Health Consultation

Matteo and Sons, Inc. Superfund Site, Operable Unit 2

Evaluation of Residential Soils at the Tempo Development Subdivision

West Deptford, Gloucester County

New Jersey

USEPA FACILITY ID: NJD000565531

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Prepared by:

New Jersey Department of Health

Environmental and Occupational Health Surveillance Program

Under a Cooperative Agreement with the

U.S. Agency for Toxic Substances and Disease Registry

Health Consultation: A Note of Explanation:

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

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Summary

Introduction

In 2015, buried battery casings were discovered during the excavation of a residential yard in the Tempo Development subdivision in West Deptford, NJ. In 2016, the U.S Environmental Protection Agency (EPA) confirmed that residential yards had lead contamination levels above the screening levels. Screening levels help evaluators understand what normal and dangerous levels of substances or chemicals in soil are. Because of the high lead levels, EPA added the Tempo Development subdivision as Operable Unit 2 (OU2) of the Matteo and Sons Inc. Superfund site (OU1). Superfund is the informal name of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) that allows EPA to clean up contaminated sites. Pursuant to the Superfund laws, the federal Agency for Toxic Substances and Disease Registry (ATSDR) is required to conduct public health assessment activities for sites proposed to or listed on the National Priorities List (NPL). The New Jersey Department of Health (NJDOH) prepared this health consultation (HC) under a cooperative agreement with ATSDR.

The buried battery casings are believed to have originated from the Matteo and Sons Inc. Superfund site. The site is located slightly more than a half-mile from the Tempo Development subdivision. NJDOH has released three reports pertaining to the Matteo and Sons, Inc. Superfund Site. In 2006, NJDOH and ATSDR assisted the Willow Woods Manufactured Home Community (adjacent to the Matteo and Sons, Inc. Superfund Site) by addressing potential health hazards from lead exposures. In 2008, NJDOH and ATSDR released a public health assessment (PHA) for the Matteo and Sons, Inc. Superfund site that evaluated past exposures to polychlorinated biphenyls, antimony, arsenic, and lead. The evaluation determined that past exposures to lead in *off-site* soil may have been harmful to children's health. Off-site soil is soil that is located outside the boundary of the site, i.e., the Matteo and Sons, Inc. Superfund site. Past exposures to polychlorinated biphenyls, antimony, arsenic, and lead in *on-site* soil were not likely to result in adverse health effects for children and adults. Past exposures to polychlorinated biphenyls and lead exposures in biota were not likely to result in adverse health effects for children and adults.

In 2016 and 2017, NJDOH and ATSDR attended public availability sessions and public meetings to address health concerns related to the discovery of battery casings in the Tempo Development subdivision. Education materials and fact sheets were disseminated to community members so that residents could take steps to protect themselves from exposure to soil contaminants until remedial actions were in place. Additionally, residents were encouraged to have their child's blood lead level tested. The links to the fact sheets on safe gardening and steps to reduce exposures to lead in soil are provided below:

- https://www.nj.gov/health/ceohs/documents/safe_gardening.pdf
- https://www.nj.gov/health/ceohs/documents/ceohs%20content/Safe_Gardening_Spanish.pdf

As of March 2022, EPA completed all remedial actions at the site. In general, since there is no safe level of lead in the blood, parents of young children should continue to follow guidelines for reducing lead exposure and continue regular lead exposure testing. There are no further actions that need to be taken pertaining to this site as it has been remediated.

The Tempo Development subdivision consists of 36 residential properties impacted by contaminated waste from the Matteo site. Contaminants of concern are antimony, arsenic, lead, thallium, benzo[a]pyrene, and polychlorinated biphenyls. Contaminants were detected in the residential soils. The completed exposure pathway is via incidental ingestion/dermal contact of residential backyard soil to residents. In other words, residents would likely be exposed by accidentally swallowing or touching contaminated backyard soil. That is called a completed exposure pathway.

The top priority of NJDOH and ATSDR is to ensure that the community has the best information possible to safeguard its health and to ensure actions are taken to interrupt the exposure pathway.

Conclusion 1

NJDOH and ATSDR conclude that current and future exposures to antimony, arsenic, lead, benzo[a]pyrene, and polychlorinated biphenyls are not expected to harm people's health.

Basis for Conclusion

In October 2016, approximately 2,000 tons of contaminated soil were excavated and removed from three residential properties. The soil was removed by EPA's removal branch as an interim remediation measure (IRM) to address ongoing exposure pathways associated with surface soil. Surface soil is the top one inch of soil. An IRM is a discrete set of planned actions for both emergency and non-emergency situations that can be conducted without the extensive investigation and evaluation.

In 2017, EPA finalized the Record of Decision (ROD). A ROD records EPA's decision that must include a brief description of the proposed action, alternatives and environmental factors considered and a commitment to mitigation. It included the preferred remedy for long-term permanent remediation. The preferred remedy consisted of

- temporary relocation of residents, as needed,
- removing battery-casing material under the roads/houses/structures, and
- remediating the soil of approximately 25 residential properties.

The preferred remedy was implemented and completed in March 2022. EPA provided oversight. At the same time, NJDOH and ATSDR attended public meetings and distributed community education materials and fact sheets on how to reduce exposures to contaminated soil.

Conclusion 2

NJDOH and ATSDR conclude that past exposures to lead and antimony in the soil of some residential yards may have harmed the health of preschool children who lived at those properties. Past exposure to lead at two properties is a health concern for developing fetuses.

Basis for Conclusion

Based on soil lead concentrations detected at three residential properties in 2016, there is the potential for noncancer health effects from past lead exposure. Prior to soil remediation (i.e., before 2022), preschool children who lived at these properties were at risk for higher blood lead levels. We used an EPA lead model to predict blood lead levels in these children. The model predicted that children at these three properties had a high probability of high blood lead levels. High probability is the high possibility of something happening; when the possibility is expressed mathematically, it is called probability. The adult lead model predicted that there is a concern for the developing fetus at the properties with 912 ppm and 947 ppm soil lead. High blood lead levels in children may lead to attention, learning, and behavioral problems. They may also cause decreased hearing and slower growth and development. Exposures to lead should be minimized as much as possible.

Several properties had elevated antimony levels in the soil. The analysis of exposures to antimony indicated that noncancer health effects are possible in children aged 6 years and younger with soil-pica behavior.

	Soil-pica behavior is the purposeful ingestion of soil that occurs sometimes in very young children. Children with typical soil ingestion are not at risk of harmful effects.
Conclusion 3	NJDOH and ATSDR conclude that past exposures to arsenic, polychlorinated biphenyls, and benzo[a]pyrene in the soil did not harm people's health.
Basis for Conclusion	Based on the highest concentration of arsenic, polychlorinated biphenyls, and benzo[a]pyrene detected in soil, harmful noncancer health effects are not expected in children and adults for acute, intermediate, and chronic exposure durations. Acute exposure durations means a short contact with a chemical that occurs once or for only a short time (up to 14 days). Intermediate exposure durations mean contact with a substance that occurs for more than 14 days and less than a year. Chronic exposure durations mean contact with a substance that occurs for more than a year. Based on the highest estimated exposure levels for carcinogens detected in the soil, the total lifetime excess cancer risks for children for average and upper end exposure conditions are two and seven extra cancer cases for every 100,000 similarly exposed individuals, respectively. This is a low cancer risk and is not a health concern.
Public Comment	The public comment period for this health consultation was from June 4, 2024 to July 31, 2024. No public comments were received.
For More Information	Questions about this health consultation should be directed to: Environmental and Occupational Health Surveillance Program Consumer and Environmental Health Services New Jersey Department of Health and Senior Services P.O. Box 369 Trenton, New Jersey 08625-0369 (609) 826-4984

Statement of Issues

In November 2016, the U. S. Environmental Protection Agency (EPA) added Tempo Development subdivision in West Deptford, NJ, as a separate Operable Unit 2 (OU2) of the Matteo and Sons Inc. (referred to as "Matteo", also designated as OU1) Superfund site (see Figure 1). The Tempo Development subdivision consists of 36 residential properties on Birchly Court, Woodlane Drive, Oakmont Court, and Crown Point Road, which have been impacted by contaminants. The contaminants are from the disposal of crushed battery casings that were used as fill material prior to developing the area for residential homes (EPA 2021). Pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the Superfund Amendments and Reauthorization Act (SARA) of 1986, the federal Agency for Toxic Substances and Disease Registry (ATSDR) is required to conduct public health assessment activities at sites proposed to or listed on the National Priorities List (NPL). NJDOH prepared this health consultation under a cooperative agreement with ATSDR.

In late 2015, buried battery casings were discovered during an excavation of a residential yard on Birchly Court. In March 2016, the New Jersey Department of Environmental Protection (NJDEP) referred the discovery to EPA for further investigation. In May 2016, EPA confirmed the area was contaminated with battery casings. NJDOH and ATSDR have evaluated contamination in areas related to the Matteo and Sons Inc. Superfund site. This resulted in a 2006 health consultation and a 2008 public health assessment (ATSDR 2006; 2008).

The purpose of this health consultation is to review the contaminants present at OU2 and the exposure pathways by which people may have been exposed to those substances. An exposure pathway is the route a contaminant takes from its source to its end point, and how people can come into contact with it. If contaminants were present at concentrations that could cause a health concern, NJDOH determined if such exposures were at levels likely to harm human health.

Background

Description and Operational History

The Tempo Development subdivision is located within one mile of the Matteo and Sons, Inc. Superfund site. The Matteo site consists of an 80-acre area, which includes an active scrap metal recycling facility, a junkyard, and an inactive landfill. Past land uses (1961 to 1985) resulted in the contamination of soil, sediment, and groundwater with lead, antimony, zinc, and polychlorinated biphenyls (PCBs). EPA placed the Matteo site on the NPL in September 2006.

The Matteo family owned 17 acres of undeveloped land (location of the Tempo Development subdivision). The location was primarily wooded; however, disturbed areas were documented in various historical aerial photographs of the area. The Matteo family purchased the 82-acre property in 1947; They used it as a landfill, junk yard and metal recycling operation beginning in 1961. NJDEP began conducting inspections from 1968-1984 and discovered that old auto batteries were included in the landfill. In 1989, the Tempo Development Company began construction of residential homes on the undeveloped area. The construction of new residences was completed between 1989 and 1994. The three former Matteo residences, located along Crown Point Road and Hessian Avenue, were constructed prior to the 1960's. It is believed that the battery casing waste was brought in[1] from the Matteo site. Prior to the development of the residential neighborhood, the area was lower in elevation than the surrounding areas. It is suspected that during the pre-construction grading of the area, fill material was mixed with the battery casing waste already in the area and then spread by heavy equipment. This redistribution created a random spread of battery casing waste in the soil throughout the subdivision (EPA 2021).

The contamination at the Tempo Development subdivision was discovered in November 2015 when crushed battery casing waste was uncovered[1] at a residence located on Birchly Court (EPA 2021). The contamination was referred to NJDEP, who subsequently referred it to EPA in March 2016. In November 2016, EPA added Tempo Development subdivision in West Deptford, NJ as a separate Operable Unit 2 (OU2) of the Matteo site.

The Tempo Development subdivision consists of 36 residential properties located on Crown Point Road, Woodlane Drive, Birchly Court, and Oakmont Court in West Deptford, NJ (see Figure 2). In general, the casing material throughout the soil depth is highly heterogeneous. This means it varies widely both within, and between, each property. Areas with substantial casing material have been observed throughout the subdivision (EPA 2021). The material appears to have been mixed with fill randomly throughout the area prior to construction to raise the ground level.

In September 2017, EPA finalized its plan for removing lead-contaminated soil from the Tempo Development subdivision. The cleanup included additional investigation and removal of battery-casing material under the roads and remediation of residential properties where soils were found to be contaminated. Under the plan (EPA 2021), lead-contaminated soil was removed from approximately 25 properties. The soil was disposed of properly at a facility licensed to handle the waste. The implementation of the preferred remedy was completed in March 2022.

Demographics

The area is a residential neighborhood with some industrial and municipal properties located within a half mile. Some of these industrial and municipal properties are the Matteo and Sons, Inc. site, Sunoco Eagle Point Refinery, and West Deptford High School. Based on the 2010 U.S. Census data, there are 584 residential properties and a population of 1,568 located within half a mile of the subdivision. Using an average occupancy of about 3.5 persons/residence, the estimated current population of Tempo Development is approximately (3.5 X 36 =) 126[2]. However, this number does not include individuals who have lived at these residences in the past who may have moved out and were exposed to the contamination.

[1] It is believed that the Matteo site and the Tempo Development subdivision were owned by the same entity and the battery casing waste material from Matteo and Sons, Inc. site were brought in for grading the area for residential construction.

[2] The census tract containing the Tempo Development subdivision has a population of 1241.

Additionally, approximately 300 children live within half a mile and are ages six and under. Approximately 700 people within half a mile of the area are women of childbearing age. This is important because one of the primary contaminants is lead, which can cause serious health effects in young children, especially those under the age of six.

Past ATSDR/NJDOH Involvement

NJDOH previously released three reports pertaining to the Matteo and Sons, Inc. Superfund site.

March 2006 Letter of Technical Assistance: In 2006, NJDOH released a letter of technical assistance to EPA and stated that there was a public health hazard for the Willow Woods Manufactured Home Community and a single-family residence adjacent to the Superfund site (see Figure 1). It was recommended that EPA notify residents of the lead contamination in the soil and take measures to reduce exposures in the community.

August 2006 Health Consultation: Later in 2006, a more comprehensive health consultation was released by NJDOH and ATSDR. An assessment of the contaminant data indicated lead levels in the surface soil were higher than soil lead standards. The report recommended restricting public access to the lead contaminated areas, implementing a remedy as soon as feasible, and blood lead screenings be made available to all children residing at the community.

August 2008 Public Health Assessment: In 2008, NJDOH and ATSDR released a public health assessment (PHA), which evaluated other contaminants in addition to lead. They determined that past exposures to lead in off-site soil may have been harmful to children's health (ATSDR 2008). Past exposures to PCBs, antimony, arsenic, and lead in on-site soil were not likely to result in adverse health effects for children and adults who live near the Matteo NPL. Past exposures to PCBs and lead exposures in biota were not likely to result in adverse health effects for children and adults who live near the Matteo NPL.

Community Concerns

On August 16, 2016, NJDOH attended two public availability sessions at the request of West Deptford Township and EPA. NJDOH addressed health concerns expressed by community members impacted by the discovery of the battery casings. Approximately 30 residents attended these sessions. Government representatives from West Deptford, including the mayor and local health officer, also attended. The main health concerns expressed by residents were related to cancer and blood lead testing for both adults and children.

In July 2017, NJDOH attended a public meeting in West Deptford regarding the Tempo Development subdivision. At this meeting, EPA explained their cleanup plan to remove battery casing waste and related lead-contaminated soil from the subdivision. NJDOH responded to health-related questions associated with potential exposure to contaminants.

In 2017, EPA finalized the preferred remedy for the Tempo Development subdivision. The remedy included:

- temporary relocation of residents (as needed),
- removal of battery-casing material under the roads/houses/structures, and
- remediation of approximately 25 residential properties.

The implementation of the preferred remedy was completed in March 2021 (EPA 2021).

Environmental Contamination

An evaluation of environmental contamination consists of a two-tiered approach: 1) a screening analysis; and 2) a more in-depth analysis to determine public health implications of contaminant exposures (ATSDR 2005). As part of the screening analysis, the maximum concentrations of the substances detected are compared to media-specific (i.e., soil, water and air) environmental comparison values (CVs). CVs are concentrations of a contaminant in soil, water, or air. If contaminant concentrations in soil, water, or air exceed the CV for that media, it is referred to as a potential contaminant of concern (COC) and selected for further evaluation. If environmental CVs are unavailable for certain contaminants, the contaminants are retained for further evaluation. If contaminant levels are found above CVs, it does not mean that adverse health effects are likely, but that a health guideline comparison and cancer risk evaluations are necessary. Once exposure doses and cancer risks are estimated, they are compared with health guidelines and relevant effect levels from toxicological studies (i.e., an in-depth tox evaluation) to determine the likelihood of health effects.

Environmental Guideline Comparison

There are several environmental CVs available for screening environmental contaminants. These CVs include ATSDR environmental media evaluation guides (EMEGs) and reference media evaluation guides (RMEGs). EMEGs are based on ATSDR's minimal risk levels, and are estimated contaminant concentrations in water, soil, or air that are not expected to result in harmful noncarcinogenic health effects. Noncarcinogenic health effects are all harmful health effects other than cancer. RMEGs are based on EPA's reference dose or reference concentration. RMEGs represent the concentration in water, soil, or air at which daily human exposure is unlikely to result in adverse noncarcinogenic effects. If the substance is a known or a probable carcinogen, ATSDR's cancer risk evaluation guides (CREGs) are also considered as comparison values. CREGs are estimated contaminant concentrations in soil, water, or air. The concentrations would be expected to cause no more than one excess cancer in a million (10^{-6}) persons exposed over their lifetime. A lifetime is defined as 78 years. One excess cancer risk in one million means that, for every one million people who are continuously exposed to a certain level of a pollutant over 78 years, one person may develop cancer. These risks are in addition to any other cancer risks from other sources.

In the absence of an ATSDR CV, values from other sources may be used to select contaminants for further evaluation. We refer to these as alternative screening levels. One example is EPA's regional screening levels (RSLs). RSLs are contaminant concentrations that correspond to a fixed level of risk in water, air, and soil (EPA 2011a). A fixed level of risk is defined as de minimis risk level based on the carcinogenicity and systemic toxicity of contaminants.

For soils and sediments, alternative screening levels include EPA Region 2 (R2) lead screening level, NJDEP Residential Soil Remediation Standards (RSRS), Ingestion-Dermal Health Based Criterion and Inhalation Health Based Criterion. Based primarily on human health impacts, these criteria also consider natural background concentrations, analytical detection limits, and ecological effects (NJDEP 2011).

Substances that exceed CVs are identified as potential COCs and evaluated to determine whether they pose a health threat to exposed or potentially exposed populations. In instances where a CV or toxicologic information is unavailable, the substance is also further evaluated.

Environmental Investigations of Residential Properties

In November 2015, crushed battery casing waste were discovered during a sewer repair on Birchly Court. The discovery was referred to NJDEP, who subsequently referred it to EPA for further assessment. Between May 2016 and January 2017, EPA evaluated the residential properties in the Tempo Development subdivision, which is part of EPA's OU2 environmental investigations of the Matteo site. Discrete soil samples were collected from the below ground surface at the following depths: 0-1, 1-6, 6-12, 12-18, 18-24, 24-30, 30-36, 36-42 and 42-48 inches. Some sampling locations were extended up to six feet.

All samples were screened for metals via X-ray fluorescence (XRF). A subset of the samples was analyzed for metals, volatile organic compounds (VOCs), and semi-volatile organic compounds (SVOCs) in the laboratory.

The 0-1 inch (see Tables A1 through A9, Appendix A), 1-6 inches (see Tables A10 through A19, Appendix A) and greater than six inches depth samples were analyzed for metals (see Tables A20 through A29). A limited number of 1-6 inches depth samples were analyzed for VOCs and SVOCs including PCBs. The SVOC soil sampling results are summarized in Tables A30 (Appendix A).

Soil (0-1 inch depth): The maximum concentrations of aluminum, barium, beryllium, chromium, cobalt, copper, manganese, mercury, nickel, selenium, silver, vanadium, and zinc detected in surface soil (0-1 inch depth) in all properties were lower than the CVs. Exposure to these contaminants is not expected to result in health effects.

Maximum concentrations of antimony, arsenic, iron and lead detected in surface soil (0 - 1 inch depth) in at least one property exceeded the CVs. The CV for thallium is unavailable. Iron was excluded from further consideration because it occurs naturally in soil. Therefore, these four metals were selected as potential COCs and were evaluated further. The property code that exceeded the CV is presented in Table 1.

Soil (1-6 inches depth): The maximum concentrations of aluminum, barium, beryllium, chromium, cobalt, copper, manganese, mercury, nickel, selenium, silver, vanadium, and zinc detected in surface soil (1 - 6 inches depth) in all properties were lower than the CVs. Exposure to these contaminants is not expected to result in health effects.

Maximum concentrations of antimony, arsenic, iron and lead detected in surface soil (1 - 6 inches depth) in at least one property exceeded the CVs. The CV for thallium is unavailable. Iron was excluded from further consideration because it occurs naturally in soil. Therefore, these four metals were selected as potential COCs and were evaluated further. The property code that exceeded the CV is presented in Table 1.

Soil (greater than six inches depth): The maximum concentrations of aluminum, barium, beryllium, chromium, cobalt, copper, manganese, mercury, nickel, selenium, silver, vanadium and zinc detected in surface soil (greater than six inches depth) in all properties were lower than the CVs. Exposure to these contaminants is not expected to result in health effects.

Maximum concentrations of antimony, arsenic, iron and lead detected in surface soil (> 6 inches depth) in at least one property exceeded the CVs. The CV for thallium is unavailable. Iron was excluded from further consideration because it occurs naturally in soil. Therefore, these four metals were selected as potential COCs and were evaluated further. The property code that exceeded the CV is presented in Table 1.

A limited number of samples were analyzed for VOCs. The concentrations were below their respective CVs (the results are not presented in this document). Therefore, the VOCs were not retained for evaluation. The soil samples from two properties (P006 and P036) were analyzed for SVOCs. The maximum concentrations of benzo[a]pyrene detected in soil (1-6 inches depth) exceeded the CV[3]. Benzo[a]pyrene is considered a potential COC for the Tempo Development subdivision (see Table 2).

EPA collected and analyzed soil samples from each property for PCBs: Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, Aroclor 1260, Aroclor 1262 and Aroclor 1268. Except for one sample (20 ppm at property P005), the detected concentrations ranged from 0.011 parts per million (ppm) to 0.51 ppm (raw data are not presented). It should be noted that there were more than 2,000 non-detect results for Aroclors reported for these properties (EPA 2021). Subsequently, during remediation of the property, the highest concentration (i.e., 20 ppm) was not detected (EPA 2023). As such, 20 ppm was considered an outlier and not retained for further evaluation. Since the highest concentration PCBs detected in surface soil of three properties (P005, P006 and P028) exceeded the CVs (0.19 ppm), PCBs are considered a potential COC for the Tempo Development subdivision (see Table 2).

Battery Casing Waste Investigation: EPA also investigated the nature and extent of battery casing waste on the 36 residential properties (EPA 2021). Battery casing waste was discovered on 32 out of 36 properties (approximately 89% of the properties). There appear to have been three major stockpiles that were pushed around to grade the area prior to construction. These piles were originally located on what is now P001, P035/P036, and P013/P019. The placement of the battery casing waste was not uniform, and waste materials were encountered as single piece, pockets, and/or layers, depending on location of the area with reference to the location stockpile. Battery casing distribution is presented in Figure 3. The boundary of the

[3]Since benzo[a]pyrene is a potential COC for the site, it is not necessary to calculate benzo[a]pyrene equivalent (ATSDR 2022) and compare against the cancer CV

sampling area was drawn after considering the historic aerial photographs of the area and locations of waste pile, wooded areas, wetlands, and the main roads. Figure 3 shows the location of test pits and soil cores. The red marks show the locations where battery casings were observed in the cores as well as test pits.

