximately 1 in 10,000)

Aroclor 1260 (0.85 mg/kg soil)

Adult

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

$$= \frac{0.85 \times 100 \times 10^{-6} \times 1.0}{70}$$

$= 1.21 \times 10^{-6}$ mg/kg body weight per day (Exposure Dose)

Cancer Slope Factor = 2.0 mg/kg-day^{-1}

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

$1.21 \times 10^{-6} \times 2 \times 30/70 = 1.04 \times 10^{-6}$ (Approximately 1 in 1 million)

Children

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

$$= \frac{0.85 \times 200 \times 10^{-6} \times 1.0}{16}$$

$= 1.06 \times 10^{-5}$ mg/kg body weight per day (Exposure Dose)

Cancer Slope Factor = 2.0 mg/kg-day^{-1}

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

$1.06 \times 10^{-5} \times 2 \times 30/70 = 9.09 \times 10^{-6}$ (Approximately 9 in 1 million)

BaP (19.14 mg/kg soil)

Adult

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

$$= \frac{19.14 \text{ x } 100 \text{ x } 10^{-6} \text{ x } 1.0}{70}$$

$= 2.73 \text{ x } 10^{-5}$ mg/kg body weight per day (Exposure Dose)

Cancer Slope Factor = 7.3 mg/kg-day^{-1}

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

$2.73 \text{ x } 10^{-5} \text{ x } 7.3 \text{ x } 30/70 = 9 \text{ x } 10^{-5}$ (Approximately 9 in 100,000)

Children

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

$$= \frac{19.14 \text{ x } 200 \text{ x } 10^{-6} \text{ x } 1.0}{16}$$

$= 2.4 \text{ x } 10^{-4}$ mg/kg body weight per day (Exposure Dose)

Cancer Slope Factor = 7.3 mg/kg-day^{-1}

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

$2.4 \text{ x } 10^{-4} \text{ x} 7.3 \text{ x } 30/70 = 7.5 \text{ x } 10^{-4}$ (Approximately 8 in 10,000)

References

1. Human Health Risk Evaluation-1 and Screening level Ecological Risk Assessment, Union Pacific Railroad Pocatello Railyard, Pocatello, Idaho. November, 2010. Prepared by Center for Toxicological and Environmental Health, L.L.C. for Union Pacific Railroad.

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

3. Alloway, B.J. (ed.). 1990. Heavy metals in soils. John Wiley and Sons, Inc., New York cited in Canadian Soil Quality Guidelines for Protection of Environmental and Human Health. Canadian Environmental Quality Guidelines Canadian Council of Ministers of the Environment, 1999.

4. Nisbet ICT & LaGoy PK. 1992. Toxic Equivalency Factors (TEFs) for aromatic Hydrocarbons (PAHs). Regulatory Toxicology & Pharmacology 16: 290-300.

5. Rood, S.M., G.A. Harris and G.J. White. 1995. Background Dose Equivalent Rates and Surficial Soil Metal and Radionuclide Concentrations for the Idaho National Engineering Laboratory. Idaho National Engineering Laboratory, Lockheed Idaho Technologies Company, Chemical and Radiological Risk Assessment Department, Idaho Falls, Idaho. INEL-94/0250.

6. Agency for Toxic Substances and Disease Registry (ATSDR). 2012. Toxicological Profile for Cadmium. Atlanta: US Department of Health and Human Services. Available at: http://www.atsdr.cdc.gov/toxprofiles/tp.asp?id=48&tid=15

7. Agency for Toxic Substances and Disease Registry (ATSDR). 2012. Toxicological Profile for Chromium. Atlanta: US Department of Health and Human Services. Available at: http://www.atsdr.cdc.gov/toxprofiles/tp.asp?id=62&tid=17

8. Environmental Protection Agency – Integrated Exposure Uptake Biokenetic (IEUBK) model found at: http://www.epa.gov/superfund/lead/products.htm

9. Agency for Toxic Substances and Disease Registry (ATSDR). 1995. Toxicological Profile for Polycyclic Aromatic Hydrocarbons (PAHs). Atlanta: US Department of Health and Human Services. Available at: http://www.atsdr.cdc.gov/toxprofiles/tp.asp?id=122&tid=25

10. Agency for Toxic Substances and Disease Registry (ATSDR). 2007. Toxicological Profile for Arsenic. Atlanta: US Department of Health and Human Services. Available at: http://www.atsdr.cdc.gov/toxprofiles/tp.asp?id=22&tid=3

11. Environmental Protection Agency (EPA). 1992. Memorandum Role of Baseline Risk Assessment in Superfund Remedy Selection Decision. Washington: Office of Solid Waste and Emergency Response. OSWER Directive 9355.0-30.

12. Agency for Toxic Substances and Disease Registry (ATSDR). 2000. Toxicological Profile for Polychlorinated Biphenyls (PCBs). Atlanta: US Department of Health and Human Services. Available at: http://www.atsdr.cdc.gov/toxprofiles/tp.asp?id=142&tid=26

Selected Glossary

Acute Occurring over a short time.

Agency for Toxic Substances and Disease Registry (ATSDR)
The principal federal public health agency involved with hazardous waste issues, responsible for preventing or reducing the harmful effects of exposure to hazardous substances on human health and quality of life. ATSDR is part of the U.S. Department of Health and Human Services.

Analyte
A substance measured in the laboratory. A chemical for which a sample (such as water, air, or soil) is tested in a laboratory. For example, if the analyte is lead, the laboratory test will determine the amount of lead in the sample.

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

Cancer Slope Factor
A number assigned to a cancer causing chemical that is used to estimate its ability to cause cancer in humans.

Carcinogen
A substance that causes cancer.

Chronic
Occurring over a long time (more than 1 year).

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.

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.

Dose
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.

EPA
The U.S. Environmental Protection Agency.

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

IDEQ The Idaho Department of Environmental Quality.

Ingestion rate
The amount of an environmental medium which could be ingested typically on a daily basis. Units are in milligram per kilogram of soil per day for this study.

Intermediate Occurring over a time more than 14 days and less than one year.

Lowest Observed Adverse Effect Level (LOAEL)
The lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals.

Media
Soil, water, air, plants, animals, or any other part of the environment that can contain contaminants.

mg/kg
Milligram per kilogram.

National Priorities List for Uncontrolled Hazardous Waste Sites (National Priorities List or NPL)
EPA's list of the most serious uncontrolled or abandoned hazardous waste sites in the United States. The NPL is updated on a regular basis.

No Observed Adverse Effect Level (NOAEL)
The highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals.

Oral Reference Dose (RfD)
An amount of chemical ingested into the body (i.e., dose) below which health effects are not expected. RfDs are published by EPA.

Relative Potency Factor (RPF)
It is extensively utilized for the estimation of risk from exposure to PAH mixtures and provides a cancer risk estimate for the whole mixture by summing the carcinogenic potential of individual PAHs relative to an index compound (e.g., benzo[a]pyrene).

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**).

Toxicity Equivalency Factor (TEF)
It is a way to express the toxicity of a mixture of toxic compounds (e.g., PAHs) in a single number, which indicates the degree of toxicity compared to the surrogate compounds (e.g., BaP).

Toxic Equivalent (TEQ)
It is a single figure resulting from the product of the concentration and individual TEF values of each congener.

Volatile organic compounds (VOCs)
Organic compounds that evaporate readily into the air. VOCs include substances such as benzene, toluene, methylene chloride, and methyl chloroform.