Groundwater Investigations: In January 2017, EPA conducted a limited groundwater investigation. There were four detections of lead ranging from 1.8 to 46 micrograms per liter (µg/L) in unfiltered samples. Corresponding filtered samples were non-detect for lead except for one sample; however, that one detected concentration was below EPA's action level for lead (15 µg/L). It should be noted that residences at the Tempo Development subdivision and surrounding areas have public water. No residents are drinking groundwater.

The investigation also included an *in vitro* bioaccessibility (IVBA) test for lead in soil. The specific absolute bioavailability (31%) of lead in soil was found to be very close to the default value (30%) used for lead exposure (i.e., Integrated Exposure Uptake Biokinetic model or IEUBK model) modeling (EPA 2017).

Summary of Contaminants of Concern

Soil: The contaminants detected in the soil (0-1 inch, 1-6 inches and greater than six inches) are designated as the potential COCs for the residential yards (see Table 1 and 2) and include antimony, arsenic, thallium, and lead. A brief discussion of the toxicologic characteristics of these potential COCs is presented in Appendix B.

Discussion

The method for assessing whether a community health hazard exists involves determining whether there is a completed or potentially completed exposure pathway from a contaminant source to an exposed population and whether exposures are at concentrations high enough to be a health concern (ATSDR 2022). Specific exposure doses are calculated and compared with health guidelines. If doses are above health guidelines, additional evaluation is done to determine if harmful effects are possible.

Assessment Methodology

An exposure pathway is a series of steps starting with the release of a contaminant in environmental media and ending at the human body. A completed exposure pathway consists of a/an:

1. source of contamination,
2. environmental media and transport mechanisms,
3. point of exposure,
4. route of exposure, and
5. exposed population.

Generally, ATSDR considers three exposure pathway categories:

1) completed exposure pathways mean all five elements of a pathway are present;
2) potential exposure pathways mean one or more of the elements may not be present, but information is insufficient to eliminate or exclude the element; and
3) eliminated exposure pathways means that one or more of the elements is absent.

Exposure pathways are used to understand and evaluate specific ways in which people were, are, or will be exposed to environmental contamination in the past, present, and future.

For past, present, and future exposure pathway evaluation for surface soil, ATSDR considers the top three inches of soil layer for incidental soil ingestion and dermal contact exposures. For metal exposures for this HC, surface soil samples collected from the 0-1 inch for the residential properties were used to evaluate the potential for health effects. 0-3 inches depth soil contamination data were unavailable. For SVOC exposures, surface soil samples collected from the 1-6 inches for the residential properties were used to evaluate the potential for health effects. 0-3 inches depth soil contamination data were unavailable.

The following exposure pathways (see Table 3) for individuals who live (or lived) at the residences in Tempo Development were identified.

Completed Pathways

Incidental ingestion of and dermal contact with contaminated soil (past): Several residential yards in the Tempo Development subdivision were contaminated with metals and SVOCs. Residents, including children, were exposed to the contaminants while engaging in outdoor activities in the yard and from tracking dust and dirt into their homes. Residents, particularly preschool children, were most likely exposed from hand-to-mouth activity involving outdoor soil and indoor dust. This scenario also includes visitors and trespassers. The exposure duration was approximately 30 years since the construction of new residences was completed between 1989 and 1994.

Eliminated Pathways

Incidental ingestion of and dermal contact with contaminated soil (present and future): Residential yards have been remediated by EPA. As such, the current and future status of this pathway is considered eliminated because residents are no longer contacting contaminated soils.

Public Health Implications of Completed Exposure Pathways

Once it has been determined that individuals have or are likely to come in contact with contaminants (i.e., a completed exposure pathway), the next step in the public health assessment process is the calculation of exposure doses and comparison with health guidelines. This involves looking at exposure conditions, estimating exposure doses, and comparing doses against health guideline doses. Health guidelines, such as ATSDR’s MRLs, are based on data from the epidemiologic and toxicologic literature and often include uncertainty or safety factors to ensure that they are protective of human health.

There are no health guidelines for lead, and exposure doses are not calculated. The Centers for Disease Control and Prevention (CDC) currently uses a blood lead reference value (BLRV) of 3.5 micrograms of lead per deciliter of blood (µg/dL) to identify children with high blood lead levels (BLL). Childhood lead exposures are usually evaluated using the EPA's IEUBK model [EPA 1994, 2021b].

Lead exposures associated with children's use of lead contaminated areas were evaluated using the IEUBK model. This model is designed to predict the probability that children ages one to six years who regularly play in areas with soil lead contamination could be exposed to lead at levels high enough to raise their blood lead levels. Probability is, simply, the possibility of something happening; when the chance is expressed mathematically, it is called probability. The model uses 5 µg/dL because this value is the lowest blood lead level verified for the model. The probability estimate should be at or below a protection level of five percent, i.e., P5 ≤ 5 percent, as recommended by the EPA Office of Solid Waste and Emergency Response (EPA 1994). Because no threshold for adverse health effects has been identified for blood lead levels, the public health goal of NJDOH and ATSDR is to reduce blood lead levels in children as much as possible.

The IEUBK model estimates a plausible distribution of children's blood lead levels centered on the geometric mean blood lead levels from available exposure information. The model also uses average soil lead concentrations to predict the percent of children above a specified blood lead level (usually 5 µg/dL). EPA guidance states that average soil lead concentrations should be used when running the model [EPA 1994; 2021b]. EPA's Adult Lead Methodology (ALM) model was used to estimate blood lead levels in fetuses and pregnant women living in the Tempo Development subdivision. This model is designed to predict the blood lead levels of fetuses that are exposed to lead during pregnancy [EPA 2003]. Because there is no safe blood lead level, it is important to reduce lead exposure in adults, particularly pregnant women, as much as possible.

Determining the Exposure Concentration for Contaminants of Concern

When assessing an exposure risk to a COC, ATSDR recommends using the 95 percent upper confidence limit (95% UCL) of the arithmetic mean as the exposure point concentration (EPC) for contaminants (ATSDR 2019). Use of the 95% UCL reduces the likelihood that the average contaminant concentrations in an exposure unit will be underestimated. The EPCs were calculated for potential COCs at those properties where these metals exceeded the environmental CV. The EPC concentration ranges are presented in Table 4. For lead, the reported values are simple arithmetic means (EPA 2007).

Noncancer Health Effects

To assess the possibility of noncancer health effects, ATSDR has developed MRLs for contaminants that are commonly found at hazardous waste sites (ATSDR 2022). An MRL is an estimate of the daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of adverse, noncancer health effects. MRLs are developed for a route of exposure (such as swallowing), over a specified time period. The time periods are acute (less than 14 days), intermediate (15-364 days), and chronic (365 days or more). MRLs are based largely on toxicological studies in animals and, if available, on reports of human studies. MRLs are usually extrapolated doses (oral MRLs) or concentrations (inhalation MRLs) from observed effect levels in animal toxicological studies or human studies and are adjusted by a series of uncertainty (or safety) factors or through the use of statistical models (EPA 2011a). Observed health effects levels are changes in health indicators resulting from exposure to a contaminant. For example, exposure to lead increases the blood lead level in human.

In toxicological literature, effect levels include:

- no-observed-adverse-effect level (NOAEL) and
- lowest-observed-adverse-effect level (LOAEL).

NOAEL is the highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals. LOAEL is the lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals. In order to provide additional perspective on the health effects, the calculated exposure doses were then compared to observed effect levels (e.g., NOAEL, LOAEL). As the exposure dose increases beyond the MRL to the level of the NOAEL and/or LOAEL, the likelihood of adverse health effects increases. The means that when the exposure dose is just above the MRL, there is less likelihood of harmful health effects and when the exposure dose is near NOAEL and/or LOAEL, there is more likelihood of harmful health effects. For some contaminants, benchmark dose modeling is used to derive the MRL. A benchmark dose model is a statistical dose-response model applied to experimental toxicological or epidemiological data to calculate a benchmark dose.

The MRLs are derived from observed health effect levels and are generally several hundred times lower than the observed or no-observed adverse health effect levels. When MRLs for specific contaminants are unavailable, other health-based guidelines, such as an EPA reference dose (RfD) may be used (EPA 1989). Or site-specific doses can be compared directly with doses from animal or human studies. The RfD is either equal or equivalent to the MRL and represents an estimate of a daily ingestion that is likely to be without an appreciable risk of deleterious effects during a lifetime.

<u>Incidental ingestion of contaminated soil:</u> Exposures are based on incidental ingestion (i.e., representing inadvertent soil/dust ingestion) of contaminated soil; noncancer residential exposure doses were calculated using the following formula in ATSDR's Public Health Assessment Tool (PHAST):

$$\text{Exposure Dose (mg/kg/day)} = \frac{\text{C x IR x EF x CF}}{\text{BW}}$$

where, mg/kg/day = milligrams of contaminant per kilogram of body weight per day;
C = concentration of contaminant in soil (mg/kg or ppm);
IR = soil ingestion rate (kg/day);
EF = exposure factor representing the site-specific exposure scenario;
CF = conversion factor (10^{-6} kg/mg) and,

BW = body weight (kg)

Dermal exposures to contaminated soil: Dermal exposure is the contact between contaminant and receptor as well as absorption of the contaminant into the body through the skin. Dermal exposure doses were also calculated using PHAST and added to the ingestion doses to create a combined dose. The dermal dose values were low compared to the ingestion dose. Dermal exposures doses were calculated using the following formula:

$$\text{Dermal Exposure Dose (mg/kg/day)} = \frac{\text{C x AF x EF x CF x } ABS_d \text{ x SA}}{\text{BW x } ABS_{GI}}$$

where, mg/kg/day = milligrams of contaminant per kilogram of body weight per day;
C = concentration of contaminant in surface soil (mg/kg);
AF = adherence factor to skin (mg/cm^2-event);
EF = exposure factor representing the site-specific exposure scenario;
CF = conversion factor (10^{-6} kg/mg);
ABS_d = dermal absorption fraction to skin;
SA = skin surface area available for contact (cm^2);
BW = body weight (kg); and,
ABS_{GI} = gastrointestinal absorption factor.

Noncancer health effects are assessed by comparing the exposure dose to ATSDR's MRL or EPA's RfD using a ratio known as the "hazard quotient" or "HQ". The hazard quotient is defined as follows.

$$\textit{Hazard Quotient (HQ)} = \frac{Exposure\ Dose}{MRL\ or\ RfD}$$

If the HQ is less than one, noncancer harmful effects are unlikely. If the HQ is greater than one, then a more in-depth toxicological evaluation is needed to determine possible harmful effects. Potential COCs with a hazard quotient exceeding a value of 1 were evaluated to determine whether they pose a health threat to exposed or potentially exposed populations. ATSDR's exposure dose guidance for soil ingestion and EPA's Exposure Factor Handbook were used to calculate exposure doses (ATSDR 2018, EPA 2011b).

Exposure Dose Assumptions and Scenarios for Contaminants Other than Lead

Exposure doses were calculated for soil ingestion scenarios using the ATSDR PHAST software. For people with typical, or average soil ingestion rates, we used a central tendency exposure (CTE) scenario. For people with higher-than-average ingestion rates, a reasonable maximum exposure (RME) scenario was used. The RME refers to people with higher-than-average exposures but still within a realistic exposure range. The input parameters and the exposure factors used in PHAST are given in Table A31 and A32 (Appendix A).

Antimony: Long-term chronic animal studies have reported liver damage and blood changes (ATSDR 1992). Although information on the toxic effects of chronic oral exposure to antimony is limited, antimony appears to affect heart muscle, the gastrointestinal tract, and the nervous system. The chronic oral RfD for antimony (0.0004 mg/kg/day) is based on reduced longevity, decreased blood glucose, and altered cholesterol levels of a group of male and female rats in an oral bioassay study. A LOAEL of 0.35 mg/kg/day and an uncertainty factor of 1,000 were used to calculate the oral RfD (ATSDR 2019).

Based on the concentration of antimony detected in the surface soil, the range of antimony EPC calculated for surface soil is 40.4 ppm to 154.4 ppm for residential properties. The HQ associated with the highest EPC (i.e., 154.4 ppm) for the RME and the CTE scenarios (see Table 5) were calculated (ATSDR 2016). The age group "birth to <1 year" has the highest HQ of 7.6. However, the chronic exposure dose for this age group (i.e., 7.6 X 0.0004 mg/kg/day = 0.00304 mg/kg/day) is about 115 times lower than the LOAEL for antimony (i.e., 0.35 mg/kg/day). As such, noncancer adverse health effects are not expected from exposure to antimony in the surface soil at this residence. It should be noted that the remaining residences have lower antimony EPC; therefore, adverse health effects are not expected in any age group although the HQ for some residences were above 1.

Several studies (ATSDR 2019) have evaluated the intermediate-duration toxicity of antimony compounds. Observed effects include reductions in body weight gain, decreases in serum glucose levels, and developmental effects (decreased pup body weight and altered vasomotor response in pups). Based on the studies, a NOAEL of 0.06 mg/kg/day and an uncertainty factor of 100 were used to calculate the oral intermediate MRL of 0.0006 mg/kg/day (ATSDR 2019). The intermediate HQ associated with the highest EPC (i.e., 154.4 ppm) for the RME and CTE scenarios (see Table 5) were calculated (ATSDR 2016). The age group "Birth to <1 year" has the highest HQ of 5. However, the intermediate-duration exposure dose for this age group (i.e., 5 X 0.0006 mg/kg/day = 0.003 mg/kg/day) is about 20 times lower than the intermediate-duration NOAEL (i.e., no observed adverse effect level) for antimony (i.e., 0.06 mg/kg/day) and is about 200 times lower than the LOAEL of 0.64 mg/kg/day from the same study. As such, noncancer adverse health effects from intermediate-duration exposure to antimony in the surface soil at this residence are not expected. It should be noted that the remaining residences have lower antimony EPC, therefore, adverse health effects are not expected in any age group although the HQ for some residences were above 1.

The dermal HQ for chronic, intermediate, and acute exposures were also calculated and found to be orders of magnitude lower than one (not presented in this document). Therefore, harmful effects are unlikely.

Arsenic: Arsenic is a naturally occurring element widely distributed in the earth's crust. The MRL for arsenic is set at a level meant to protect against noncancer health effects, specifically dermal lesions such as hyperpigmentation and hyperkeratosis (ATSDR 2007). Chronic exposure to low levels of inorganic arsenic can cause a darkening of the skin (hyperpigmentation) and the appearance of small corns or warts on the palms, soles, and torso (hyperkeratosis). Skin contact with inorganic arsenic may cause redness and swelling. Organic arsenic compounds are less toxic than inorganic arsenic compounds because they are easily excreted by the kidneys.

Based on the concentration of arsenic detected in the surface soil, the range of arsenic EPC calculated for surface soil is 4.17 ppm to 37.4 ppm. Using the highest EPC of arsenic, the chronic HQ for the RME and the CTE scenarios were calculated (see Table 6). The child age group "birth to <1 year" with the RME scenario has the highest HQ of 1.5. The chronic exposure dose for this age group (i.e., 1.5 X 0.0003 mg/kg/day = 0.00045 mg/kg/day) is about two times lower than the NOAEL (i.e., no observed adverse effect level) for arsenic (i.e., 0.0008 mg/kg/day). The estimated exposure (0.00045 mg/kg/day) is also about four times lower than the threshold dose for dermal effect of 0.002 mg/kg/day. These NOAELs and LOAELs for arsenic are based on a robust study in humans.

It should be noted that the arsenic MRL is based on the NOAEL with an uncertainty factor of three. As such, noncancer adverse health effects from exposure to arsenic in the surface soil for the child age group "birth to less than one year" at this residence are not expected. The other residences have lower arsenic EPC; therefore, adverse health effects are not expected for any age groups although the HQ for some residences were above one.

Although the health guidelines for arsenic for intermediate exposure duration is unavailable, the health guidelines for arsenic for acute (i.e., 0.005 mg/kg/day) and chronic (i.e., 0.0003 mg/kg/day) durations are available. The HQ for chronic and acute exposures were also calculated and found to be lower than 1 (see Table 6); therefore, harmful effects from intermediate duration exposure (two weeks to one year) are also not expected.

Thallium: Pure thallium is a bluish-white metal that is found in trace amounts in the earth's crust. Thallium is used mostly in manufacturing electronic devices. Thallium affects the nervous system, lungs, heart, liver, and kidneys. Birth defects in human due to chronic exposures were not reported. There is no information available on the health effects of skin contact with thallium (ATSDR 1992).

Health guideline values for thallium for chronic, intermediate, and acute exposures are not available, and very few studies are reported in ATSDR's 1992 toxicological profile; EPA reviewed the scientific literature for thallium in 2009 and decided not to develop a reference dose because the studies were of poor quality.

Thallium levels in soil from most properties in Tempo Development were below 1 ppm with the maximum soil levels reported in two properties as high as 2.3 ppm and 2.8 ppm (see Tables A3 to A29). A nationwide soil survey by the U.S. Geological Society found average soil levels of thallium to be 8.0 ppm. The thallium soil levels in Tempo Development are lower than the background levels (Smith et al., 2013).

Benzo[a]pyrene: Benzo[a]pyrene belongs to a class of over 100 different compounds (known as Polycyclic Aromatic Hydrocarbons or PAHs) that are found and formed during incomplete combustion of coal, oil, wood, or other organic substances (ATSDR 1995). More commonly they are found in petroleum-based products such as coal tar, asphalt, creosote, and roofing tar. In the environment, benzo[a]pyrene is found in a complex mixtures of other PAH compounds; many of these PAHs have similar toxicological effects and environmental fate. PAHs are widespread in the environment; Table 7 shows the background level of benzo[a]pyrene in the urban background soil. The concentrations of benzo[a]pyrene detected in residential soil at Tempo Development exceeded the concentrations typically found in urban background soil (see Tables 7 and A30).

Noncancer adverse health effects associated with benzo[a]pyrene exposures have been observed in animals but generally not in humans (ATSDR 1995). Noncancer effects are usually seen following exposure to much higher levels than found in the environment. The main concern for PAH exposures is potential cancer effects.

The combined (i.e., ingestion and dermal) HQ for the CTE and RME scenarios associated with benzo[a]pyrene was calculated and found to be orders of magnitude lower than 1 (see Table 8). Therefore, noncancerous effects from exposure to benzo[a]pyrene are unlikely. Although the health guideline values for intermediate and acute exposure condition are unavailable, noncancer adverse health effects from intermediate and acute exposure (through ingestion and dermal contact) to benzo[a]pyrene will also likely be orders of magnitude lower than 1 calculated for chronic exposures. As such, noncancer adverse health effects from exposure to benzo[a]pyrene in the surface soil at the residences are not expected.

PCBs: PCBs are mixtures of up to 209 individual chlorinated compounds (known as congeners). Most PCBs were used in dielectric fluids for use in transformers, capacitors, and other electrical components. Animals fed smaller amounts of PCBs in food over several weeks or months developed various kinds of health effects, including anemia; acne-like skin conditions; and liver, stomach, and thyroid gland injuries. None of these health effects are likely. A few studies of workers indicate that PCBs were associated with cancer of the liver and biliary tract. Rat studies have shown that PCBs cause liver and thyroid cancers (ATSDR 2000).

Although the concentrations of a number of commercial PCB mixtures (i.e., Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, Aroclor 1260, Aroclor 1262 and Aroclor 1268) were reported, health guidelines are unavailable except for Aroclor 1016 and Aroclor 1254[4]. Small amounts of Aroclor 1260 were detected in some soil samples but they were much lower than the Aroclor 1254 concentrations and did not contribute significantly to PCB exposure. Aroclor 1016 was not detected in any of the samples collected. Except for one soil sample (i.e., 20 ppm), the range of Aroclor 1254 concentrations for surface soil was 0.26 to 0.51 ppm.

Using the highest value in this range (i.e., 0.51 ppm), the chronic and intermediate HQ for the RME and CTE scenarios were found to be several orders of magnitude less than 1 (not shown in Table 9). As such, noncancer adverse health effects from exposure to Aroclor-1254 in the surface soil at the residence is not expected. It should be noted that the remaining residences have lower Aroclor-1254 EPC, therefore, adverse health effects are not expected for all residences.

Lead – Evaluating Health Effects

Protecting children from exposure to lead is important to lifelong good health. Even low

[4]Aroclor 1254 and 1016 are commercial PCB mixtures that were marketed between the 1930s and 70s.

levels of lead in blood have been shown to negatively affect a child's health. Exposure to lead can seriously harm a child's health and cause well-documented harmful effects such as:

- Damage to the brain and nervous system
- Slow growth and development
- Learning and behavior problems
- Hearing and speech problems

The lead exposures can cause lower IQ, decreased ability to pay attention, and underperformance in school. The health effects of exposure are more harmful to children less than six years of age because their bodies are still developing and growing rapidly. Young children are more likely to be exposed to lead than older children because they tend to put their hands or other objects, which may be contaminated with lead dust, into their mouths (CDC 2022).

Lead exposures were evaluated using the EPA's IEUBK V2.0 model. This model estimates a plausible distribution of blood lead levels centered on the geometric mean blood lead levels from available exposure information. Blood lead levels are indicators of exposure and are the most widely used index of internal lead body burdens associated with potential health effects. CDC uses a blood lead reference value (BLRV) of 3.5 µg/dL to identify children with blood lead levels higher than most children in the U.S.[5]

The EPA Region 2 uses a lead concentration of 200 mg/kg as a screening level to determine whether an additional property-specific risk evaluation is necessary. If the average lead concentration in the top two feet of soil exceeds this screening value, the IEUBK model is used to quantify lead exposures and characterize risk. When risks above EPA thresholds are identified using this model, remediation is performed by targeting individual data points at levels exceeding the current NJDEP Residential Direct Contact Soil Cleanup Criteria (RDCSCC) of 400 mg/kg and performing additional excavations as needed to ensure the resulting post-remedy property average is at or below 200 mg/kg. EPA used soil depths of 0-2 feet to determine the need for residential soil remediation. Using 0-2 feet samples might not adequately represent the lead concentration in the top few inches of soil. Therefore, NJDOH used surface soil depths of 0-1 inch to evaluate the potential for health effects.

NJDOH evaluated the broad scope of lead exposures in this community, looking at the potential contribution of lead on children's blood lead levels. NJDOH also evaluated this community and their potential for increased child blood lead levels based on several other risk

[5] In October 2021, CDC updated the blood lead reference value (BLRV) from 5 µg/dL to 3.5 µg/dL. However, lead models are not currently validated for levels below 5 µg/dL. Therefore, ATSDR uses 5 µg/dL in the models in our health evaluations until the updated BLRV of 3.5 µg/dL can be verified by EPA in their models. CDC's BLRV is a screening tool to identify children who have higher levels of lead in their blood compared with most children. The reference value is not health-based and is not a regulatory standard. States independently determine action thresholds based on state laws, regulations, and resource availability. CDC encourages healthcare providers and public health professionals to follow the recommended follow-up actions based on confirmed blood lead levels (https://www.cdc.gov/lead-prevention/hcp/clinical-guidance/?CDC_AAref_Val=https://www.cdc.gov/nceh/lead/advisory/acclpp/actions-blls.htm).

factors, besides soil lead concentration. Factors associated with the increased risk of higher blood lead levels include:

- living in rental housing,
- being a member of a minority groups,
- being a child younger than six,
- living in the Northeast region of the United States, and
- being a member of immigrant and refugee populations.

This community has many of these factors and that makes it a higher risk for high blood lead levels in children. NJDOH will continue to work collaboratively with the EPA and ATSDR to stop, reduce, and prevent exposure to lead.

Lead exposures associated with children's use of lead contaminated areas were evaluated using the EPA's IEUBK V2.0 model. This model is designed to predict the probability that children who regularly play in areas with soil lead contamination could be exposed to lead at levels high enough to raise their blood lead levels above 5 µg/dL. This level is the lowest blood lead level validated for the IEUBK model. Therefore, ATSDR uses 5 µg/dL in the model in our health evaluations until the updated BLRV of 3.5 µg/dL can be verified by EPA in their models. The primary goal for NJDOH and ATSDR is to reduce exposures to lead as much as possible since there is no safe level for blood lead in children.

Many factors influence lead exposure and uptake, which limits the accuracy of the IEUBK model to predict individual blood lead levels. These limitations include lead bioavailability and individual nutritional status, lead exposure risk factors, variable soil intake rates, seasonality, exposure age, and multiple sources of lead exposure.

Average lead levels in surface soils (0-1 inch) were used as an input value to calculate the distribution of expected children's blood lead levels from incidental ingestion of lead-contaminated soils. The assumptions for the residential exposure scenario for children are as follows:

- Exposure every day to the same soil concentrations
- Exposure to the average soil lead concentration in the area of interest
- Exposure to other sources of lead (air, water, dust, diet, paint, etc.) consistent with default (or typical) values identified by EPA [EPA 2002]

As mentioned earlier, the arithmetic mean of soil lead concentration in three of the residences (i.e., 294 ppm, 912 ppm, and 947 ppm) exceeded EPA Region 2 lead screening level. The highest and lowest lead levels were used as the input to the model. The model predicted the geometric mean blood lead levels and the probability of blood lead levels exceeding 5 µg/dL (P_5) for children. The higher the probability of exceeding 5 µg/dL, the greater the concern for harmful effects in children from lead exposure from soil. Because no safe blood lead level has been identified, our goal is to reduce blood lead levels in children as much as possible.

For the residential soil lead ingestion exposure scenario associated with 294 ppm lead, the model prediction are (see Table 10a and 10b):

- the geometric mean BLL for children (0 to 60 months) was 3.9 µg/dL, and
- the probabilities of BLL exceeding 5 µg/dL for some children were above 5% (30%).

For the residential soil lead ingestion exposure scenario associated with 912 ppm lead, the model prediction are (see Table 10a and 10b):

- the geometric mean BLL for children (0 to 60 months) was 8.33 µg/dL, and
- the probabilities of BLLs exceeding 5 µg/dL for some children was much greater than 5% (86%).

For the residential soil lead ingestion exposure scenario associated with 947 ppm lead, the model prediction are (see Table 10a and 10b):

- the geometric mean BLL for children (0 to 60 months) was 9.4 µg/dL, and
- the probabilities of BLLs exceeding 5 µg/dL for some children was much greater than 5% (91%).

As such, noncancer adverse health effects were possible in children from exposure to lead in the surface soil at the three residences with soil lead concentrations 294 ppm, 912 ppm, and 947 ppm.

Adult Lead Exposure: EPA's Adult Lead Methodology (ALM) model was used to estimate blood lead levels in adult receptors. The most sensitive receptor is the fetus of a worker who develops a body burden as a result of exposure to lead. (EPA 2003b). The model is designed to predict the blood lead levels of workers and fetuses that are exposed to lead in utero from 1988 to 2014.

Using 365 days of exposure in the ALM and soil lead concentrations of 294 ppm, 912 ppm, and 947 ppm, the calculated geometric mean blood lead levels of adults during 2009 – 2014 were 1.0 µg/dL, 1.9 µg/dLand 2.9 µg/dL, respectively (see Table 11a). The calculated geometric mean blood lead levels of adult for the duration 2007-2010, 2004-2007 and 1988-1994 are also given in Table 11a. The noncancer adverse health effects from exposure to lead in the surface soil would be unlikely for adult workers.

The model also predicted that the percentage of fetal blood lead levels during 2009-2014 and 2007-2010 exceeding 5 µg/dL were below 5% (see Table 11b). As such, noncancer adverse health effects from exposure to lead in the surface soil would be unlikely for pregnant women and fetuses at these properties. The percentage of fetal blood lead levels during 2004-2007 and 1988-1994 exceeding 5 µg/dL were mostly above 5% (see Table 11b). As such, there was a concern for health effects for developing fetuses at these properties.

Childhood Blood Lead Data

NJDOH requires every physician, professional registered nurse, and health care facility to screen for lead exposure in all children under six years of age who come to them for care (Public Law 1995, chapter 328). N.J.A.C. 8:51A continues to require that children be screened at both ages one and two years. Therefore, NJDOH recommends that all children be screened for lead exposure at 12 and 24 months of age, as well as any child between three and six years of age who has never previously been screened. While it is ideal for all children to be tested at both one and two years of age, at a minimum all children should have at least one blood lead test done before their third birthday. NJDOH's Childhood Lead Poisoning Prevention (CLPP) program uses the age span of 6 to 29 months to capture data on tests that are performed either earlier than the age of 12 months or later than the age of 24 months. This is because not all children are tested exactly at the age of one and two years. In addition, NJDOH recommends that any child who is six months of age or older, and who may be exposed to a known or suspected lead hazard, should be screened.

Since July 1999, NJDOH has required clinical laboratories to report all blood lead test results to the state. The NJDOH CLPP program maintains a central surveillance database and patient tracking system called LeadTrax. Using LeadTrax, CLPP coordinates with local health departments to document, share, and track case management data and environmental intervention activities. The LeadTrax database includes the following information on each laboratory report: patient's identifying information, patient's address, patient's age at time of blood specimen collection, type of screening specimen (venous or capillary), and blood lead result in micrograms of lead per deciliter of blood (µg/dL).

In May 2021, CDC updated its blood lead reference value to 3.5 µg/dL in response to the Lead Exposure Prevention and Advisory Committee's recommendation made on May 14, 2021 [CDC 2021]. Prior to this, CDC used a blood lead reference value of 5 µg/dL [CDC 2021]. The new reference value places an emphasis on primary prevention and triggering targeted public health actions at lower blood lead levels. Primary prevention involves controlling or eliminating sources of lead in children's environments so that they are not exposed.

On September 18, 2017, New Jersey amended its rules (N.J.A.C. 8:51[6]) to require nurse case management at a single, venous blood lead level of 5 µg/dL or higher. The rule amendment also requires an environmental inspection whenever a child has two venous blood lead levels of 5 to 9 µg/dL one to four months apart, or a single venous blood lead level of 10 µg/dL or higher. Both actions are performed by a local health department and require a home visit.

From January 1, 2000, through December 31, 2016, blood lead test results were extracted for lead analysis from LeadTrax for children of all ages living in West Deptford Township. Results were summarized for the Tempo Development subdivision neighborhood and West Deptford (see Table 12). In each of these areas, the percent of children tested whose blood lead test reached or exceeded 5, 10, and 20 µg/dL was computed for the entire period (2000 to 2016) and for each year. Additionally, the percent of children under the age of 3 at the time of testing whose blood lead test reached or exceeded 5, 10 and 20 µg/dL was compared in each of these areas to the State of New Jersey.

No children of any age tested in the Tempo Development subdivision had blood levels equal to or exceeding 5 ug/dL. This can be compared to approximately 5% (or 5 out every 100) of the children tested in West Deptford and the state have BLL above 5 µg/dL.

[6]Available from: gloucestercountynj.gov/DocumentCenter/View/926/NJAC-851-Childhood-Elevated-Blood-Lead-Levels-PDF

Cancer Health Effects

NJDOH evaluates the potential for cancer health effects by assessing the excess cancer risk relating to exposure over the background cancer risk. In New Jersey, approximately 45% of women and 47% of men (about 46% overall), will be diagnosed with cancer in their lifetime [NJDOH 2023]. This is referred to as the "background cancer risk."

The term "excess cancer risk" represents the risk on top of the background cancer risk and is referred to as the Lifetime Excess Cancer Risk, or LECR. An LECR of "one-in-a-million" (1/1,000,000 or 10^{-6} cancer risk) means that if one million people are exposed to a cancer-causing substance at a certain level for the same period of time, then one cancer above the background number of cancers may develop in those one million people over the course of their lifetime (considered to be 78 years).

To put the LECR of 10^{-6} in context of New Jersey's background cancer risk, the number of cancers expected in one million people over their lifetime is 460,000 (46%) in New Jersey. If these one million people are all exposed to a cancer-causing substance for a specific duration, then 460,001 people may develop cancer instead of the expected 460,000 over the course of their lifetime (78 years).

The NJDOH follows ATSDR's guidelines to evaluate theoretical cancer risks from environmental exposures (ATSDR 2022). When the estimated cancer risk is above one additional cancer case per 10,000 people (expressed quantitatively as $1x10^{-4}$), there is a concern for an increased cancer risk. When cancer risk estimates are less than 1×10^{-4}, a determination is needed as to whether a concern exists or does not exist for an increased risk of cancer. Several factors are considered in determining whether cancer risks less than 1×10^{-4} are a health concern. Some of these factors include the length of exposure, sensitive populations who may already have an elevated risk due to exposure to other carcinogens, and exposure to mutagenic carcinogens at a young age. Additionally, if the maximum concentrations were used to estimate cancer risk because of limited data, the estimated risk may not represent actual exposures. It should be noted that the estimated cancer risks are a theoretical estimate of risk that NJDOH and ATSDR use as a tool for deciding whether public health actions are needed to protect health. It is not an actual estimate of cancer cases in a community and is not a prediction that cancer will occur.

According to the U.S. Department of Health and Human Services (DHHS), possible cancer classes of contaminants detected at a site are as follows:

1 = Known human carcinogen
2 = Reasonably anticipated to be a carcinogen
3 = Not classified

The CREGs developed for carcinogens presented earlier are based on one excess cancer case per 1,000,000 individuals exposed for a lifetime. NJDOH considers estimated cancer risks of less than or equal to one additional cancer case among one million persons exposed an unlikely increased cancer risk (expressed exponentially as 10^{-6}).

The exposure assumptions and recommended exposure factors used to calculate the LECR are the same as those used to assess noncancer health effects. The LECRs were calculated using the following formula (ATSDR 2005):

LECR = Cancer Exposure Dose x CSF

Exposure dose for carcinogenic chemicals were calculated using the following formula:

$$\textit{Cancer Exposure Dose (mg/kg/day)} = \frac{\text{C x IR x EF x CF}}{BW} \text{ x } \frac{ED}{AT}$$

where, C = concentration of contaminant in soil (mg/kg);
IR = soil ingestion rate (kg/day);
EF = exposure factor representing the site-specific exposure scenario;
CF = conversion factor (10^{-6} kg/mg)
ED = exposure duration[7] (year);
BW = body weight (kg); and,
AT = averaging time[7] (year)[8]

Using exposure assumptions (i.e., residential exposures for 30 years), the LECRs were calculated by multiplying the exposure dose by the cancer slope factor. We assumed residents were exposed for 30 years over a 78-year lifetime. The cancer slope factor is defined as the slope of the dose-response curve obtained from animal and/or human cancer studies and is expressed as the inverse of the daily exposure dose, i.e., $(mg/kg/day)^{-1}$.

The LECR for chemicals that act with a mutagenic mode of action (MOA) for carcinogenesis can be quantified using age-dependent adjustment factors (ADAFs). The ADAFs are factors by which cancer risk is multiplied to account for increased susceptibility to mutagenic compounds when exposure takes place early in life – standard ADAFs are 10 (for ages below two years), three (for ages two years up to 16 years), and one (for ages greater than 16) (ATSDR 2016).

<u>Incidental ingestion of contaminated soil</u>

The LECRs associated with incidental ingestion of contaminated soil in the residential backyard were evaluated. Arsenic, benzo[a]pyrene and PCBs were the carcinogens found in surface soil.

Arsenic: Arsenic is the only metal carcinogen detected in the residential soil exposure pathway. Based on the highest estimated EPC (at P004), the calculated LECR[9] range for children is approximately two to six extra cancer cases for every 100,000 similarly exposed individuals (for CTE and RME scenarios), which represents a low cancer risk (see Table 6). The

[7]Residents were assumed to be exposed for 30 years
[8]The averaging time for noncancer endpoints was 30 years. The averaging time for cancer endpoints was 78 years.
[9]Note that the LECR is a theoretical estimate of cancer risk that ATSDR uses as a tool for deciding whether public health actions are needed to protect health—it is not an actual estimate of cancer cases in a community.

calculated LECR range for adults is five extra cancer cases for every 1,000,000 similarly exposed individuals and two extra cancer cases for every 100,000 similarly exposed individuals for the CTE and the RME scenarios, respectively (see Table 6). Both these LECRs represent a low[10] cancer risk and are not a health concern.

It should be noted that the arsenic concentrations in the other properties are much lower than 37 ppm (see Table 4) with the lowest concentration being 4.2 ppm which is about an order of magnitude lower. As such, the estimated LECR for children associated with these residences will also be lower ranging from two to six extra cancer cases for every 1,000,000 similarly exposed individuals (for CTE and RME scenarios). The calculated LECR range for adults is five extra cancer cases for every 10,000,000 similarly exposed individuals and two extra cancer cases for every 1,000,000 similarly exposed individuals for the CTE and the RME scenarios, which are considered a no and low cancer risk, respectively.

Benzo[a]pyrene and other PAHs: Although the concentration of other PAHs detected in the soil (i.e., benzo[a]anthracene, chrysene, benzo[b]fluoranthene, benzo[k]fluoranthene, indeno[1,2,3-cd]pyrene, dibenz[a,h]anthracene and benzo[g,h,i]perylene) were below their respective CVs, they were included in the cancer calculation (ATSDR 2022). Benzo[*a*]pyrene and other PAHs are widespread in the environment and are formed during incomplete combustion or pyrolysis of organic material. The DHHS has determined that PAHs may reasonably be expected to be carcinogens. Chronic exposure to PAHs has been found to cause cancer. In laboratory animal tests, some PAHs have caused cancer via inhalation (lung cancer), ingestion (stomach cancer), or dermal contact (skin cancer).

ATSDR has developed guidelines (ATSDR 2022) to assess cancer risk associated with PAH exposures using a relative potency estimate approach (EPA 1993). Using this approach, the cancer potency of carcinogenic PAHs can be estimated based on their relative potency with reference to benzo[a]pyrene. For each of the carcinogenic PAHs, the benzo[a]pyrene equivalence was calculated by multiplying the EPC concentration with the cancer potency factor. The total benzo[a]pyrene equivalence was then obtained by summing each of the individual benzo[a]pyrene equivalences[11].

Benzo[*a*]pyrene and other PAHs were detected in residential properties in Tempo Development. Using the benzo[a]pyrene equivalent of all PAHs the calculated child LECRs are one extra cancer cases for every 100,000 similarly exposed individuals and three extra cancer case for 100,000 similarly exposed individuals for the CTE and RME scenarios, respectively (see Table 8), which are considered a low cancer risk. For adults, the calculated LECR was seven extra cancer case for every 10,000,000 similarly exposed individuals for CTE scenario and two extra cancer case for every 1,000,000 similarly exposed individuals for RME scenarios. This represents no and low concern for increased cancer risk.

PCBs: PCBs are also cancer-causing contaminants detected in the surface soil. Using the

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[10]The subjective description of cancer risks is based on: less then $1x10^{-6}$ is considered “no” concern; greater than $1x10^{-6}$ and less than $1x10^{-4}$ is considered "low" concern and greater than $1x10^{-4}$ is considered a concern

[11]Benzo[a]pyrene equivalent = 1.7*0.01+202*0.1+0.97*0.1+1.4*1+0.59*0.1+0.17*2.4=2.19

EPCs of PCBs detected in the soil, the calculated child LECRs[12] range from seven extra cancer cases for every 10,000,000 to two extra cancer cases for every 1,000,000 for similarly exposed individuals for the CTE and the RME scenarios, respectively (see Table 9). This represents a no to low increased cancer risk and is not a health concern. For adults there was no concern for increased cancer risk for both scenarios because estimated cancer risks were below one in a million. It should be noted that the PCB EPC ranges from 0.26 to 0.51 ppm in all the residences (see table 4), which is approximately a factor of two in variation). As such, the estimated cancer risk for children and adults living in other residences will be less than one extra cancer case for every 1,000,000 similarly exposed individuals, which is not a health concern.

Child Health Considerations

ATSDR and NJDOH recognize that the unique vulnerabilities of infants and children demand special consideration. Children are often at greater risk than adults from certain types of exposures to hazardous substances. Their lower body weight and higher intake rate results in a greater dose of hazardous substance per unit of body weight. The developing body systems of children can sustain permanent damage if toxic exposures occur during critical growth stages. Most importantly, children depend completely on adults for risk identification, risk management decisions, housing decisions, and access to medical care.

Some residential yards in Tempo Development were contaminated with SVOCs and metals. Children who lived at those properties were exposed to the contaminants while engaging in outdoor activities in their yards and from soil and dust tracked indoors. Antimony, arsenic, lead, PCBs, and benzo[a]pyrene were identified as potential COCs. Based on the highest concentration of antimony, arsenic, PCBs, and benzo[a]pyrene detected in soil, the calculated HQs for acute, intermediate, and chronic exposure durations show that adverse noncancer health effects are not expected in children.

NJDOH and ATSDR evaluated the potential risk for children who were exposed to the lead detected in the residential soil. EPA's IEUBK was used to estimate the probability of high BLLs for children aged 0 to 60 months old (see Table 10).

For the highest residential soil lead (i.e., 947 ppm), the model predicted a high probability of children having BLL above 5 µg/dL. For the lowest residential soil lead (i.e., 294 ppm), the model predicted that more than 5% of children exceeded a BLL of 5 µg/dL. As such, noncancer adverse health effects in children from exposure to lead in the surface soil at certain properties is possible.

The ALM model predicted that the percentage of fetal blood lead levels during 2009 – 2014 and 2007 – 2010 exceeding 5 µg/dL were below 5% (see Table 11b). As such, noncancer adverse health effects from exposure to lead in the surface soil would be unlikely for fetuses at these properties. The percentage of fetal blood lead levels during 2004 – 2007 and 1988 – 1994

[12] There are no CSFs for individual PCBs. The LECRs were calculated based on total PCBs detected at the property with the highest total PCB concentration.

exceeding 5 µg/dL were mostly above 5% (see Table 11b). As such, the was a concern for health effects for pregnant women and developing fetuses at these properties.

The cancer risk from exposure to the carcinogens in the soil were also evaluated (see Table 6, 8 and 9). For the CTE and RME exposure scenarios associated with highest concentrations of arsenic, PCBs and benzo[a]pyrene, the calculated LECRs for children are up to six extra cancer cases for every 100,000 similarly exposed individuals (based on arsenic). This is considered a low cancer risk and is not a health concern**.**

NJDOH and ATSDR also evaluated exposures in children who exhibit soil-pica behavior (ATSDR 2021). Soil-pica is the repeated ingestion of unusually high amounts of soil. A high amount of soil could be 1,000-5,000 milligrams per day, three times per week. Children aged six years and younger and individuals who are developmentally delayed are at risk from soil-pica behavior. An analysis of exposures to aluminum, cadmium, chromium, copper, vanadium, fluoranthene, and Aroclor 1254 in the surface soil did not indicate a health concern in children who exhibit soil-pica behavior (see Appendix C). Noncancer adverse health effects associated with antimony exposures in children aged six years and younger is possible because the estimated dose is approaching health effects level. There are no human studies available to assess the health effect of chronic exposure to antimony. The health guideline value for antimony is based on reduced longevity, decreased blood glucose, and altered cholesterol levels of a group of male and female rats in an oral bioassay study (see Appendix C).

Public Comment

The public comment period for this health consultation was from June 4, 2024 to July 31, 2024. This document was posted on the internet and shared with the EPA, NJDEP, Gloucester County Health Department and West Deptford Township.

No public comments were received.

Conclusions

The Tempo Development subdivision in West Deptford, New Jersey is the OU2 of the Matteo and Sons Inc. Superfund site. The Matteo site includes an active scrap metal recycling facility, a junkyard, and an inactive landfill. These activities have resulted in the contamination of environmental media with lead, antimony, and PCBs. The Matteo family owned 17 acres of undeveloped land (currently known as Tempo Development subdivision) east of the Matteo site. The battery casing contaminated waste were believed to be brought from the Matteo site to Tempo Development subdivision when the area was developed for residences.

Antimony, arsenic, lead, thallium, benzo[a]pyrene, and PCBs detected in the residential yard soil are considered the potential COCs for the Tempo Development subdivision. NJDOH has reached the following conclusions:

NJDOH and ATSDR conclude that current and future exposures to antimony, arsenic, lead, benzo[a]pyrene, and PCBs are not expected to harm people's health. In October 2016, approximately 2,000 tons of contaminated soil were excavated and removed from three residential properties. The soil was removed by EPA's removal branch as an interim remediation measure to address on-going exposure pathways associated with surface soil. In 2017, finalized the Record of Decision including the preferred remedy for long-term permanent EPA remediation (i.e., elimination of all exposure pathways). The preferred remedy consisted of temporary relocation of residents (as needed), removal of battery-casing material under the roads/houses/structures, and soil remediation of approximately 25 residential properties. The remedial actions were implemented under EPA oversight and completed in March 2022. Over this time period, NJDOH and ATSDR attended public meetings and distributed community education materials and fact sheets on how to reduce exposures to contaminated soil.

NJDOH and ATSDR conclude that past exposures to lead and antimony in the soil of some residential yards may have harmed the health of preschool children who lived at those properties. Past exposures to lead at two properties was a health concern for developing fetuses. Based on soil lead concentrations detected at three residential properties in 2016, there was a potential for noncancer adverse health effects from exposure to lead in the past. Prior to soil remediation (i.e., before 2022), preschool children who lived at certain properties were at risk for higher blood lead levels. We used an EPA's Adult Lead Model (ALM) to predict blood lead levels in children. The model predicted that children had a high probability of high blood lead levels. The ALM predicted that the percentage of fetal blood lead levels exceeding 5 µg/dL were 0.8% at 294 ppm soil lead and 13.6% at 947 soil lead. As such, noncancer adverse health effects from exposure to lead in the surface soil would be unlikely for fetuses at the property with 294 ppm soil lead. However, there is a concern for pregnant women and the developing fetus at the properties with 912 ppm and 947 ppm soil lead. high blood lead levels in children may lead to attention, learning, and behavioral problems. They may also cause decreased hearing, slower growth and development. Exposures to lead should be minimized as much as possible. Several properties had high antimony levels in the yard soil. An analysis of exposures to antimony indicated that noncancer adverse health effects in children aged 6 years and younger with soil-pica behavior is possible.

NJDOH and ATSDR conclude that past exposures to antimony, arsenic, PCBs, and benzo[a]pyrene in the soil did not harm people's health. Based on the highest concentration of arsenic, PCBs, and benzo[a]pyrene detected in soil, adverse noncancer health effects for the acute, intermediate and chronic exposure durations are not expected in children and adults. Based on the highest estimated exposure levels of carcinogens detected in the soil, the total lifetime excess cancer risks for children for average and upper end exposure conditions are two and seven extra cancer cases for every 100,000 similarly exposed individuals, respectively. This is a low cancer risk and is not a health concern.

Recommendations

Remedial actions, described in the Record of Decision, for the Tempo Development subdivision of the Matteo Superfund site have been implemented which included temporary relocation of residents (as needed), removal of battery-casing material under the roads/houses/structures, and soil remediation of approximately 25 residential properties in March 2022. When NJDOH became aware of the soil contamination in this neighborhood, educational materials were provided to all residents, regardless of remediation status and the level of lead detected on each property to interrupt the exposure pathway. Residents were encouraged to have their child's blood lead level tested. The links to the fact sheets on safe gardening and steps to reduce exposures to lead in soil are provided below:

- https://www.nj.gov/health/ceohs/documents/safe_gardening.pdf
- https://www.nj.gov/health/ceohs/documents/ceohs%20content/Safe_Gardening_Spanish.pdf

In general, since there is no safe level of lead in the blood, parents of young children should continue to follow guidelines for reducing lead exposure and continue regular lead exposure testing to reduce exposures and protect their health and the health of their family.

Public Health Action Plan

The purpose of a public health action plan is to ensure that a health consultation identifies public health hazards and provides a plan of action to mitigate and prevent adverse human health effects resulting from exposure to hazardous substances in the environment. Included is a commitment on the part of ATSDR and NJDOH to follow up on the plan to ensure that it is implemented. The following are actions undertaken or planned in relation to community concerns about lead exposure in the population living at the Tempo Development subdivision.

Public Health Actions Undertaken by NJDOH and ATSDR

1. In 2006, NJDOH and ATSDR provided assistance to EPA, the Willow Woods Manufactured Home Community, and a single-family residence about health hazards associated with lead exposure.

2. In 2008, NJDOH and ATSDR released a public health assessment, which evaluated past exposures to PCBs, antimony, arsenic, and lead in on- and off-site soil of Matteo and Sons, Inc. Superfund site.

3. In 2008, the blood lead levels of children living around the Matteo and Sons, Inc. Superfund site were reviewed (for the period for July 1999 through March 2007) using data from the Childhood Lead Poisoning Prevention Surveillance System (ATSDR 2008).

4. On August 16, 2016, NJDOH and ATSDR attended two public availability sessions at the request of West Deptford and EPA to address health concerns expressed by community members impacted by the discovery of battery casings in Tempo Development subdivision.

5. In July 2017, NJDOH and ATSDR attended a public meeting in West Deptford (Gloucester County) regarding the Tempo Development. NJDOH and ATSDR responded to health-related questions associated with potential exposure to contaminants.

Public Health Actions Planned by NJDOH

1. NJDOH will make this health consultation available to concerned residents via the township libraries and the Internet. Area residents will be notified that this report is available for their review and provided with a copy upon request.

2. NJDOH will continue participation in public meetings as needed to address health concerns with community representatives.

3. NJDOH will continue to recommend prospective home builders to assess environmental hazards before constructing housing.

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Report Preparation

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Tables

Table 1: Summary of potential contaminants of concern (COCs) and property identifier (based on 2016 Soil Sampling)

Soil Depth = 0 – 1 inch

Contaminant	Property Code
Antimony	P001, P012, P028 and P030
Arsenic	All Residences
Lead[a]	P001, P005, P006, P007, P016, P017, P019, P021, P022, P030, P034, P035 and P036

[a]Mean Lead concentration was used for screening the properties.

Soil Depth = 1 – 6 inches

Contaminant	Property Code
Antimony	P006 and P028
Arsenic	All Residences
Lead[a]	P001, P002, P006, P013, P016, P017, P019, P028 and P031

[a]Mean Lead concentration was used for screening the properties.

Soil Depth >6 inches

Contaminant	Property Code
Antimony	P001, P003, P004, P020, P021, P022, P023 and P028
Arsenic	All Residences
Lead[a]	P001, P002, P003, P004, P006, P013, P015, P016, P017, P019, P020, P022, P023, P024, P028, P029, P032, P034, P035 and P036

[a]Mean Lead concentration was used for screening the properties.

Table 2: Summary of SVOC potential contaminants of concern (COCs) and property identifier (based on 2016 Soil Sampling)

Contaminant	Property Code
Benzo[a]pyrene	P006
PCBs	P005, P006 and P028

Table 3: Surface Soil (0 – 1 inch and 1 – 6 inches depth) Exposure Pathway

Environmental Pathway	Exposure Point	Route of Exposure	Receptor	Past Pathway	Current Pathway	Future Pathway
Surface Soil	Soil	Ingestion /Dermal Contact	Resident	Completed	Eliminated	Eliminated

Table 4: Calculated Soil Exposure Point Concentration Ranges of Contaminants Detected at the Residential Backyard Soils

Contaminant	Exposure Point Concentrations (ppm)	Contaminant	Exposure Point Concentrations (ppm)
Antimony	40 - 154	Benzo[a]pyrene[a]	1.4
Arsenic	4.2 - 37	PCB[a,b]	0.51
Lead[c]	294 - 947	-	-

[a]Maximum value due to small sample size; [b]Polychlorinated Byphenyl; [c]Arithmetic mean (EPA 2007)

Table 5: Combined ingestion and dermal HQs for chronic and intermediate exposure to antimony in soil at 154.4 mg/kg*

Exposure Group	Chronic CTE HQ	Chronic RME HQ	Intermediate CTE HQ	Intermediate RME HQ	Exposure Duration (yrs)
Birth to < 1 year	2.9	7.6	1.9	5	1
1 to < 2 years	3.2	6.9	2.1	4.6	1
2 to < 6 years	1.4	4.5	1	3	4
6 to < 11 years	0.8	2.5	0.5	1.7	5
11 to < 16 years	0.3	0.7	0.2	0.5	1
16 to < 21 years	0.2	0.6	0.1	0.4	0
Adult	0.2	0.5	0.1	0.3	12

Source: Table 4

Abbreviations: CTE = central tendency exposure (typical); mg/kg/day = milligram chemical per kilogram body weight per day; mg/kg = milligram chemical per kilogram soil; RME = reasonable maximum exposure (higher); yrs = years; *The calculations in this table were generated using ATSDR's PHAST v2.1.1.0. The HQ were calculated using the EPC: 150 mg/kg and a chronic (lifetime) reference dose of 0.0004 mg/kg/day and an intermediate MRL of 0.0006 mg/kg/day.

Table 6: Combined ingestion and dermal HQs for chronic exposure to arsenic in soil at 37.36 mg/kg along with cancer risk estimates*

PUBLIC HEALTH ASSESSMENT SITE TOOL PHAST Exposure Group	CTE HQ	CTE Cancer Risk	RME HQ	RME Cancer Risk	Exposure Duration (yrs)
Birth to < 1 year	0.5	-	1.5	-	1
1 to < 2 years	0.6	-	1.3	-	1
2 to < 6 years	0.3	-	0.9	-	4
6 to < 11 years	0.1	-	0.5	-	5
11 to < 16 years	0.05	-	0.1	-	5
16 to < 21 years	5×10^{-2}	-	0.1	-	5
Total Child	-	2×10^{-5}	-	5.7×10^{-5}	21
Adult	3.1×10^{-2}	5.4×10^{-6}	0.1	1.7×10^{-5}	30

Source: Table 4
Abbreviations: CTE = central tendency exposure (typical); mg/kg/day = milligram chemical per kilogram body weight per day; mg/kg = milligram chemical per kilogram soil; RME = reasonable maximum exposure (higher); yrs = years; *The calculations in this table were generated using ATSDR's PHAST v2.1.1.0. The noncancer HQs were calculated using the EPC: 37 mg/kg and chronic MRL of 0.0003 mg/kg/day and the cancer risks were calculated using the cancer slope factor of 1.5 $(mg/kg/day)^{-1}$.

Table 7: PAH levels in urban and rural background soil that were detected in Tempo Development subdivision soils

Contaminant	Rural Background Soil Concentration (ppm)	Urban Background Soil Concentration (ppm)
Benzo[a]pyrene	NA	0.165 – 0.22

NA=not available

Table 8: Combined ingestion and dermal HQs for chronic exposure to benzo[a]pyrene in soil along with cancer risk estimates*

Exposure Group	CTE HQ	CTE Cancer Risk	RME HQ	RME Cancer Risk	Exposure Duration (yrs)
Birth to < 1 year	0.036	-	0.093	-	1
1 to < 2 years	0.040	-	0.085	-	1
2 to < 6 years	0.019	-	0.056	-	4
6 to < 11 years	0.011	-	0.031	-	5
11 to < 16 years	0.0040	-	0.0098	-	5
16 to < 21 years	0.0034	-	0.0079	-	5
Total Child	-	1.25×10^{-5}	-	3.12×10^{-5}	21
Adult	0.0023	7.03×10^{-7}	0.0064	1.87×10^{-6}	30

Source: Table 4
Abbreviations: CTE = central tendency exposure (typical); mg/kg/day = milligram chemical per kilogram body weight per day; mg/kg = milligram chemical per kilogram soil; RME = reasonable maximum exposure (higher); yrs = years; *The calculations in this table were generated using ATSDR's PHAST v2.1.1.0. The noncancer hazard quotients were calculated using a concentration of 1.4 mg/kg and the chronic (lifetime) reference dose of 0.0003 mg/kg/day. The cancer risks were calculated using a benzo[a]pyrene equivalent concentrations of 2.19 mg/kg, the cancer slope factor of 1.7 $(mg/kg/day)^{-1}$ and age-dependent adjustment factors.

Table 9: Combined ingestion and dermal cancer risk estimates for chronic exposure to PCBs in soil at 0.51 mg/kg

Exposure Group	CTE HQ	CTE Cancer Risk	RME HQ	RME Cancer Risk	Exposure Duration (yrs)
Total Child	-	6.8×10^{-7}	-	1.8×10^{-6}	21
Adult	-	1.9×10^{-7}	-	5.4×10^{-7}	30

Source: Table 4
Abbreviations: CTE = central tendency exposure (typical); mg/kg/day = milligram chemical per kilogram body weight per day; mg/kg = milligram chemical per kilogram soil; RME = reasonable maximum exposure (higher); yrs = years; *The calculations in this table were generated using ATSDR's PHAST v2.1.1.0. The noncancer hazard quotients were calculated using the chronic (lifetime) reference dose of 0.02 mg/kg/day and the cancer risks were calculated using the cancer slope factor of 2 $(mg/kg/day)^{-1}$.

Table 10a: The IEUBK model (Version 2, Build 1) Results for past Residential Exposure Scenario: Geometric Mean Blood Lead Level (µg/dL) for 0 to 60 month old children for the three soil lead concentration

294 ppm	912 ppm	947 ppm
3.9	8.33	9.4

Table 10b: The IEUBK model (Version 2, Build 1) Results for past Residential Exposure Scenario: Probability of exceeding blood lead level of 5 µg/dL for 0 to 60 month old children for the three soil lead concentration

294 ppm	912 ppm	947 ppm
30	86.16	91

Table 11a: Geometric Mean Blood Lead Levels in adult workers

Soil Lead Concentration (ppm)	Geometric Mean BLL 2009-2014	Geometric Mean BLL 2007-2010	Geometric Mean BLL 2004-2007	Geometric Mean BLL 1988-1994
294	1	1.1	1.4	1.9
912	1.9	2.0	2.3	2.8
947	2.0	2.1	2.4	2.9

[a]GSDi and PbBo from Analysis of NHANES 2009-2014; GSDi and PbBo from Analysis of NHANES 2007-2010; GSDi and PbBo from Analysis of NHANES 2004-2007; GSDi and PbBo from Analysis of NHANES III (Phases 1&2)

Table 11b: Probability that fetal PbB exceeds target PbB, assuming lognormal distribution

Soil Lead Concentration (ppm)	Probability that fetal PbB exceeds target PbB 2009-2014[a]	Probability that fetal PbB exceeds target PbB 2007-2010[b]	Probability that fetal PbB exceeds target PbB 2004-2007[c]	Probability that fetal PbB exceeds target PbB 1988-1994[d]
294	0.2	0.1	1.0	7.6
912	3.5	2.8	6.8	18.0
947	3.8	3.1	7.3	18.6

[a]GSDi and PbBo from Analysis of NHANES 2009-2014; GSDi and PbBo from Analysis of NHANES 2007-2010; GSDi and PbBo from Analysis of NHANES 2004-2007; GSDi and PbBo from Analysis of NHANES III (Phases 1&2)

Table 12: Percent blood lead levels in children under 3 years from 2000 through 2016

Population	% ≥ 5 µg/dL	% ≥10 µg/dL	% ≥ 20 µg/dL
Impacted area	0%	0%	0%
West Deptford	4.9%	0.3%	<0.1%
State of New Jersey	5.9%	1.4%	0.24%

Figures

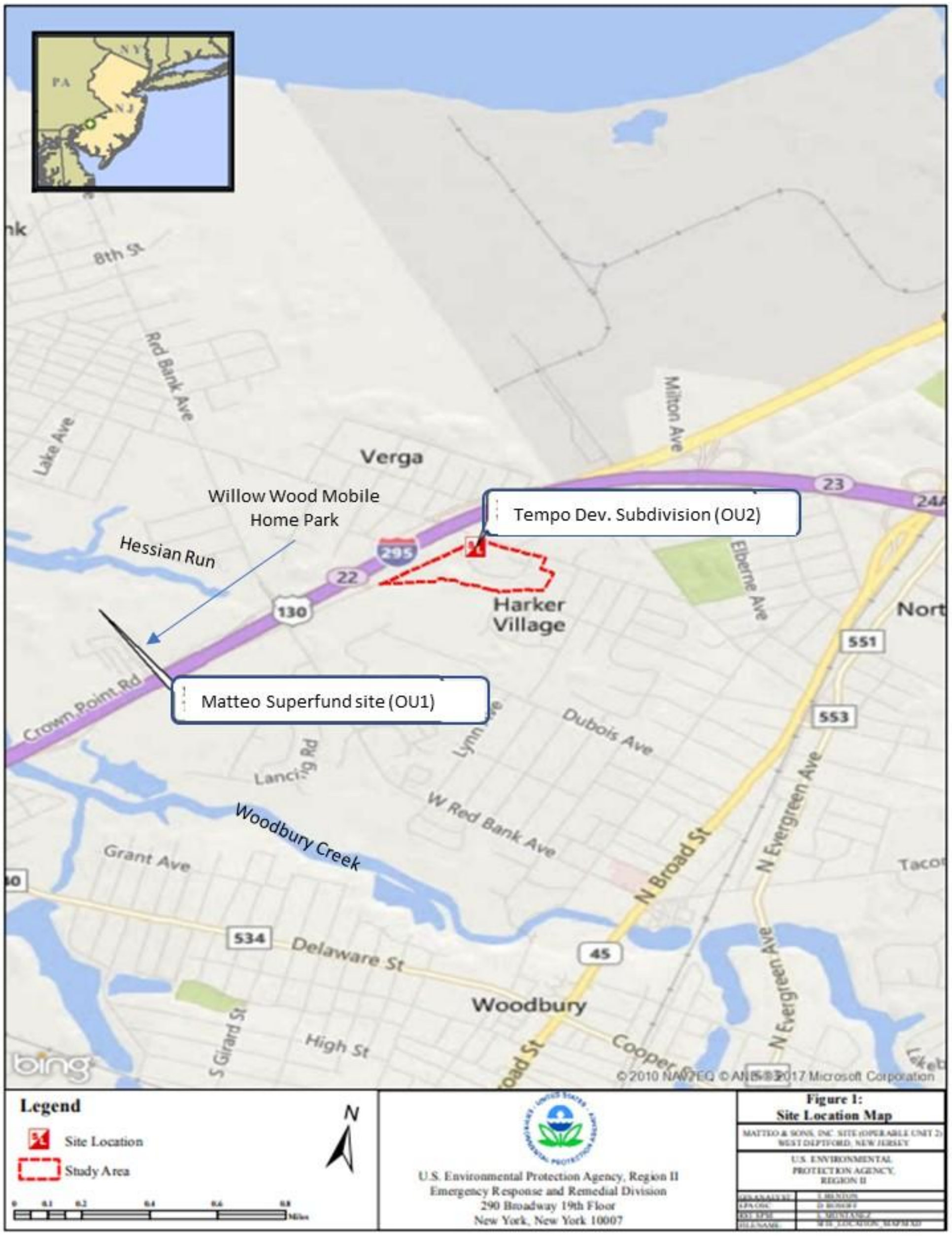

Figure 1: Map showing the location of the Hessian Run, Woodbury Creek, Tempo Development subdivision (OU2), Matteo and Sons, Inc. Superfund site (OU1) and Willow Wood Mobile Home Park (EPA 2023)

Figure 2: Residences in the Tempo Development subdivision (USEPA 2023)

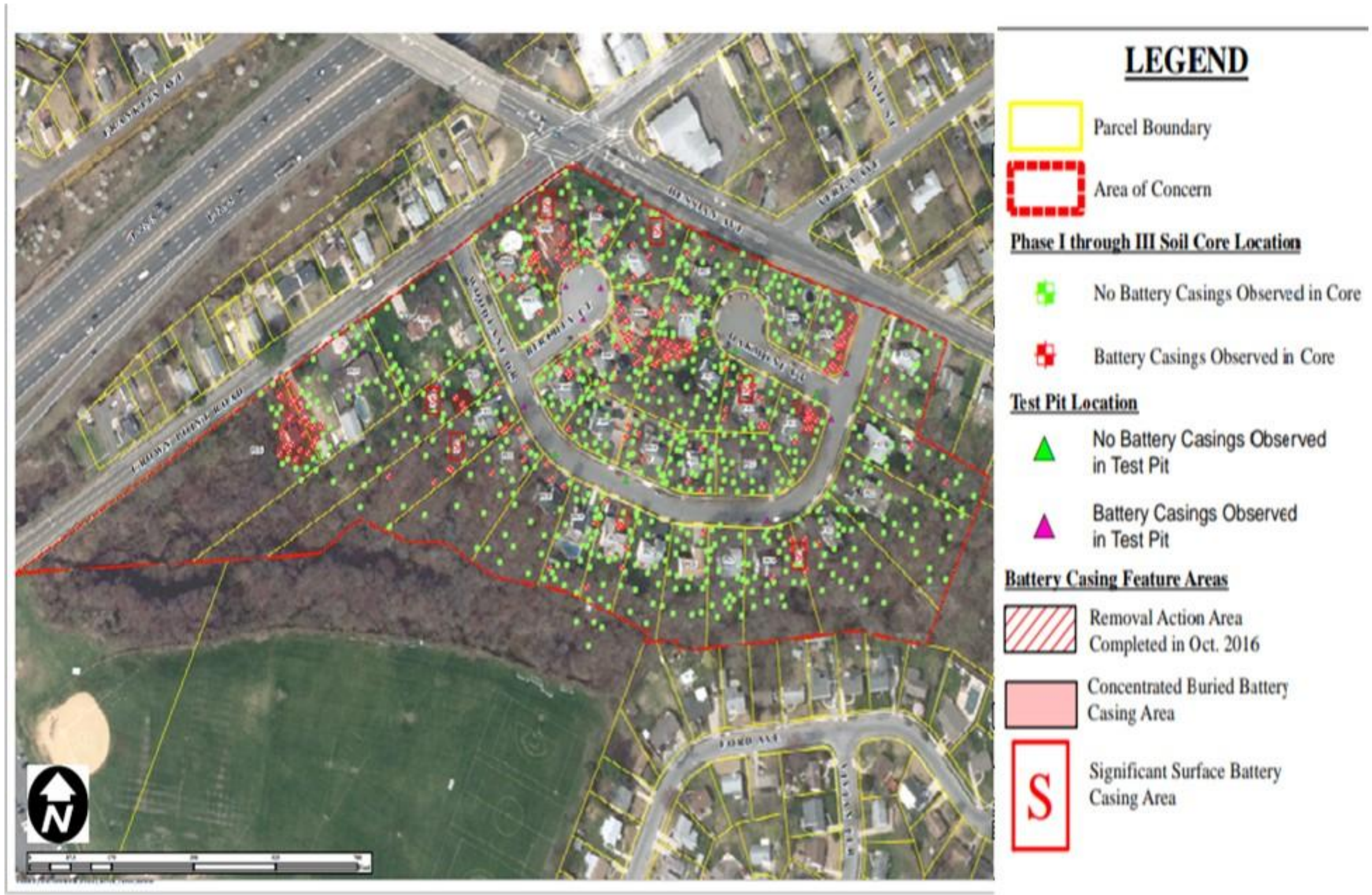

Figure 3: Spatial Distribution of Battery Casings in the Tempo Development subdivision (USEPA 2023)

Appendix A – Additional Tables

Table A1: Residential Soil Sampling Results (2016): The range and mean concentration (in ppm) of metals detected in the soil (0 – 1”) for residences P001 through P004

Contaminant	Residence# P001 Range/Mean	Residence# P002 Range/Mean	Residence# P003 Range/Mean	Residence# P004 Range/Mean	CV[a]
Aluminum	2,800 -5,800/4,390	4,300 - 6,500/5,400	4,000 -7,500/5,557	4,900 - 5,100/5,000	52,000 (EMEG[b])
Antimony	2.3 – 59§/12.69	NA**/NA	5.7 -5.7/5.7	1.6 - 2.4/2	21 (RMEG[c])
Arsenic	4.5 – 10§/6.44	3.8 – 5§/4.37	5.0 - 9.4§/7	5.5 - 6.3§/5.9	0.26 (CREG[d])
Barium	13 – 45/26.55	28 – 45/37	26 – 45/34	49 – 59/54	10,000 (EMEG)
Beryllium	0.31 - 0.42/0.36	0.31 - 0.37/0.33	0.31 - 0.38/0.35	0.51 - 0.80/0.68	100 (EMEG)
Cadmium	0.48 - 0.48/0.48	ND*/ND	ND/ND	ND/ND	5.2 (EMEG)
Chromium	10 – 38/17.64	13 – 22/17	11 – 17/15	18 – 23/21	240 (RSRS[e])
Cobalt	2.1 - 2.6/2.33	1.9 - 2.1/1.97	1.8 - 2.1/1.93	1.9 - 2.2/2.08	23 (EPA SL[f])
Copper	6.1 – 52/15.23	10 – 13/12	7.7 – 23/13.96	31 – 47/39	600 (RSRS)
Iron	7,500 - 16,000/11,245	8,200 - 10,000/8,866	9,800 - 16,000/11,971	10,000 - 11,000/10,500	55,000 (EPA SL)
Lead	96 - 7,000§/946	50 – 100/73	58 – 120/84	94 – 130/116	200 (EPA R2[g])
Manganese	30 – 94/56.45	53 – 93/79.67	56 – 120/72.43	72 – 84/76	1,900 (EPA SL)
Mercury	0.03 - 0.1/0.05	0.04 - 0.04/0.04	0.04 - 0.1/0.07	0.03 - 0.03/0.03	14 (RSRS)
Nickel	3 - 6.5/4.45	5.1 – 8/6.07	4.10 - 5.90/5.26	5.10 - 6.2/5.65	1000 (RMEG)
Vanadium	16 – 42/25.27	18 – 24/20.67	21 – 28/25.43	27 – 30/28.25	370 (RSRS)
Zinc	22 – 180/55.45	40 – 66/53	45 – 160/80.43	160 – 300/220	16,000 (EMEG)

[a]Comparison Values given in ppm; [b]Environmental Media Evaluation Guide; [c]Reference Media Evaluation Guide; [d]Cancer Risk Evaluation Guide; [e]New Jersey Residential Soil Remediation Standard; [f]EPA Screening Level; [g]EPA Region 2 Screening Level; *Not detected; **Not Available; §indicates exceedance

Table A2: Residential Soil Sampling Results (2016): The range and mean concentration (in ppm) of Lead[a] detected in the soil (0 – 1”) for residences P005 through P008

Contaminant	Residence# P005 Range/Mean	Residence# P006 Range/Mean	Residence# P007 Range/Mean	Residence# P008 Range/Mean	CV[a]
Lead	110 – 350[§]/162.5	65 – 760[§]/293.94	37 – 290[§]/109.6	36 – 140/90.3	200 (EPA R2[b])

[a]The concentration of other metals were not analyzed for these yards; [b]EPA Region 2 Screening Level; [§]indicates exceedance

Table A3: Residential Soil Sampling Results (2016): The range and mean concentration (in ppm) of metals detected in the soil (0 – 1”) for residences P009 through P012

Contaminant	Residence# P009 Range/Mean	Residence# P010 Range/Mean	Residence# P011 Range/Mean	Residence# P012 Range/Mean	CVs[a]
Aluminum	1,840 – 3,880/2,802	1,870 – 4,940/2,936	1,810 – 6,830/2,894	1,360 – 3,360/2,517	52,000 (EMEG[b])
Antimony	0.33 - 2.25/1.27	0.95 - 2.22/1.42	1.01 - 9.07/2.32	1.75 - 317.84[§]/58.41	21 (RMEG[c])
Arsenic	1.97 - 17.08[§]/7.7	2.5 - 35.52[§]/11.22	1.48 - 17.94[§]/4.64	1.62 - 9.63[§]/5.08	0.26 (CREG[d])
Barium	10 - 50.98/23.39	5.62 - 50.79/25.51	9.04 - 238.99/34.81	9.58 - 27.8/18.09	10,000 (EMEG)
Beryllium	0.04 - 0.21/0.1	0.09 - 0.58/0.24	0.09 - 0.86/0.26	0.08 - 0.31/0.19	100 (EMEG)
Cadmium	0.07 - 0.34/0.18	0.06 - 0.32/0.16	0.02 - 0.81/0.22	0.04 - 0.46/0.15	5.2 (EMEG)
Chromium	5.42 - 22.06/14.64	6.28 - 48.78/16.68	3.58 - 26.81/10.28	2.97 - 15.76/9.55	240 (RSRS[e])
Cobalt	0.67 - 1.83/1.15	0.76 - 2.19/1.57	0.34 - 7.91/1.92	0.41 - 4.02/1.81	23 (EPA SL[f])
Copper	3.18 - 30.2/13.97	4.19 - 63.03/18.3	3.79 - 49.61/10.28	2.51 - 14.78/8.12	600 (RSRS)
Iron	4,600 – 8,620/6,792	4,160 – 7,190/6,195	3,460 – 47,300/10,289	4,150 – 20,100/8,900	55,000 (EPA SL)
Lead	6.33 - 68.58/43.59	10.92 - 124.76/42.55	16.93 - 86.99/41.62	8.9 - 55.75/29.8	200 (EPA R2[g])
Manganese	31.29 - 154.06/71.48	16.52 - 142.8/72.35	24.11 - 507.95/90.4	14.29 - 151.63/52.74	1,900 (EPA SL)
Nickel	2.21 - 6.03/3.7	2.26 - 5.31/3.81	1.41 - 13.15/4.46	1.57 - 7.09/4.07	1000 (RMEG)
Selenium	1.17 - 1.82/1.4	3.22 - 3.22/3.22	1.95 - 1.99/1.98	ND*/ND	260 (EMEG)
Silver	0.21 - 0.21/0.21	0.17 - 0.92/0.41	0.18 - 0.81/0.33	0.15 - 0.46/0.25	260 (RMEG)
Thallium	ND/ND	2.3 - 2.3/2.3	ND/ND	0.46 - 0.73/0.59	NA**
Vanadium	6.2 – 18/12.35	6.11 - 14.52/10.41	6.77 - 88.1/16.14	6.2 - 43.09/16.08	370 (RSRS)
Zinc	10.92 - 67.5/33.38	13.37 - 78.34/34.69	11.1 - 131.21/38.06	11.19 - 44.33/27.32	16,000 (EMEG)

[a]Comparison Values given in ppm; [b]Environmental Media Evaluation Guide; [c]Reference Media Evaluation Guide; [d]Cancer Risk Evaluation Guide; [e]New Jersey Residential Soil Remediation Standard; [f]EPA Screening Level; [g]EPA Region 2 Screening Level, *Not detected **Not Available; [§]indicates exceedance

Table A4: Residential Soil Sampling Results (2016): The range and mean concentration (in ppm) of metals detected in the soil (0-1”) for residences P013 through P016

Contaminant	Residence# P013 Range/Mean	Residence# P014 Range/Mean	Residence# P015 Range/Mean	Residence# P016 Range/Mean	CVs[a]
Aluminum	2,020 – 4,020/2,928	2,170 – 5,090/3,305	1,420 – 4,780/3,065	2,260 – 4,000/3,116	52,000 (EMEG[b])
Antimony	1.26 - 5.54/2.32	1.02 - 3.14/1.53	1 - 5.15/1.97	1.1 - 5.7/2.13	21 (RMEG[c])
Arsenic	2.32 - 6.39[§]/3.62	2.5 - 17.67[§]/7.96	2.44 - 29.81[§]/7.54	3.32 - 8.3[§]/5.44	0.26 (CREG[d])
Barium	8.47 - 76.51/25.17	8.83 - 55.78/22.63	7.6 - 56.1/22.97	5.6 - 41.8/21.32	10,000 (EMEG)
Beryllium	0.09 - 0.4/0.21	0.08 - 0.49/0.21	0.09 - 0.49/0.2	0.12 - 0.29/0.2	100 (EMEG)
Cadmium	0.03 - 0.48/0.22	0.05 - 0.57/0.29	0.05 - 0.35/0.13	0.11 - 0.49/0.22	5.2 (EMEG)
Chromium	4.01 - 12.35/7.81	3.86 - 25.75/12.5	4.37 - 37.89/13.72	11 - 30.3/17.72	240 (RSRS[e])
Cobalt	0.48 - 4.52/1.57	0.36 - 4.77/1.74	0.7 - 5.25/1.58	0.74 - 2.2/1.42	23 (EPA SL[f])
Copper	2.9 - 18.35/9.04	1.81 - 32.24/12.07	4.71 - 38.04/13.82	3.9 - 33.3/12.01	600 (RSRS)
Iron	3,840 – 10,800/6,199	4,030 – 26,900/9,752	3,340 – 30,400/7,691	6,250 – 10,600/8,357	55,000 (EPA SL)
Lead	9.79 - 138.75/43.97	5.69 - 82.77/45.31	15.03 - 151.54/51.92	36.84 - 315.6[§]/102.3	200 (EPA R2[g])
Manganese	19.86 - 357.16/83.72	11.37 - 160.6/66.94	14.11 - 177.48/62.84	16.3 – 142/53.59	1,900 (EPA SL)
Nickel	1.61 - 13.06/4.16	1.32 - 8.72/3.67	1.82 - 9.6/3.94	1.6 – 7/3.73	1000 (RMEG)
Selenium	1.64 - 1.64/1.64	ND*/ND	1.54 - 3.55/2.47	3.6 - 3.6/3.6	260 (EMEG)
Silver	0.13 – 1/0.28	0.16 - 1.06/0.44	0.13 - 0.51/0.24	0.18 - 0.2/0.19	260 (RMEG)
Thallium	0.49 - 0.97/0.81	ND/ND	0.49 - 0.71/0.59	0.55 - 0.55/0.55	NA**
Vanadium	8.91 - 16.29/11.42	7.03 - 55.07/19.24	7.98 - 67.75/17.12	12.1 - 46.8/23.39	370 (RSRS)
Zinc	8.37 - 60.41/27.64	6.74 - 76.45/36.2	10.34 - 89.1/39.37	15 - 87.44/43.49	16,000 (EMEG)

[a]Comparison Values given in ppm; [b]Environmental Media Evaluation Guide; [c]Reference Media Evaluation Guide; [d]Cancer Risk Evaluation Guide; [e]New Jersey Residential Soil Remediation Standard; [f]EPA Screening Level; [g]EPA Region 2 Screening Level, *Not detected; **Not Available; [§]indicates exceedance

Table A5: Residential Soil Sampling Results (2016): The range and mean concentration (in ppm) of metals detected in the soil (0 – 1”) for residences P017 through P020

Contaminant	Residence# P017 Range/Mean	Residence# P018 Range/Mean	Residence# P019 Range/Mean	Residence# P020 Range/Mean	CVs[a]
Aluminum	2,620 – 5,000/3,937	1,890 – 5,530/3,790	2,260 – 4,460/2,921	2,590 – 9,610/4,851	52,000 (EMEG[b])
Antimony	0.87 - 4.2/2.23	0.8 - 3.44/1.73	0.71 - 7.05/2.26	0.53 - 3.2/2.03	21 (RMEG[c])
Arsenic	2.83 - 20.2[§]/8.88	4.19 - 11.66[§]/7.94	2.6 - 32.93[§]/6.17	2.8 - 28.6[§]/12.17	0.26 (CREG[d])
Barium	7.08 – 253/72.17	12.97 - 45.95/24.9	9.57 - 32.84/16.34	16.9 - 59.6/44.78	10,000 (EMEG)
Beryllium	0.07 - 0.37/0.29	0.19 - 0.51/0.29	0.1 - 0.37/0.16	0.19 – 1/0.4	100 (EMEG)
Cadmium	0.05 - 1.3/0.45	0.15 - 0.49/0.3	0.03 - 0.27/0.09	0.06 - 0.33/0.2	5.2 (EMEG)
Chromium	5.09 - 34.2/18.46	8.69 - 30.34/15.52	4.85 - 67.68/11.33	10.5 - 53.9/24.08	240 (RSRS[e])
Cobalt	0.62 – 4/2.41	1.46 - 7.24/3.68	0.52 - 4.42/1.17	0.82 - 11.5/3.77	23 (EPA SL[f])
Copper	1.43 - 36.1/20.88	4.68 - 86.82/16.41	3.81 - 56.39/10.54	6.5 - 47.5/17.37	600 (RSRS)
Iron	3,840 – 11,700/8,866	6,010 – 26,000/14,709	4,000 – 22,700/7,028	6,310 – 70,800[§]/17,982	55,000 (EPA SL)
Lead	3.33 – 294[§]/135.63	17.47 - 64.25/38.35	15.07 – 424[§]/132.36	49.9 – 143/100.37	200 (EPA R2[g])
Manganese	14.69 - 242.1/120.84	28.51 - 157.73/90.31	23.71 – 106/41.4	50.8 – 273/133.93	1,900 (EPA SL)
Nickel	1.81 - 9.1/5.87	3.04 - 10.99/5.83	1.84 - 7.95/3.2	4.9 – 21/8.22	1000 (RMEG)
Selenium	1.1 - 2.17/1.87	1.72 - 1.72/1.72	ND*/ND	ND/ND	260 (EMEG)
Silver	0.15 - 0.26/0.21	0.31 - 0.54/0.38	0.15 - 0.27/0.2	0.22 – 1/0.54	260 (RMEG)
Thallium	0.41 - 1.4/0.91	1.05 - 1.05/1.05	0.99 - 0.99/0.99	0.78 - 0.78/0.78	NA**
Vanadium	6.36 - 25.08/17.21	7.9 - 71.91/31.47	7.69 - 42.83/15.16	15.4 – 129/32.76	370 (RSRS)
Zinc	10.98 – 157/79.8	20.25 - 74.61/42.48	13.28 - 77.43/26.41	48.9 - 86.5/72.92	16,000 (EMEG)

[a]Comparison Values given in ppm; [b]Environmental Media Evaluation Guide; [c]Reference Media Evaluation Guide; [d]Cancer Risk Evaluation Guide; [e]New Jersey Residential Soil Remediation Standard; [f]EPA Screening Level; [g]EPA Region 2 Screening Level, *Not detected; **Not Available; [§]indicates exceedance

Table A6: Residential Soil Sampling Results (2016): The range and mean concentration (in ppm)of metals detected in the soil (0 – 1”) for residences P021 through P024

Contaminant	Residence# P021 Range/Mean	Residence# P022 Range/Mean	Residence# P023 Range/Mean	Residence# P024 Range/Mean	CVs[a]
Aluminum	1,360 – 4,720/3,245	850.57 – 7,960/3,120	907 – 3,160/2,018	1,510 – 6,620/3,888	52,000 (EMEG[b])
Antimony	1.02 - 4.15/2.17	1.1 - 5.26/2.21	0.95 - 6.56/2.24	0.36 - 4.35/1.78	21 (RMEG[c])
Arsenic	1.77 - 35.7§/10.46	1.06 – 11§/5.12	2.16 - 14.96§/7.36	2.98 - 22.92§/8.53	0.26 (CREG[d])
Barium	21.77 - 78.34/34.84	6.73 – 964/81.7	4.82 - 66.33/33.77	10.52 - 114.32/33.93	10,000 (EMEG)
Beryllium	0.09 - 0.42/0.23	0.06 - 0.9/0.26	0.07 - 0.26/0.14	0.05 - 0.71/0.33	100 (EMEG)
Cadmium	0.03 - 0.46/0.2	0.05 - 4.2/0.44	0.05 - 0.38/0.2	0.04 - 1.49/0.4	5.2 (EMEG)
Chromium	3.73 - 55.54/16.11	2.26 - 26.3/10.4	3.65 - 25.8/11.74	6.61 – 39/20.22	240 (RSRS[e])
Cobalt	0.62 - 4.3/2.22	0.23 - 19.6/2.46	0.37 - 1.91/1.11	0.3 - 6.81/3.4	23 (EPA SL[f])
Copper	8.2 – 76/23.22	2.4 - 41.2/15.2	4.79 - 50.99/17.98	5.42 - 47.01/11.93	600 (RSRS)
Iron	2,800 - 46,100/11,121	2,200 – 17,100/7,819	3,180 – 6,960/5,129	5,130 – 46,800/20,212	55,000 (EPA SL)
Lead	29.31 – 7,720§/912.5	8.35 – 1,560§/137.4	21.58 - 80.24/50.38	28.77 - 108.48/52.3	200 (EPA R2[g])
Manganese	32.11 - 452.8/150.6	7.78 – 1530/150.6	10.86 - 320.5/142.2	19.89 - 339.47/137.85	1,900 (EPA SL)
Nickel	2.72 - 6.7/5.03	0.82 - 20.5/5.33	1.66 - 4.34/3.06	2.58 - 22.98/7.99	1000 (RMEG)
Selenium	ND*/ND	1.51 - 1.51/1.51	ND/ND	0.95 - 1.65/1.3	260 (EMEG)
Silver	0.14 - 0.82/0.35	0.13 - 1.6/0.39	0.14 - 0.94/0.31	0.08 - 0.52/0.24	260 (RMEG)
Thallium	0.75 - 0.75/0.75	0.65 - 2.2/1.11	ND/ND	0.65 - 0.9/0.78	NA**
Vanadium	8.03 - 23.07/13.79	4.06 - 24.8/13.37	7.53 - 14.12/10.16	11.04 - 126.21/52.55	370 (RSRS)
Zinc	36.3 - 127.9/62.76	7.57 – 355/55.47	10.02 - 91.9/37.19	14.47 - 236.53/59.56	16,000 (EMEG)

[a]Comparison Values given in ppm; [b]Environmental Media Evaluation Guide; [c]Reference Media Evaluation Guide; [d]Cancer Risk Evaluation Guide; [e]New Jersey Residential Soil Remediation Standard; [f]EPA Screening Level; [g]EPA Region 2 Screening Level, *Not detected; **Not Available; §indicates exceedance

Table A7: Residential Soil Sampling Results (2016): The range and mean concentration (in ppm) of metals detected in the soil (0 – 1”) for residences P025 through P028

Contaminant	Residence# P025 Range/Mean	Residence# P026 Range/Mean	Residence# P027 Range/Mean	Residence# P028 Range/Mean	CVs[a]
Aluminum	2,380 – 4,720/3,423	2,200 – 4,250/2,987	2,020 – 9,110/3,719	1,890 – 4,630/3,226	52,000 (EMEG[b])
Antimony	0.27 - 2.87/1.29	0.55 - 4.52/1.59	0.79 - 4.66/2.2	0.58 - 74.91[§]/15.14	21 (RMEG[c])
Arsenic	3.52 - 11.25[§]/6.49	2.56 - 8.76[§]/5.46	1.86 - 15.79[§]/6.05	1.46 - 15.31[§]/6.01	0.26 (CREG[d])
Barium	11.19 – 36/25.18	11.05 - 31.78/18.61	9.9 - 108.93/31.19	7.7 - 28.83/20.67	10,000 (EMEG)
Beryllium	0.11 - 0.41/0.22	0.08 - 0.25/0.15	0.09 - 0.96/0.29	0.05 - 0.28/0.14	100 (EMEG)
Cadmium	0.09 - 0.26/0.19	0.05 - 0.24/0.12	0.03 - 1.26/0.35	0.06 - 0.28/0.19	5.2 (EMEG)
Chromium	7.4 - 24.91/15.18	6.29 - 18.96/11.15	5.38 - 48.18/14.83	3.56 - 25.28/11.96	240 (RSRS[e])
Cobalt	0.76 - 5.62/2.65	0.71 - 1.98/1.23	0.45 - 8.39/2.69	0.92 - 2.86/1.49	23 (EPA SL[f])
Copper	5.6 - 10.43/8.33	5.21 - 28.01/12.68	4.22 - 36.62/10.64	1.72 - 12.6/8.13	600 (RSRS)
Iron	5,470 – 28,200/12,686	4,960 – 14,500/7,112	4,330 – 80,300[§]/16,195	3,600 – 10,900/8,183	55,000 (EPA SL)
Lead	27.89 - 82.68/57.58	17.59 - 53.05/32.4	14.54 - 137.57/43.51	2.77 - 140.6/53.11	200 (EPA R2[g])
Manganese	36.55 - 196.92/100.36	29.28 - 125.31/77.47	44.06 - 358.07/151.72	13.66 - 127.54/69.12	1,900 (EPA SL)
Nickel	2.74 - 8.63/5.21	2.29 - 7.35/3.81	1.85 - 20.66/6.93	1.41 - 7.82/4.08	1000 (RMEG)
Selenium	ND*/ND	0.95 - 0.95/0.95	1.36 - 5.36/3.36	1.11 - 1.9/.48	260 (EMEG)
Silver	0.09 - 0.22/0.14	0.06 - 0.61/0.26	0.3 - 1.98/0.8	0.11 - 0.34/0.2	260 (RMEG)
Thallium	0.46 - 0.55/0.49	0.21 - 1.63/0.69	0.29 - 2.84/1.09	0.39 - 0.46/0.44	NA**
Vanadium	11.76 - 88.85/37.03	8.62 - 44.4/15.39	8.18 - 138.52/33.81	5.02 - 29.55/15.34	370 (RSRS)
Zinc	22.08 - 57.28/41.77	18.11 - 76.55/35.29	14.51 - 216.3/57.61	6.62 - 48.12/30.79	16,000 (EMEG)

[a]Comparison Values given in ppm; [b]Environmental Media Evaluation Guide; [c]Reference Media Evaluation Guide; [d]Cancer Risk Evaluation Guide; [e]New Jersey Residential Soil Remediation Standard; [f]EPA Screening Level; [g]EPA Region 2 Screening Level, *Not detected; **Not Available; [§]indicates exceedance

Table A8: Residential Soil Sampling Results (2016): The range and mean concentration (in ppm) of metals detected in the soil (0 – 1”) for residences P029 through P032

Contaminant	Residence# P029 Range/Mean	Residence# P030 Range/Mean	Residence# P031 Range/Mean	Residence# P032 Range/Mean	CVs[a]
Aluminum	1,900 – 6,850/3,952	850 – 9,610/3,346	845 – 3,710/2,811	2,470 – 10,200/4,382	52,000 (EMEG[b])
Antimony	1.9 - 5.84/3.36	0.27 - 317.84§/6.33	1.23 - 15.85/4.31	0.7 - 7.3/4.07	21 (RMEG[c])
Arsenic	3.7 - 20.7§/10.38	1.06 – 47§/7.59	0.92 - 27.25§/8.81	3.32 - 17.1§/7.17	0.26 (CREG[d])
Barium	11.2 - 95.1/42.66	4.38 – 964/36.63	15.47 - 82.51/43.21	19.3 – 175/46.57	10,000 (EMEG)
Beryllium	0.13 - 0.73/0.31	0.03 – 1/0.25	0.02 - 0.45/0.14	0.06 - 0.58/0.19	100 (EMEG)
Cadmium	0.07 - 0.68/0.29	0.02 - 4.2/0.26	0.09 - 0.66/0.4	0.3 - 3.9/0.8	5.2 (EMEG)
Chromium	6.8 - 65.25/27.03	2.26 - 67.68/15.13	3.36 - 43.04/15.83	9.09 - 36.3/15.51	240 (RSRS[e])
Cobalt	0.5 - 5.18/2.24	0.23 - 19.6/2.12	1.14 - 3.86/1.99	0.58 - 5.4/1.93	23 (EPA SL[f])
Copper	6 - 43.3/25.21	1.43 - 86.82/15.36	6.67 - 63.77/23.42	9.47 - 75.6/19.83	600 (RSRS)
Iron	5,120 – 37,800/12,049	2,200 – 80,300§/10,544	2,200 – 15,800/8,827	5,940 – 36,300/12,783	55,000 (EPA SL)
Lead	20 – 182/78	2.77 – 7,720§/129	16.42 - 152.3/72.88	23.36 – 185/61.43	200 (EPA R2[g])
Manganese	40 - 693.76/189.31	7.78 – 1530/104.77	48.35 - 413.26/140.45	36.29 – 337/108.37	1,900 (EPA SL)
Nickel	2.3 - 9.7/6.12	0.82 - 22.98/4.97	3.53 - 8.89/5.88	2.97 - 21.6/6.75	1000 (RMEG)
Selenium	ND*/ND	ND/ND	1.31 - 2.42/1.9	1.25 - 1.55/1.44	260 (EMEG)
Silver	0.22 - 0.4/0.29	0.06 - 1.98/0.35	0.07 - 0.18/0.14	0.28 - 0.28/0.28	260 (RMEG)
Thallium	0.53 - 0.75/0.64	0.21 - 2.84/0.85	0.32 - 0.32/0.32	0.43 - 0.43/0.43	NA**
Vanadium	10 - 116.1/30.44	4.06 - 138.52/22.16	5.32 - 48.99/17.9	10 - 74.9/28.61	370 (RSRS)
Zinc	14.5 - 84.9/57.95	6.62 – 355/51.29	28.55 - 104.41/61.32	27.24 – 544/103.29	16,000 (EMEG)

[a]Comparison Values given in ppm; [b]Environmental Media Evaluation Guide; [c]Reference Media Evaluation Guide; [d]Cancer Risk Evaluation Guide; [e]New Jersey Residential Soil Remediation Standard; [f]EPA Screening Level; [g]EPA Region 2 Screening Level, *Not detected; **Not Available; §indicates exceedance

Table A9: Residential Soil Sampling Results (2016): The range and mean concentration (in ppm) of metals detected in the soil (0 – 1") for residences P013 through P016

Contaminant	Residence# P033 Range/Mean	Residence# P034 Range/Mean	Residence# P035 Range/Mean	Residence# P036 Range/Mean	CVs[a]
Aluminum	1,730 – 4,500/2,772	3,470 – 6,970/4,720	2,720 – 14,800/7,730	2,470 – 11,600/5,712	52,000 (EMEG[b])
Antimony	1.38 - 5.05/2.32	0.51 - 2.59/1.75	0.68 - 7.4/2.46	0.41 - 3.6/1.7	21 (RMEG[c])
Arsenic	3.08 - 7.96[§]/5.04	6.68 - 19.08[§]/9.93	2.1 - 14.5[§]/5.96	1.9 - 8.6[§]/5.36	0.26 (CREG[d])
Barium	4.18 - 56.63/19.05	9.5 - 55.25/30.38	19.6 – 389/98.31	13.5 – 104/53.92	10,000 (EMEG)
Beryllium	0.02 - 0.19/0.09	0.16 - 0.51/0.27	0.16 - 1.7/0.54	0.13 - 0.72/0.39	100 (EMEG)
Cadmium	0.07 - 0.85/0.33	0.32 - 0.48/0.4	0.04 - 1.5/0.39	0.04 - 2.9/0.51	5.2 (EMEG)
Chromium	3.3 - 39.34/15.85	13.89 - 42.78/23.62	8.2 - 58.8/23.32	6.2 - 93.3/23.75	240 (RSRS[r])
Cobalt	0.43 - 2.73/1.16	0.91 - 3.58/1.95	1.1 - 11.8/4.62	1 - 8.2/3.58	23 (EPA SL[f])
Copper	5.82 - 15.72/10.23	3.81 - 13.57/8.23	6.3 – 213/36.38	5.8 – 64/25.6	600 (RSRS)
Iron	3,130 – 14,400/8,464	10,600 – 15,800/12,700	5,330 – 28,600/12,985	5,870 – 25,900/12,278	55,000 (EPA SL)
Lead	25.36 - 102.24/59.92	18.54 – 905[§]/161.04	10.9 – 623[§]/110.08	10.9 – 594[§]/156.2	200 (EPA R2[g])
Manganese	10.35 - 189.35/52.85	46.4 - 214.8/101.55	44.5 – 1000/218.72	44.8 - 665.04/168.5	1,900 (EPA SL)
Nickel	0.93 - 4.64/3.12	2.4 - 7.66/4.48	3.2 - 31.9/12.53	3.2 - 37.9/12.47	1000 (RMEG)
Selenium	1.1 - 2.31/1.62	0.99 - 3.35/1.62	1.2 - 2.2/1.56	1.5 - 2.5/1.87	260 (EMEG)
Silver	ND*/ND	1.01 - 1.01/1.01	0.17 - 0.93/0.35	0.24 - 0.79/0.45	260 (RMEG)
Thallium	0.21 - 0.21/0.21	0.22 - 2.53/0.89	0.42 - 0.42/0.42	0.81 – 2/1.3	NA
Vanadium	10.33 - 49.87/24.89	18.02 - 47.19/28.34	13.2 - 66.8/28.39	8.6 – 52/23.91	370 (RSRS)
Zinc	8.39 - 129.53/34.15	26.29 - 79.42/47.46	28.1 – 175/78.64	17.8 – 215/64.48	16,000 (EMEG)

[a]Comparison Values given in ppm; [b]Environmental Media Evaluation Guide; [c]Reference Media Evaluation Guide; [d]Cancer Risk Evaluation Guide; [e]New Jersey Residential Soil Remediation Standard; [f]EPA Screening Level; [g]EPA Region 2 Screening Level, *Not detected; **Not Available; [§]indicates exceedance

Table A10: Residential Soil Sampling Results (2016): The range and mean concentration (in ppm) of metals detected in the soil (1” - 6”) for residences P001 through P004

Contaminant	Residence# P001 Range/Mean	Residence# P002 Range/Mean	Residence# P003 Range/Mean	Residence# P004 Range/Mean	CV[a]
Aluminum	2,700 – 5,900/4,300	4,300 – 7,600/5,900	2,900 – 8,200/5,840	4,100 – 5,700/5,160	52,000 (EMEG[b])
Antimony	1.9 - 9.3/4.71	2.2 - 9.3/2.77	2.8 - 2.8/2.8	1.7 - 2.1/1.90	21 (RMEG[c])
Arsenic	4.2 - 7.1§/6.09	4.8 – 10§/6.88	4.3 - 8.1§/6.6	4.4 – 10§/6.34	0.26 (CREG[d])
Barium	13 – 230/43.22	40 – 230/45.50	15 – 67/37	20 – 47/37.40	10,000 (EMEG)
Beryllium	0.27 - 0.44/0.33	0.35 - 0.58/0.45	0.38 - 0.56/0.44	0.33 – 3/1.08	100 (EMEG)
Cadmium	0.33 - 0.33/0.33	0.33 - 0.33/0.33	0.29 - 0.34/0.32	ND*/ND	5.2 (EMEG)
Chromium	8.9 – 17/13.21	16 – 29/20.25	9.1 – 17/14.82	10 – 19/16.20	240 (RSRS[e])
Cobalt	1.8 - 2.1/1.93	1.8 - 3.1/2.20	1.9 – 3/2.45	1.9 - 3.5/2.48	23 (EPA SL[f])
Copper	6.5 – 13/8.10	7.7 – 19/12.33	6.8 – 92/27.74	9.8 – 120/39.36	600 (RSRS)
Iron	7,200 – 12,000/10,155	11,000 – 15,000/12,500	7,700 – 16,000/11,780	8,400 – 16,000/12,080	55,000 (EPA SL)
Lead	88 – 980§/379.78	88 – 980§/177	25 – 230/110.2	43 – 140/93.40	200 (EPA R2[g])
Manganese	35 – 69/47.11	48 – 87/64	41 – 99/69.2	56 – 120/81.20	1,900 (EPA SL)
Mercury	0.036 - 0.17/0.08	0.035 - 0.17/0.08	0.037 - 0.36/0.14	0.036 - 0.038/0.04	23 (RSRS)
Nickel	2.9 - 4.6/3.70	4.2 - 8.4/5.58	4 - 7.5/5.92	3.8 - 8.4/5.84	1000 (RMEG)
Vanadium	17 – 27/21.67	24 – 39/29.5	12 – 28/24	17 – 30/24.60	370 (RSRS)
Zinc	22 – 210/52.11	43 – 210/54.75	22 – 190/83.4	37 – 820/231	16,000 (EMEG)

[a]Comparison Values given in ppm; [b]Environmental Media Evaluation Guide; [c]Reference Media Evaluation Guide; [d]Cancer Risk Evaluation Guide; [e]New Jersey Residential Soil Remediation Standard; [f]EPA Screening Level; [g]EPA Region 2 Screening Level; *Not Detected; §indicates exceedance

Table A11: Residential Soil Sampling Results (2016): The range and mean concentration (in ppm) of metals detected in the soil (1” - 6”) for residences P005. P007 and P008

Contaminant	Residence# P005 Range/Mean	Residence# P007 Range/Mean	Residence# P008 Range/Mean	CV[a]
Lead	28 – 1,200§/255	25 – 1,900§/322	9.2 – 230§/133	200 (EPA R2[b])

[a]Comparison Values given in ppm; [b]EPA Region 2 Screening Level; §indicates exceedance

Table A12: Residential Soil Sampling Results (2016): The range and mean concentration (in ppm) of metals detected in the soil (1" - 6") for residences P006 through P010

Contaminant	Residence# P006 Range/Mean	Residence# P009 Range/Mean	Residence# P010 Range/Mean	Residence# P011 Range/Mean	CVs[a]
Aluminum	2950 – 4210/3536	2110 – 4350/2663	1770 – 4080/2731	1580 – 3490/2163	52,000 (EMEG[b])
Antimony	0.54 - 72.5§/11.00	0.33 - 1.88/0.86	0.73 - 2.06/1.28	1.03 - 2.36/1.58	21 (RMEG[c])
Arsenic	4.1 - 23.5§/8.91	2.09 - 7.58§/3.68	2.92 - 6.07§/4.12	1.72 - 3.73§/2.43	0.26 (CREG[d])
Barium	13.9 - 41.6/24.85	8.06 - 33.32/15.60	6.90 - 29.07/20.25	5.9 - 39.03/13.21	10,000 (EMEG)
Beryllium	0.25 - 0.45/0.31	0.06 - 0.14/0.08	0.11 - 0.48/0.24	0.08 - 0.31/0.13	100 (EMEG)
Cadmium	0.27 - 0.47/0.34	0.07 - 0.29/0.14	0.13 - 0.41/0.22	0.02 - 0.2/0.08	5.2 (EMEG)
Chromium	12.2 - 35.3/22.26	5.69 - 14.29/8.81	3.78 - 12.02/7.94	2.91 - 12.74/5.68	240 (RSRS[e])
Cobalt	0.82 - 1.7/1.29	0.61 - 1.67/1.02	0.43 - 3.37/1.56	0.25 - 2.5/0.92	23 (EPA SL[f])
Copper	5.9 - 30.9/13.28	2.91 – 23/6.95	3.17 - 9.90/6.98	2.39 - 22.18/4.79	600 (RSRS)
Iron	7810 – 11200/9213	4300 – 9270/6078	3710 – 10100/6561	3170 – 9060/5037	55,000 (EPA SL)
Lead	41 – 4,260§/962	6.3 – 152/37.09	16.8 - 49.7/30.48	8.78 - 85.94/32.01	200 (EPA R2[g])
Manganese	27.1 - 98.7/53.56	25.6 - 110.9/48.14	17.4 - 116.5/62.68	10.73 - 154.4/30.40	1,900 (EPA SL)
Mercury	0.03 - 0.053/0.04	ND*/ND	ND/ND	ND/ND	23 (RSRS)
Nickel	2.4 - 7.1/4.15	2.05 - 5.21/3.09	1.54 - 6.97/3.84	1.01 - 6.82/2.54	1000 (RMEG)
Vanadium	20.4 - 42.3/31.08	6.31 - 17.53/11.19	8.10 - 18.29/13.00	6.02 - 16.12/9.55	370 (RSRS)
Zinc	23.3 - 63.5/37.60	12.8 - 59.6/25.19	7.15 - 30.17/19.38	5.79 - 61.74/15.46	16,000 (EMEG)

[a]Comparison Values given in ppm; [b]Environmental Media Evaluation Guide; [c]Reference Media Evaluation Guide; [d]Cancer Risk Evaluation Guide; [e]New Jersey Residential Soil Remediation Standard; [f]EPA Screening Level; [g]EPA Region 2 Screening Level; *Not detected; §indicates exceedance

Table A13: Residential Soil Sampling Results (2016): The range and mean concentration (in ppm) of metals detected in the soil (1" - 6") for residences P012 through P015

Contaminant	Residence# P012 Range/Mean	Residence# P013 Range/Mean	Residence# P014 Range/Mean	Residence# P015 Range/Mean	CVs[a]
Aluminum	1640 – 8629/2618	1550 – 5810/2337	2380 – 6149/3885	1690 – 7320/3376	52,000 (EMEG[b])
Antimony	1.04 - 23.79/5.60	0.62 - 11.45/2.40	1.45 - 4.24/2.7	0.63 - 6.2/1.77	21 (RMEG[c])
Arsenic	1.47 - 38.06§/6.19	2.13 - 5.15§/3.20	3.48 - 20.78§/10.57	1.51 - 19.11§/5.52	0.26 (CREG[d])
Barium	6.35 - 79.19/15.79	6.41 - 46.08/13.70	9.48 - 46.53/23.59	5.81 - 40.78/17.25	10,000 (EMEG)
Beryllium	0.08 - 1.27/0.22	0.09 - 0.58/0.14	0.14 - 0.75/0.36	0.09 - 0.78/0.22	100 (EMEG)
Cadmium	0.02 - 1.5/0.53	0.03 - 0.12/0.06	0.09 - 1.05/0.38	0.04 - 0.07/0.05	5.2 (EMEG)
Chromium	3.08 - 51.01/8.87	2.74 - 13.91/5.17	5.18 - 30.39/15.37	3.37 - 34.32/10.78	240 (RSRS[e])
Cobalt	0.4 - 14.03/1.94	0.28 - 5.34/0.89	0.98 - 7.83/3.43	0.53 - 8.77/1.69	23 (EPA SL[f])
Copper	2.48 - 4.69/3.62	2.43 - 22.76/6.07	5.5 - 17.28/9.35	3.08 - 17.6/7.52	600 (RSRS)
Iron	3520 – 103000§/14525	3400 – 11500/4645	4320 – 49800/20038	3470 – 48900/9995	55,000 (EPA SL)
Lead	6.77 - 56.28/20.83	9.71 – 589§/100.66	26.3 - 63.7/43.5	16.6 - 194.3/38.85	200 (EPA R2[g])
Manganese	14 - 270.57/45.09	9.72 – 252/37.58	29 - 218.7/97.24	9.81 - 166.64/46.39	1,900 (EPA SL)
Nickel	1.01 - 23.27/3.86	0.79 - 9.24/2.39	2.39 - 14.5/6.5	1.65 - 14.18/3.82	1000 (RMEG)
Vanadium	4.98 - 141.82/21.34	5.48 - 20.48/10.26	9.95 - 95.28/41.45	8.34 - 104.69/21.54	370 (RSRS)
Zinc	6.76 - 72.23/17.04	6 - 44.56/13.87	15.66 - 76.93/38.98	6.88 - 91.52/25.60	16,000 (EMEG)

[a]Comparison Values given in ppm; [b]Environmental Media Evaluation Guide; [c]Reference Media Evaluation Guide; [d]Cancer Risk Evaluation Guide; [e]New Jersey Residential Soil Remediation Standard; [f]EPA Screening Level; [g]EPA Region 2 Screening Level; §indicates exceedance

Table A14: Residential Soil Sampling Results (2016): The range and mean concentration (in ppm) of metals detected in the soil (1” - 6”) for residences P016 through P019

Contaminant	Residence# P016 Range/Mean	Residence# P017 Range/Mean	Residence# P018 Range/Mean	Residence# P019 Range/Mean	CVs[a]
Aluminum	2480 – 3659/2911	1560 – 11000/3726	3260 -8860/5748	1950 – 4670/2885	52,000 (EMEG[b])
Antimony	1.04 - 3.1/2.04	0.94 - 3.1/2.04	1.03 -3.37/1.93	0.98 - 6.37/2.43	21 (RMEG[c])
Arsenic	2.59 - 6.33[§]/4.28	1.79 – 23[§]/7.27	5.45 - 29.64[§]/14.74	2.27 - 19.62[§]/5.63	0.26 (CREG[d])
Barium	5.2 - 56.72/18.58	7.17 – 308/68.36	13.67 -91.03/50.02	6.79 - 31.38/17.94	10,000 (EMEG)
Beryllium	0.1 - 0.26/0.18	0.08 - 0.56/0.25	0.19 -1.31/0.59	0.09 - 0.27/0.16	100 (EMEG)
Cadmium	0.05 - 0.27/0.14	0.07 - 2.4/0.42	0.15 -0.36/0.24	0.04 - 0.47/0.12	5.2 (EMEG)
Chromium	8.64 - 22.3/16.86	3.59 - 42.8/16.86	7.48 - 40.33/20.93	4.17 - 28.25/9.11	240 (RSRS[e])
Cobalt	0.63 - 1.85/1.15	0.26 - 6.58/2.39	1.55 -13.61/5.25	0.46 - 3.07/1.07	23 (EPA SL[f])
Copper	2.9 - 49.44/11.32	1.35 - 43.4/15.73	6.3 -24.38/12.19	2.82 - 39.3/10.5	600 (RSRS)
Iron	5550 – 9950/7372	2870 – 25800/8883	7650 – 54300/24336	4230 – 14000/6373	55,000 (EPA SL)
Lead	12.8 – 225[§]/96	5.17 – 682[§]/159	17.38 - 48.53/34	14.2 – 3,370[§]/341.96	200 (EPA R2[g])
Manganese	17.2 - 130.5/49.78	8.87 – 282/108.12	32.55 -1010/244.98	13.17 - 81.06/41.57	1,900 (EPA SL)
Nickel	2 - 5.35/3.22	1.01 - 20.42/7.42	3.06 -23.29/9.37	1.53 - 9.52/3.38	1000 (RMEG)
Vanadium	13.89 – 35/23.78	5.3 - 45.12/18.30	15.41 -128.97/51.98	7.56 - 26.59/14.78	370 (RSRS)
Zinc	10.9 - 74.11/33.25	5.61 - 259.67/80.71	25 -72.86/50.57	8.67 - 56.85/27.72	16,000 (EMEG)

[a]Comparison Values given in ppm; [b]Environmental Media Evaluation Guide; [c]Reference Media Evaluation Guide; [d]Cancer Risk Evaluation Guide; [e]New Jersey Residential Soil Remediation Standard; [f]EPA Screening Level; [g]EPA Region 2 Screening Level; [§]indicates exceedance

Table A15: Residential Soil Sampling Results (2016): The range and mean concentration (in ppm) of metals detected in the soil (1" - 6") for residences P020 through P023

Contaminant	Residence# P020 Range/Mean	Residence# P021 Range/Mean	Residence# P022 Range/Mean	Residence# P023 Range/Mean	CVs[a]
Aluminum	2230 – 8900/4592	1150 – 4470/2638	857 – 12100/4701	907 – 9530/3812	52,000 (EMEG[b])
Antimony	0.68 - 3.8/1.59	0.83 - 3.58/1.79	0.85 - 3.6/1.88	0.94 - 4.44/2.02	21 (RMEG[c])
Arsenic	2.3 - 30.4[§]/8.16	2.1 - 16.97[§]/5.52	1.82 – 14[§]/6.19	3.22 - 26.65[§]/8.47	0.26 (CREG[d])
Barium	8.5 – 72/36.79	5.42 - 63.61/19.75	5.19 – 276/67.87	6.2 - 136.9/45.84	10,000 (EMEG)
Beryllium	0.11 - 0.86/0.37	0.06 - 0.37/0.15	0.04 - 1.1/0.33	0.06 - 1.1/0.30	100 (EMEG)
Cadmium	0.021 - 0.49/0.22	0.03 - 0.31/0.12	0.03 - 0.59/0.21	0.03 - 1.21/0.30	5.2 (EMEG)
Chromium	5.9 - 43.5/15.66	3.33 - 22.73/8.60	3.14 - 21.1/10.10	2.87 - 64.16/13.31	240 (RSRS[e])
Cobalt	0.38 - 8.3/3.01	0.34 - 2.29/1.16	0.26 - 11.5/2.76	0.26 - 12.17/2.21	23 (EPA SL[f])
Copper	5 - 49.2/13.79	2.7 - 27.94/9.92	3.91 – 103/17.04	5.04 - 77.15/17.86	600 (RSRS)
Iron	4060 – 21900/10341	3110 – 9260/5631	2930 – 20400/8772	4400 – 24600/8674	55,000 (EPA SL)
Lead	35.6 – 179/76.65	14.12 - 124.5/48.03	22.17 – 174/69.14	23.42 – 170/62.68	200 (EPA R2[g])
Manganese	30.1 – 337/124.34	7.58 - 249.06/58.25	9.92 – 883/178	5.87 - 403.84/121.07	1,900 (EPA SL)
Nickel	2.9 – 11/6.38	1.2 - 5.45/3.14	1.16 - 16.7/5.28	1.02 - 13.98/5.03	1000 (RMEG)
Vanadium	9.2 – 50/18.05	7.12 - 20.26/13.02	5 - 46.9/18.00	7.72 - 34.89/15.39	370 (RSRS)
Zinc	17.9 – 110/53.41	6.09 - 86.78/28.21	5.74 – 292/52.71	6.45 - 142.8/45.31	16,000 (EMEG)

[a]Comparison Values given in ppm; [b]Environmental Media Evaluation Guide; [c]Reference Media Evaluation Guide; [d]Cancer Risk Evaluation Guide; [e]New Jersey Residential Soil Remediation Standard; [f]EPA Screening Level; [g]EPA Region 2 Screening Level; [§]indicates exceedance

Table A16: Residential Soil Sampling Results (2016): The range and mean concentration (in ppm) of metals detected in the soil (1" - 6") for residences P024 through P027

Contaminant	Residence# P024 Range/Mean	Residence# P025 Range/Mean	Residence# P026 Range/Mean	Residence# P027 Range/Mean	CVs[a]
Aluminum	2110 – 6050/4015	2860 – 3710/3231	1960 – 8310/3955	1630 – 8850/3762	52,000 (EMEG[b])
Antimony	0.27 - 5.14/2.01	0.33 - 1.53/0.76	1.21 - 4.16/2.07	0.54 - 14.63/4.47	21 (RMEG[c])
Arsenic	2.92 - 16.42[§]/9.45	3.76 - 6.94[§]/5.50	1.55 - 13.93[§]/5.71	2.14 - 18.03[§]/6.18	0.26 (CREG[d])
Barium	16.04 - 48.15/29.91	9.97 - 30.4/20.87	8.19 - 53.59/21.54	5.02 - 50.66/20.01	10,000 (EMEG)
Beryllium	0.12 - 0.79/0.36	0.11 - 0.24/0.17	0.07 - 0.96/0.32	0.05 - 0.45/0.17	100 (EMEG)
Cadmium	0.08 - 0.4/0.23	0.02 - 0.18/0.11	0.15 - 0.48/0.31	0.07 - 0.1/0.09	5.2 (EMEG)
Chromium	7.13 - 35.96/19.34	7.92 - 17.16/12.36	3.69 - 39.05/14.25	4 - 55.13/17.05	240 (RSRS[e])
Cobalt	0.92 - 8.78/4.00	1.02 - 2.68/1.66	0.45 - 8.86/3.02	0.59 - 4.44/1.68	23 (EPA SL[f])
Copper	3.87 - 10.83/6.60	3.52 - 12.14/7.44	2.39 - 15.05/8.42	2.7 - 21.99/7.64	600 (RSRS)
Iron	6100 – 48500/22726	6640 – 13900/9290	4000 – 20600/9702	4030 – 34400/12334	55,000 (EPA SL)
Lead	20.65 - 59.1/31.47	10.69 - 98.19/44.79	4.6 - 42.78/26.28	5.11 - 89.11/28.95	200 (EPA R2[g])
Manganese	46 – 226/98.57	35.7 - 103.09/58.48	15 – 153/74.92	22 – 179/71.75	1,900 (EPA SL)
Nickel	2.78 - 12.45/6.86	2.89 - 5.14/4.08	1.63 - 11.89/5.06	2.19 - 13.7/5.25	1000 (RMEG)
Vanadium	16 – 106/55.22	14.31 - 49.4/24.21	5.6 - 119.17/40.4	6.52 - 209.58/56.47	370 (RSRS)
Zinc	15.46 - 57.54/34.21	19.04 - 41.21/28.76	7.28 - 67.85/29.65	11.31 - 87.06/32.55	16,000 (EMEG)

[a]Comparison Values given in ppm; [b]Environmental Media Evaluation Guide; [c]Reference Media Evaluation Guide; [d]Cancer Risk Evaluation Guide; [e]New Jersey Residential Soil Remediation Standard; [f]EPA Screening Level; [g]EPA Region 2 Screening Level; [§]indicates exceedance

Table A17: Residential Soil Sampling Results (2016): The range and mean concentration (in ppm) of metals detected in the soil (1" - 6") for residences P028 through P031

Contaminant	Residence# P028 Range/Mean	Residence# P029 Range/Mean	Residence# P030 Range/Mean	Residence# P031 Range/Mean	CVs[a]
Aluminum	1590 – 4670/3208	1660 – 8240/3485	1430 – 4710/2931	976 – 8840/3160	52,000 (EMEG[b])
Antimony	0.47 - 29.16§/6.20	0.74 - 8.5/2.67	0.63 - 2.12/1.28	0.78 - 2.54/1.65	21 (RMEG[c])
Arsenic	3.15 - 9.62§/5.03	1.21 - 22.4§/7.59	2.11 - 7.48§/4.79	2.11 - 27.16§/7.29	0.26 (CREG[d])
Barium	5.33 - 55.85/21.64	7.6 - 58.1/23.26	3.9 - 44.81/18.77	6.04 - 85.8/28.10	10,000 (EMEG)
Beryllium	0.04 - 0.31/0.13	0.09 - 0.92/0.29	0.02 - 0.24/0.11	0.04 - 0.48/0.19	100 (EMEG)
Cadmium	0.04 - 0.41/0.17	0.03 - 1.2/0.31	0.04 - 0.28/0.16	0.08 - 1.28/0.33	5.2 (EMEG)
Chromium	4.06 - 19.4/9.94	3 - 63.15/18.24	3.83 - 22.82/10.62	3.2 - 43.48/13.61	240 (RSRS[e])
Cobalt	0.45 - 2.05/1.21	0.13 - 10.2/2.36	0.55 - 1.93/1.19	0.35 - 6.69/2.21	23 (EPA SL[f])
Copper	3.69 - 8.69/6.06	2.1 - 34.8/9.94	2.71 - 9.66/6.32	2.47 - 30.95/11.10	600 (RSRS)
Iron	4400 – 173009179	3030 – 55600§/14111	2770 – 11400/6720	3850 – 41400/10205	55,000 (EPA SL)
Lead	10.98 – 260§/70.20	6.19 - 124.88/41.60	12 – 131/62.08	10.05 - 318.3§/67.83	200 (EPA R2)
Manganese	18.92 - 57.89/42.41	12.7 – 269/75.84	7.59 - 140.25/45.84	7.41 - 176.2/65.63	1,900 (EPA SL[g])
Nickel	0.98 - 5.43/3.46	1.2 – 25/6.52	0.72 - 4.52/2.92	0.23 - 9.94/4.31	1000 (RMEG)
Vanadium	9.24 - 54.32/20.04	5.46 – 134/34.64	8.92 - 32.27/16.78	8.7 - 97.36/21.51	370 (RSRS)
Zinc	6.6 - 61.42/27.88	6.3 - 98.4/33.34	5.98 - 51.85/25.49	4.52 - 95.04/36.74	16,000 (EMEG)

[a]Comparison Values given in ppm; [b]Environmental Media Evaluation Guide; [c]Reference Media Evaluation Guide; [d]Cancer Risk Evaluation Guide; [e]New Jersey Residential Soil Remediation Standard; [f]EPA Screening Level; [g]EPA Region 2 Screening Level; §indicates exceedance

Table A18: Residential Soil Sampling Results (2016): The range and mean concentration (in ppm) of metals detected in the soil (1" - 6") for residences P032 through P034

Contaminant	Residence# P032 Range/Mean	Residence# P033 Range/Mean	Residence# P034 Range/Mean	CVs[a]
Aluminum	1110 – 5450/3266	2590 – 7690/4786.36	5170 – 5530/5380	52,000 (EMEG[b])
Antimony	1.27 - 7.18/3.44	0.71 - 2.35/1.74	0.98 - 1.97/1.33	21 (RMEG[c])
Arsenic	2.78 - 16.04/7.37	2.75 - 18.12/6.09	7.8 - 9.32/8.41	0.26 (CREG[d])
Barium	5.24 - 52.9/23.25	7.99 – 196/46.27	24.11 - 32.14/27.62	10,000 (EMEG)
Beryllium	0.02 - 0.25/0.14	0.03 - 0.47/0.18	0.17 - 0.24/0.20	100 (EMEG)
Cadmium	0.05 - 0.55/0.28	0.1 - 0.55/0.35	0.38 - 0.61/0.46	5.2 (EMEG)
Chromium	3.7 - 31.22/12.91	4.02 - 53.72/18.65	14.5 - 19.91/17.14	240 (RSRS[e])
Cobalt	0.59 - 2.92/1.55	0.24 - 4.19/1.97	1.37 - 4.53/2.71	23 (EPA SL[f])
Copper	7.22 - 33.2/13.11	3.57 - 16.36/8.80	7.7 - 11.29/9.47	600 (RSRS)
Iron	3260 – 12600/9396	3260 – 18100/10400	9590 – 24000/14630	55,000 (EPA SL)
Lead	37 - 96.14/59.62	11.78 - 217.5/58.09	34.28 - 36.37/35.21	200 (EPA R2)
Manganese	9.63 - 145.19/49.98	16.33 - 686.6/121.26	49.9 - 140.4/99.94	1,900 (EPA SL[g])
Nickel	1.58 - 6.63/4.07	1.41 - 8.24/4.84	3.86 - 5.5/4.67	1000 (RMEG)
Vanadium	12.98 - 39.73/25.53	10.77 - 70.9/25.48	17.77 - 26.39/21.04	370 (RSRS)
Zinc	9.07 - 64.32/30.18	8.19 - 71.45/34.15	32.24 - 40.32/37.01	16,000 (EMEG)

[a]Comparison Values given in ppm; [b]Environmental Media Evaluation Guide;; [c]Reference Media Evaluation Guide; [d]Cancer Risk Evaluation Guide; [e]New Jersey Residential Soil Remediation Standard; [f]EPA Screening Level; [g]EPA Region 2 Screening Level

Table A19: Residential Soil Sampling Results (2016): The range and mean concentration (in ppm) of metals detected in the soil (1" - 6") for residences P035 through P036

Contaminant	Residence# P035 Range/Mean	Residence# P036 Range/Mean	CVs[a]
Aluminum	5450 – 8850/7635	5610 – 11000/7466	52,000 (EMEG[b])
Antimony	1.1 - 2.1/1.50	0.85 - 1.9/1.38	21 (RMEG[c])
Arsenic	5.1 – 10/6.95	1.5 – 6/4.27	0.26 (CREG[d])
Barium	19 - 59.6/45.28	60.1 – 116/92.37	10,000 (EMEG)
Beryllium	0.32 - 0.44/0.38	0.32 - 0.73/0.54	100 (EMEG)
Cadmium	0.21 - 0.3/0.26	0.28 - 0.9/0.59	5.2 (EMEG)
Chromium	13.2 - 29.7/18.25	14.5 - 29.7/20	240 (RSRS[e])
Cobalt	1.7 - 6.9/3.43	2.7 - 7.9/4.47	23 (EPA SL[f])
Copper	7.9 - 31.9/17.50	14.6 - 43.8/25.83	600 (RSRS)
Iron	7470 – 13600/9460	8960 – 19600/12853	55,000 (EPA SL)
Lead	34.6 - 58.1/44.45	40.1 – 198/104.37	200 (EPA R2[g])
Manganese	56.1 – 130/101	75 – 453/285	1,900 (EPA SL)
Mercury	ND*/ND	0.06 - 0.06/0.06	23 (RSRS)
Nickel	4.3 - 8.6/6.08	6.6 - 23.3/12.63	1000 (RMEG)
Vanadium	17.3 - 35.4/24.78	17.2 - 33.3/23.9	370 (RSRS)
Zinc	19.7 - 56.9/37.6	29.2 - 86.3/61.47	16,000 (EMEG)

[a]Comparison Values given in ppm; [b]Environmental Media Evaluation Guide;; [c]Reference Media Evaluation Guide; [d]Cancer Risk Evaluation Guide; [e]New Jersey Residential Soil Remediation Standard; [f]EPA Screening Level; [g]EPA Region 2 Screening Level; *Not detected

Table A20: Residential Soil Sampling Results (2016): The range and mean concentration (in ppm) of metals detected in the soil (>6 inches) for residences P001 through P004

Contaminant	Residence# P001 Range/Mean	Residence# P002 Range/Mean	Residence# P003 Range/Mean	Residence# P004 Range/Mean	CV[a]
Aluminum	1700 – 8700/4644	4700 – 6900/5520	2900 – 13000/5621	0 – 9900/9900	52,000 (EMEG[b])
Antimony	2.6 – 1200[§]/195	3.3 - 4.3/4	2.7 – 18[§]/7.98	1.6 – 410[§]/410.00	21 (RMEG[c])
Arsenic	1.6 – 69[§]/12.50	3.5 – 6[§]/5	2 – 14[§]/5.52	1.8 – 25[§]/25	0.26 (CREG[d])
Barium	11 – 420/88.52	20 – 2300/531	8.8 – 200/42.78	10 – 88/88	10,000 (EMEG)
Beryllium	0.26 - 0.9/0.40	0.32 - 0.39/0.35	0.25 - 0.6/0.37	0.26 - 0.9/0.9	100 (EMEG)
Cadmium	0.31 - 1.8/0.65	0.35 - 0.36/0.36	0.26 - 0.41/0.34	0.25 - 0.68/0.68	5.2 (EMEG)
Chromium	3.3 – 41/16.04	13 – 17/15	6.1 – 29/13.53	4.5 – 41/41	240 (RSRS[e])
Cobalt	1.7 – 23/4.11	1.6 - 3.2/2	1.6 - 7.3/2.39	1.7 - 5.1/5.1	23 (EPA SL[f])
Copper	2.3 – 100/20.25	6.5 – 18/12	2.1 – 130/17.33	4.9 – 130/130	600 (RSRS)
Iron	3100 – 28000/11303	8700 – 11000/9820	5600 – 26000/11042	4500 – 49000/49000	55,000 (EPA SL)
Lead	5.2 – 68000[§]/6986.44	19 – 2300[§]/323	2.4 – 870[§]/192	9.8 – 25000[§]/25000	200 (EPA R2[g])
Manganese	23 – 450/60.93	38 – 97/60	23 – 250/64.11	8.6 – 130/130	1,900 (EPA SL)
Mercury	0.034 - 0.71/0.15	0.1 - 0.11/0	0.032 - 0.91/0.19	0.038 - 0.22/0.22	23 (RSRS)
Nickel	1.8 – 30/5.51	3.8 - 6.1/5	2.4 – 15/5.16	2.1 – 14/14	1000 (RMEG)
Silver	0.54 - 3.6/1.63	ND*/ND	1 – 1/1.00	0.85 - 0.85/0.85	260 (EMEG)
Vanadium	5.7 – 61/26.44	18 – 24/22	7.7 – 39/23.14	12 – 58/58	370 (RSRS)
Zinc	11 – 330/76.69	22 – 380/143	14 – 190/48.42	7.6 – 120/120	16,000 (EMEG)

[a]Comparison Values given in ppm; [b]Environmental Media Evaluation Guide; [c]Reference Media Evaluation Guide; [d]Cancer Risk Evaluation Guide; [e]New Jersey Residential Soil Remediation Standard; [f]EPA Screening Level; [g]EPA Region 2 Screening Level; *Not detected

Table A21: Residential Soil Sampling Results (2016): The range and mean concentration (in ppm) of metals detected in the soil (>6") for residences P005 through P008

Contaminant	Residence# P005 Range/Mean	Residence# P006 Range/Mean		Residence# P007 Range/Mean	Residence# P008 Range/Mean	CV[a]
Lead	8 – 540/157	ND*	ND	9 – 1900/219	11 – 300/99	200 (EPA R2[b])

[a]Comparison Values given in ppm; [b]EPA Region 2 Screening Level; *Not detected

Table A22: Residential Soil Sampling Results (2016): The range and mean concentration (in ppm) of metals detected in the soil (>6”) for residences P006 through P011

Contaminant	Residence# P006 Range/Mean	Residence# P009 Range/Mean	Residence# P010 Range/Mean	Residence# P011 Range/Mean	CVs[a]
Aluminum	2100 – 6540/4262	1600 – 5460/2506	1500 – 3470/2310	1650 – 3830/2267	52,000 (EMEG[b])
Antimony	0.56 - 48.2/13.305	ND*/ND	ND/ND	4.2 - 6.7/5.18	21 (RMEG[c])
Arsenic	2.4 - 19.5[§]/8.16	0.95 - 6.9[§]/2.45	1.5 - 12.3[§]/4	1.3 - 3.7[§]/2.31	0.26 (CREG[d])
Barium	11.2 - 87.6/37.74	6 - 29.5/11.54	5.8 - 19.4/11	3.3 - 38.4/11.59	10,000 (EMEG)
Beryllium	0.18 - 0.63/0.392	0.029 - 0.17/0.08	0.083 - 0.25/0	0.082 - 0.33/0.13	100 (EMEG)
Cadmium	0.17 - 1.2/0.66	0.019 - 0.19/0.06	0.032 - 0.16/0	0.032 - 0.23/0.07	5.2 (EMEG)
Chromium	4 – 158/44.64	2.6 - 15.8/5.58	3.3 - 20.7/8	3.2 - 11.6/5.73	240 (RSRS[e])
Cobalt	0.97 - 2.4/1.574	0.28 - 2.1/0.72	0.37 - 1.9/1	0.41 - 2.5/0.90	23 (EPA SL[f])
Copper	4 - 31.4/17.86	2.4 - 6.9/3.99	2.1 - 10.2/5	2 - 21.2/4.29	600 (RSRS)
Iron	6140 – 23400/13420	2250 – 10800/4307.50	2680 – 8210/4927	3200 – 9420/5082	55,000 EPA SL)
Lead	23 – 18000[§]/1536	2.6 – 79/22.29	5.1 – 36/19	1.8 - 60.2/14.08	200 (EPA R2[g])
Manganese	22.3 - 54.1/37.88	8.2 - 62.3/18.99	12.9 - 49.1/29	9.7 – 156/32.36	1,900 (EPA SL)
Mercury	0.017 - 0.092/0.0532	ND/ ND	ND/ ND	ND/ ND	23 (RSRS)
Nickel	2.3 - 46.1/12.4	0.76 - 5.8/2.11	1.3 - 4.3/3	1.3 - 6.4/2.63	1000 (RMEG)
Selenium	ND/ND	ND/ND	ND/ND	1.8 - 2.5/2.13	260 (EMEG)
Silver	ND/ND	ND/ND	ND/ND	0.13 - 0.3/0.18	260 (EMEG)
Thallium	ND/ND	0.23 - 0.23/0.23	ND/ND	2.1 - 2.1/2.10	NA**
Vanadium	7.5 - 71.9/34.32	4 - 21.6/7.62	5.5 - 16.8/ND	4.6 - 13.1/7.51	370 (RSRS)
Zinc	14.9 – 113/49.62	5.6 - 32.3/11.56	5.9 - 21.8/14	5.5 - 56.712.83	16,000 (EMEG)

[a]Comparison Values given in ppm; [b]Environmental Media Evaluation Guide;; [c]Reference Media Evaluation Guide; [d]Cancer Risk Evaluation Guide; [e]New Jersey Residential Soil Remediation Standard; [f]EPA Screening Level; [g]EPA Region 2 Screening Level, *Not detected; **Not Available; [§]indicates exceedance

Table A23: Residential Soil Sampling Results (2016): The range and mean concentration (in ppm) of metals detected in the soil (>6”) for residences P012 through P015

Contaminant	Residence# P012 Range/Mean	Residence# P013 Range/Mean	Residence# P014 Range/Mean	Residence# P015 Range/Mean	CVs[a]
Aluminum	1760 – 3140/2296	1940 – 3100/2458	1960 – 8430/3436	1720 – 7130/3228	52,000 (EMEG[b])
Antimony	2.3 - 2.3/2	ND*/ND	ND/ND	ND/ND	21 (RMEG[c])
Arsenic	1.1 - 9.4[§]/3	1.1 – 3[§]/2	1.6 - 27.1[§]/7	0.95 - 16.5[§]/5	0.26 (CREG[d])
Barium	3.9 - 60.4/17	3.2 - 10.7/7	7.2 - 57.3/22	6.2 - 55.7/17	10,000 (EMEG)
Beryllium	0.38 - 0.52/0	0.092 - 0.37/0.21	0.54 - 1.1/1	0.075 - 0.6/0	100 (EMEG)
Cadmium	0.024 - 1.5/1	0.051 - 0.051/0.051	0.025 - 1.9/1	0.03 - 0.21/0	5.2 (EMEG)
Chromium	3.6 - 13.3/6	2.8 - 6.5/4	3.1 - 44.6/12	3.3 - 26.3/10	240 (RSRS[e])
Cobalt	0.47 - 3.3/1	0.24 - 1.1/1	0.36 – 12/3	0.28 – 6/2	23 (EPA SL[f])
Copper	1.6 - 14.6/5	2 - 6.2/4	2.5 - 16.1/7	1.6 – 17/6	600 (RSRS)
Iron	3500 – 50690/13010	3340 – 6570/4102	3630 – 96300[§]/14731	2570 – 39000/8901	55,000 (EPA SL)
Lead	1.6 – 133/30	2.4 – 244[§]/74	2.8 - 60.8/29	3.2 – 232/58	200 (EPA R2[g])
Manganese	11.6 - 77.5/28	9.3 - 35.8/16	10.9 – 525/69	7.2 – 159/34	1,900 (EPA SL)
Nickel	1.6 - 6.2/3	0.88 - 3.5/2	0.97 - 20.9/5	1.3 – 11/3	1000 (RMEG)
Selenium	ND/ND	ND/ND	2.6 - 2.6/3	1.6 - 2.8/2	260 (EMEG)
Silver	0.12 - 0.35/0.18	0.12 – 1/0.78	0.17 – 1/0.42	0.14 - 0.81/0	260 (EMEG)
Thallium	0.6 - 0.6/1	0.49 - 0.71/1	1.2 - 4.1/3	0.56 - 2.9/1	NA**
Vanadium	5.2 - 34.6/12	4.7 - 9.2/6	5.6 – 137/26	6 - 69.8/19	370 (RSRS)
Zinc	5.4 – 184/40	4.2 – 16/8	5.4 – 78/22	6.3 – 55/23	16,000 (EMEG)

[a]Comparison Values given in ppm; [b]Environmental Media Evaluation Guide; [c]Reference Media Evaluation Guide; [d]Cancer Risk Evaluation Guide; [e]New Jersey Residential Soil Remediation Standard; [f]EPA Screening Level; [g]EPA Region 2 Screening Level; *Not detected; **Not Available; [§]indicates exceedance

Table A24: Residential Soil Sampling Results (2016): The range and mean concentration (in ppm) of metals detected in the soil (>6”) for residences P016 through P019

Contaminant	Residence# P016 Range/Mean	Residence# P017 Range/Mean	Residence# P018 Range/Mean	Residence# P019 Range/Mean	CVs[a]
Aluminum	1960 – 7280/ 4169	1680 – 7730/ 4423	2030 – 14400/ 4129	1510 – 3960/ 2784	52,000 (EMEG[b])
Antimony	ND*/ND	6.3 - 10.8/9	ND/ND	ND/ND	21 (RMEG[c])
Arsenic	3.2 – 11§/6	0.97 – 17§/6	0.92 - 20.8§/8	1.1 - 6.3§/3	0.26 (CREG[d])
Barium	3.8 – 2000/123	7 – 929/102	6.5 – 104/31	4.6 - 70.2/13	10,000 (EMEG)
Beryllium	0.12 - 0.5/0.08	0.07 - 0.9/0.48	0.068 - 0.98/0.59	0.051 - 0.21/0.12	100 (EMEG)
Cadmium	0.03 - 1.9/1	0.02 - 6.5/1	0.024 - 0.59/0.35	0.021 - 0.081/0.052	5.2 (EMEG)
Chromium	8.8 - 53.1/19	2.9 - 75.5/17	3.1 - 44.8/13	2.4 - 12.4/5	240 (RSRS[e])
Cobalt	0.39 - 4.3/2	0.13 - 8.5/3	0.58 - 8.4/	0.17 - 3.3/1	23 (EPA SL[f])
Copper	1.3 - 19.2/9	1.3 – 210/18	2.1 - 18.6/10	2.4 – 17/7	600 (RSRS)
Iron	4200 – 23700/10897	2680 – 35900/11224	1990 – 38900/13960	2760 – 16400/4839	55,000 (EPA SL)
Lead	8.6 – 749§/154	4.6 – 1430§/203	2.9 – 156/44	2.7 – 586§/106	200 (EPA R2[g])
Manganese	12.2 – 214/56	8.6 – 197/83	7.4 – 238/77	5.4 - 80.1/20	1,900 (EPA SL)
Nickel	1.2 - 7.8/4	0.59 - 12.9/6	1.3 - 15.8/6	0.5 - 6.5/2	1000 (RMEG)
Selenium	2.5 - 3.3/3	1.6 - 6.7/3	NA/NA	1.6 - 1.6/2	260 (EMEG)
Silver	0.13 - 0.95/0.56	0.13 - 1.6/0.88	0.17 - 0.55/0.42	0.13 - 0.21/0.16	260 (EMEG)
Thallium	0.5 - 2.4/1	0.43 - 4.2/1	0.61 - 2.2/1	0.68 - 0.73/1	NA**
Vanadium	15.1 - 83.7/29	4.7 - 80.2/24	4.9 - 87.1/30	4.9 – 33/10	370 (RSRS)
Zinc	12.8 – 712/90	5.9 – 526/94	5.3 - 78.6/36	4.2 - 34.8/14	16,000 (EMEG)

[a]Comparison Values given in ppm; [b]Environmental Media Evaluation Guide; [c]Reference Media Evaluation Guide; [d]Cancer Risk Evaluation Guide; [e]New Jersey Residential Soil Remediation Standard; [f]EPA Screening Level; [g]EPA Region 2 Screening Level; *Not detected; **Not Available; §indicates exceedance

Table A25: Residential Soil Sampling Results (2016): The range and mean concentration (in ppm) of metals detected in the soil (>6") for residences P020 through P023

Contaminant	Residence# P020 Range/Mean	Residence# P021 Range/Mean	Residence# P022 Range/Mean	Residence# P023 Range/Mean	CVs[a]
Aluminum	1990 – 5080/2820	1190 – 2900/2024	675 – 11700/3441	555 – 12100/2974	52,000 (EMEG[b])
Arsenic	1.2 – 12§/4	1 - 5.8§/3	1.4 - 21.4§/5	0.83 – 26§/7	0.26 (CREG[c])
Barium	4.4 – 182/45	3.5 - 27.9/12	5.9 – 880/79	2.6 – 211/28	10,000 (EMEG)
Beryllium	0.07 - 0.3/0.18	0.061 - 0.12/0.018	0.38 - 1.1/1	0.64 - 1.5/1	100 (EMEG)
Cadmium	0.03 - 0.72/0.4	0.028 - 0.36/.22	0.019 - 4.2/2.1	0.027 - 1.6/0.08	5.2 (EMEG)
Chromium	3.8 – 29/8	2.2 - 8.2/4	1.8 - 35.6/9	0.64 – 101/17	240 (RSRS[d])
Cobalt	0.22 - 4.2/2	0.22 - 1.8/1	0.21 - 18.7/2	0.14 - 18.6/3	23 (EPA SL[e])
Copper	2.4 - 30.8/10	1.6 - 14.9/7	2.2 - 38.6/12	2.9 – 110/14	600 (RSRS)
Iron	3310 – 72700§/9543	1800 – 7390/3839	889 – 19300/7416	1700 – 96600§/13079	55,000 (EPA SL)
Lead	1.5 – 574§/123	1.8 - 84.4/37	3.4 – 1580§/131	2.9 – 617§/62	200 (EPA R2[f])
Manganese	12.1 – 297/64	3.4 - 87.4/29	2.9 – 1410/137	4.3 – 781/82	1,900 (EPA SL)
Nickel	1.6 - 15.1/4	0.75 - 4.8/2	0.44 - 19.5/4	0.097 - 22.6/4	1000 (RMEG)
Selenium	3 – 3/3	2.8 - 2.9/3	1.7 - 2.5/2	1.9 - 2.9/2	260 (EMEG)
Silver	0.19 - 1.1/0	0.16 - 0.82/0	0.12 - 0.84/0	0.12 - 1.8/0	260 (EMEG)
Thallium	0.55 – 6/2	2 - 2.1/2	0.56 - 2.2/1	1.7 - 2.9/2	NA**
Vanadium	4.6 - 23.9/10	4.5 - 19.4/9	4.3 - 38.9/15	4.3 – 265/33	370 (RSRS)
Zinc	5.9 – 369/57	5.7 – 120/23	3.9 – 401/49	2.3 – 177/33	16,000 (EMEG)

[a]Comparison Values given in ppm; [b]Environmental Media Evaluation Guide; [c]Cancer Risk Evaluation Guide; [d]New Jersey Residential Soil Remediation Standard; [e]EPA Screening Level; [f]EPA Region 2 Screening Level; **Not Available; §indicates exceedance

Table A26: Residential Soil Sampling Results (2016): The range and mean concentration (in ppm) of metals detected in the soil (>6”) for residences P024 through P027

Contaminant	Residence# P024 Range/Mean	Residence# P025 Range/Mean	Residence# P026 Range/Mean	Residence# P027 Range/Mean	CVs[a]
Aluminum	1310 – 9660/4037	1110 – 8100/3164	1610 – 5290/2563	1660 – 6010/3009	52,000 (EMEG[b])
Antimony	ND*/ND	0.39 - 2.9/1	1.2 - 1.2/1	ND/ND	21 (RMEG[c])
Arsenic	1.5 - 30.1[§]/9	1.6 - 29.5[§]/7	1.2 - 17.5[§]/4	1.4 – 13[§]/5	0.26 (CREG[d])
Barium	5.6 – 183/39	3.4 - 67.5/26	4.9 - 31.9/12	3.6 – 114/27	10,000 (EMEG)
Beryllium	0.036 - 1.2/0	0.023 - 0.8/0	0.035 - 0.19/0	0.047 - 0.61/0	100 (EMEG)
Cadmium	0.028 - 3.7/1	0.033 - 0.53/0	0.026 - 0.41/0	0.81 - 1.2/1	5.2 (EMEG)
Chromium	3.2 - 47.2/17	2.8 - 45.8/14	2.6 - 13.7/6	3.1 - 29.2/9	240 (RSRS[e])
Cobalt	0.35 - 15.4/4	0.24 - 12.4/3	0.37 – 2/1	0.5 - 4.1/1	23 (EPA SL[f])
Copper	1.4 – 31/9	1.4 - 28.3/8	2.3 - 21.5/7	2 – 154/22	600 (RSRS)
Iron	2630 – 107000[§]/19370	2980 – 81200[§]/14739	2950 – 13200/5448	2850 – 36200/9385	55,000 (EPA SL)
Lead	2.4 – 216[§]/53	1.9 – 181/41	2.5 - 73.2/23	1.8 – 145/47	200 (EPA R2[g])
Manganese	8.9 – 374/84	8.8 – 364/81	10.6 – 128/43	15.8 – 157/51	1,900 (EPA SL)
Nickel	0.53 – 25/7	0.69 - 21.7/5	1 - 5.4/3	1.7 - 17.2/5	1000 (RMEG)
Selenium	0.93 - 0.93/1	0.83 - 3.6/2	ND/ND	2.2 - 2.9/2	260 (EMEG)
Silver	0.35 - 0.66/1	0.11 - 0.75/0	0.074 - 0.23/0	0.11 – 1/0	260 (EMEG)
Thallium	0.96 - 0.97/1	0.2 - 1.2/0	0.27 - 0.35/0	0.48 - 0.48/0	NA**
Vanadium	6.6 – 138/45	4.1 – 140/33	5 - 35.4/11	5.5 - 57.7/18	370 (RSRS)
Zinc	4.5 – 190/45	4.6 – 86/32	4.9 - 46.7/15	6.2 – 195/37	16,000 (EMEG)

[a]Comparison Values given in ppm; [b]Environmental Media Evaluation Guide;; [c]Reference Media Evaluation Guide; [d]Cancer Risk Evaluation Guide; [e]New Jersey Residential Soil Remediation Standard; [f]EPA Screening Level; [g]EPA Region 2 Screening Level, *Not detected; **Not Available

Table A27: Residential Soil Sampling Results (2016): The range and mean concentration (in ppm) of metals detected in the soil (>6”) for residences P028 through P031

Contaminant	Residence# P028 Range/Mean	Residence# P029 Range/Mean	Residence# P030 Range/Mean	Residence# P031 Range/Mean	CVs[a]
Aluminum	1450 – 7080/3477	1590 – 9060/3676	1690 – 7430/3829	1180 – 4180/3040	52,000 (EMEG[b])
Antimony	0.4 - 62.9[§]/11	ND*/ND	ND/ND	0.25 - 0.41/0.29	21 (RMEG[c])
Arsenic	1.7 - 10.9[§]/5	1.3 - 17.2[§]/6	0.91 - 8.3[§]/5	1.9 - 10.1[§]/5	0.26 (CREG[d])
Barium	6.3 – 105/34	6.9 – 121/27	6 - 37.5/22	6.6 - 56.6/19	10,000 (EMEG)
Beryllium	0.031 - 0.8/0	0.069 - 0.92/0	0.041 - 0.35/0	0.044 - 0.11/0	100 (EMEG)
Cadmium	0.027 - 1.6/0	0.02 - 0.74/0	0.082 - 0.54/0	0.092 - 0.58/0	5.2 (EMEG)
Chromium	2.2 - 20.2/11	2.9 - 69.5/15	2.6 - 20.5/12	3.3 - 17.4/10	240 (RSRS[e])
Cobalt	0.3 – 5/2	0.1 - 5.6/2	0.53 - 4.9/2	0.24 - 0.83/1	23 (EPA SL[f])
Copper	2.6 - 26.1/9	2.4 – 16/7	1.6 - 19.6/7	2.1 - 10.7/5	600 (RSRS)
Iron	2750 – 18400/8763	2420 – 50600/13199	2340 – 18000/8862	4020 – 15100/8171	55,000 (EPA SL)
Lead	7.9 – 519[§]/138	2.5 – 207[§]/45	2.9 – 157/65	12.6 – 240[§]/76	200 (EPA R2[g])
Manganese	13 – 113/42	6.6 – 255/46	10.5 – 106/42	20.4 - 78.7/39	1,900 (EPA SL)
Nickel	0.83 - 15.1/5	0.82 - 15.2/5	1.1 - 8.4/4	0.69 – 6/3	1000 (RMEG)
Selenium	0.84 - 2.9/2	1.7 – 4/3	1.7 - 1.7/2	1.3 - 2.7/2	260 (EMEG)
Silver	0.078 - 0.41/0.11	0.41 - 0.43/0.42	ND/ND	0.14 - 0.29/0.21	260 (EMEG)
Thallium	0.25 - 0.68/0.41	0.54 - 1.2/1	0.22 - 0.46/0.32	0.46 - 0.89/1	NA**
Vanadium	4.3 - 29.2/17	5.3 – 198/38	3.6 - 31.4/19	8.2 - 32.1/16	370 (RSRS)
Zinc	4.8 – 230/58	5.2 – 148/33	4.2 - 76.9/30	4.8 - 57.6/21	16,000 (EMEG)

[a]Comparison Values given in ppm; [b]Environmental Media Evaluation Guide; [c]Reference Media Evaluation Guide; [d]Cancer Risk Evaluation Guide; [e]New Jersey Residential Soil Remediation Standard; [f]EPA Screening Level; [g]EPA Region 2 Screening Level; *Not detected; **Not Available

Table A28: Residential Soil Sampling Results (2016): The range and mean concentration (in ppm) of metals detected in the soil (>6") for residences P032 through P034

Contaminant	Residence# P032 Range/Mean	Residence# P033 Range/Mean	Residence# P034 Range/Mean	CVs[a]
Aluminum	1080 – 19700/3743	1700 – 17700/4450	1680 – 8350/4873	52,000 (EMEG[b])
Antimony	ND*/ND	5.4 - 5.4/5	0.34 - 1.9/1	21 (RMEG[c])
Arsenic	1 - 39.9§/7	1.4 - 57.2§/7	2.3 - 26.2§/9	0.26 (CREG[d])
Barium	4.6 – 198/23	5.6 - 92.5/32	9 – 294/72	10,000 (EMEG)
Beryllium	0.025 - 0.71/0	0.16 - 0.81/0.51	0.065 - 0.47/0.31	100 (EMEG)
Cadmium	0.045 - 2.6/0	0.037 - 4.5/1	0.082 - 2.1/1	5.2 (EMEG)
Chromium	2.5 - 61.2/13	2.9 – 95/19	4.6 - 95.4/23	240 (RSRS[e])
Cobalt	0.87 - 9.4/4	0.3 - 4.7/2	0.42 - 6.5/3	23 (EPA SL[f])
Copper	1.9 - 15.6/6	2.5 – 34/11	2.3 – 1910/100	600 (RSRS)
Iron	2120 – 81500§/10573	2960 – 138400§/15408	4190 – 45200/15561	55,000 (EPA SL)
Lead	6.6 – 1780§/162	3.8 – 144/58	4.5 – 5210§/395	200 (EPA R2[g])
Manganese	7.6 – 201/37	9.1 – 144/52	11.5 – 252/79	1,900 (EPA SL)
Nickel	1.2 - 23.4/5	0.55 - 17.5/5	2 - 17.5/6	1000 (RMEG)
Selenium	1.4 - 2.6/2	1.3 - 2.9/2	0.94 - 8.2/3	260 (EMEG)
Silver	0.12 - 0.2/0.15	0.071 - 0.37/0.31	0.11 - 1.3/0.77	260 (EMEG)
Thallium	0.88 - 0.88/0.88	0.19 - 0.19/0.19	0.21 - 0.52/0.39	NA**
Vanadium	3.9 – 166/21	5.6 – 257/32	6.8 – 111/29	370 (RSRS)
Zinc	5.1 – 103/23	5.1 – 181/38	10.8 – 562/119	16,000 (EMEG)

[a]Comparison Values given in ppm; [b]Environmental Media Evaluation Guide; [c]Reference Media Evaluation Guide; [d]Cancer Risk Evaluation Guide; [e]New Jersey Residential Soil Remediation Standard; [f]EPA Screening Level; [g]EPA Region 2 Screening Level, *Not detected; **Not Available

Table A29: Residential Soil Sampling Results (2016): The range and mean concentration (in ppm) of metals detected in the soil (>6”) for residences P035 through P036

Contaminant	Residence# P035 Range/Mean	Residence# P036 Range/Mean	CVs[a]
Aluminum	1040 – 17600/6567	637 – 18900/5038	52,000 (EMEG[b])
Antimony	0.83 – 697/158.0	1.5 – 4720/202	21 (RMEG[c])
Arsenic	0.46 – 115§/13.6	0.79 – 478§/16	0.26 (CREG[d])
Barium	5.9 – 165/45.4	7.2 – 234/35	10,000 (EMEG)
Beryllium	0.07 - 1.3/0.4	0.09 - 1.1/0	100 (EMEG)
Cadmium	0.03 - 5.8/1.0	0.02 - 2.4/1	5.2 (EMEG)
Chromium	4.1 – 113/23.3	1.9 – 1140/28	240 (RSRS[e])
Cobalt	0.4 - 14.1/2.7	0.41 – 11/2	23 (EPA SL[f])
Copper	0.57 – 91/18.3	2 - 90.4/17	600 (RSRS)
Iron	952 – 38500/12048.7	495 – 60100§/10353	55,000 (EPA SL)
Lead	1.5 – 54900§/4904.9	4.3 – 57300§/7795	200 (EPA R2[g])
Manganese	2.5 – 497/82.9	4 – 791/95	1,900 (EPA SL)
Mercury	0.015 - 0.1/0.018	0.017 - 0.038/0.025	23 (RSRS)
Nickel	1.3 - 34.6/6.8	0.71 - 37.5/6	1000 (RMEG)
Selenium	3.6 - 3.9/3.8	0.67 - 5.8/3	260 (EMEG)
Silver	0.13 - 2.1/0.7	0.14 - 4.3/1	260 (EMEG)
Thallium	0.39 - 2.8/1.4	0.5 - 1.1/1	NA*
Vanadium	4.2 – 101/24.8	2.6 – 241/20	370 (RSRS)
Zinc	2.2 – 180/37.4	4 – 229/32	16,000 (EMEG)

[a]Comparison Values given in ppm; [b]Environmental Media Evaluation Guide;; [c]Reference Media Evaluation Guide; [d]Cancer Risk Evaluation Guide; [e]New Jersey Residential Soil Remediation Standard; [f]EPA Screening Level; [g]EPA Region 2 Screening Level; *Not Available

Table A30: Residential Soil Sampling Results (2016): The range and mean concentration (in ppm) of semivolatile organic compounds detected in the soil

Contaminant	Environmental CV[a]	Soil (1-6" depth) Residence# P006 Range/ Mean	Soil (1-6" depth) Residence# P036 Range/ Mean	Potential COC	Subsurface Soil Res# P006/P036	Potential COC
Benzaldehyde	5,200 (RMEG[b])	0.08 - 0.08/0.08	ND*ND	No	0.51/1.2	No
Phenol	16,000 (EMEG[c])	0.13 - 0.2/0.16	0.13-0.18/0.16	No	0.23/0.31	No
Acetophenone	5,200 (RMEG)	ND/ND	ND/ND	No	0.22/0.49	No
Naphthalene	1,000 (RMEG)	ND/ND	ND/ND	No	0.16/0.26	No
2-Methylnaphthalene	2,100 (EMEG)	ND/ND	ND/ND	No	0.16/0.29	No
1,1-Biphenyl	NA**	ND/ND	ND/ND	No	0.38/0.22	No
Dimethylphthalate	5,200 (RMEG)	0.1 - 0.23/0.17	0.18-0.49/0.29	No	0.22/0.24	No
Acenaphthene	3,100 (RMEG)	0.05 - 0.06/0.06	ND/ND	No	ND/ND	No
Fluorene	3,100 (RMEG)	0.0 6 - 0.07/0.07	ND/ND	No	ND/ND	No
N-Nitrosodiphenylamine	3,100 (RMEG)	ND/ND	ND/ND	No	ND/0.56	No
Phenanthrene	NA	ND/0.49	ND/ND	No	0.57/0.82	No
Anthracene	16,000 (RMEG)	0.1 - 0.15/0.12	ND/ND	No	ND/ND	No
Carbazole	NA	0.05 - 0.25/0.15	ND/ND	No	ND/ND	No
Di-n-butylphthalate	5,200 (RMEG)	ND/ND	ND/ND	No	0.52/ND	No
Fluoranthene	2,100 (RMEG)	0.07 - 2.9/0.66	0.04-0.12/0.08	No	0.14/0.33	No
Pyrene	1,600 (RMEG)	0.07 - 2.5/0.56	0.04-0.1/0.07	No	0.42/1.60	No
Butylbenzylphthalate	10,000 (RMEG)	0. 4 - 0.4/0.40	ND/ND	No	ND/ND	No
Benzo[a]anthracene	5.1 (RSRS[d])	0.06 - 1.3/0.43	ND/ND	No	1.80/ND	No
Chrysene	510 (RSRS)	0.04 - 1.7/0.44	ND/ND	No	0.96/ND	No
Bis(2-ethylhexyl)phthalate	49 (RSRS)	0.06 - 0.43/0.18	ND/ND	No	ND/2.10	No
Benzo[b]fluoranthene	5.1 (RSRS)	0.06 - 2.2/0.57	ND/ND	No	ND/ND	No
Benzo[k]fluoranthene	51 (RSRS)	0.07 - 0.97/0.39	ND/ND	No	ND/ND	No

Table A30: (Cont'd.)

Contaminant	Environmental CV[a]	Soil (1-6" depth) Residence# P006 Range/ Mean	Soil (1-6" depth) Residence# P036 Range/ Mean	Potential COC	Subsurface Soil Res# P006/P036	Potential COC
Benzo[a]pyrene	0.065 (CREG[e])	0.07 - 1.4/0.44	ND/ND	**Yes**	ND/ND	No
Indeno[1,2,3-cd]pyrene	5.1 (RSRS)	0.0 - 0.59/0.25	ND/ND	No	ND/ND	No
Dibenzo[a,h]anthracene	0.51 (RSRS)	0.17 - 0.17/0.17	ND/ND	No	ND/ND	No
Benzo[g,h,i]perylene	NA	0.06 - 0.54/0.23	ND/ND	No	ND/ND	No

[a]Comparison Values given in ppm; [b]Reference Media Evaluation Guide; [c]Environmental Media Evaluation Guide; [d]New Jersey Residential Soil Remediation Standard; [e]Cancer Risk Evaluation Guide; *Not detected; **Not Available

Table A31: Input Parameters and Equations used to calculate exposure doses in PHAST

Site-specific Input Parameters and Equations PHAST Report, v2.5.1.0, August 15, 2025

Equations

Soil/Sediment Ingestion Exposure Dose Equation

$$D_{noncancer} = (C \times IR \times EF_{noncancer} \times CF) \div BW \quad \textbf{Equation 1}$$

$D_{noncancer}$ = dose (mg/kg/day), C = contaminant concentration (mg/kg), IR = intake rate (mg/day), $EF_{noncancer}$ = exposure factor (unitless), CF = conversion factor (10^{-6} kg/mg), BW = body weight (kg)

Administered Dermal Dose Equation

$$ADD_{noncancer} = (C \times EF_{noncancer} \times CF \times AF \times ABS_{d} \times SA) \div (BW \times ABS_{GI}) \quad \textbf{Equation 2}$$

$ADD_{noncancer}$ = administered dermal dose (mg/kg/day), C = contaminant concentration (mg/kg), $EF_{noncancer}$ = exposure factor (unitless), CF = conversion factor (10^{-6} kg/mg), AF = adherence factor (mg/cm^2-event), ABS_{d} = dermal absorption fraction (unitless), SA = skin surface area available for contact (cm^2), BW = body weight (kg), ABS_{GI} = gastrointestinal absorption factor (unitless)

Hazard Quotient

$$HQ = D_{noncancer} \div HG \quad \textbf{Equation 3}$$

HQ = hazard quotient, $D_{noncancer}$ = dose (mg/kg/day), HG = health guideline (e.g., oral MRL, RfD)

Cancer Risk Equations

$$CR = (D_{noncancer} \times CSF) \times (ED \div LY) \text{ for each exposure group} \quad \textbf{Equation 4}$$

$$\text{ADAF-adjusted } CR = (D_{noncancer} \times CSF) \times (ED \div LY) \times ADAF \text{ for each exposure group} \quad \textbf{Equation 5}$$

$$\text{Total } CR = \text{Sum of the CR for all exposure groups} \quad \textbf{Equation 6}$$

CR = cancer risk (unitless), $D_{noncancer}$ = dose, CSF = oral cancer slope factor [$(mg/kg/day)^{-1}$], EF (cancer) = exposure factor (cancer) calculated as follows: EF (noncancer; unitless) x exposure group specific exposure duration (years) ÷ lifetime of 78 years, ADAF = age-dependent adjustment factor (unitless), ED = exposure duration (years), LY = lifetime years (78 years)

Site-specific Exposure Parameters

Exposure Group	**Body Weight (kg)**	**Exposure Duration (years)**	**CTE Intake Rate (mg/day)**	**RME Intake Rate (mg/day)**	**Custom Intake Rate (mg/day)**	**Adherence Factor to Skin ($mg/cm^2/event$)**	**Combined Skin Surface Area (cm^2)**	**Notes**
Birth to < 1 year	7.8	1	55	150	-	0.2	211	-
1 to < 2 years	11.4	1	90	200	-	0.2	300	-
2 to < 6 years	17.4	4	60	200	-	0.2	348	-
6 to < 11 years	31.8	5	60	200	-	0.2	510	-
11 to < 16 years	56.8	5	30	100	-	0.2	720	-
16 to < 21 years	71.6	5	30	100	-	0.2	830	-
Total Child (all age groups)	-	21	-	-	-	-	-	-
Adult	80	30	30	100	-	0.07	980	-

Abbreviations: cm^2 = centimeters square skin; CTE = central tendency exposure (typical); kg = kilograms; $mg/cm^2/event$ = milligram chemical per centimeter square of skin per event; mg/day = milligram soil per day; RME = reasonable maximum exposure (higher)

Table A32: Exposure Factors used to calculate exposure doses in PHAST

Duration Category	Days per Week	Weeks per Year	Years	Exposure Group Specific $EF_{noncancer}$	Exposure Group Specific* EF_{cancer}
Acute	-	-	-	1	-
Intermediate	7	-	-	1	-
Chronic	7	52.14	30	1	$= EF_{noncancer} \times (ED_{age\text{-}specific\ (yrs)} \div 78$ years)

Abbreviations: EF = exposure factor; NC = not calculated

Note: The dermal absorbed dose equation includes 1 event/day EF parameter.

* Cancer risk is averaged over a lifetime of exposure (78 years).

Appendix B – Toxicological Summary

Toxicological Summaries

The toxicological summaries provided in this appendix are based on ATSDR's ToxFAQs (https://wwwn.cdc.gov/TSP/ToxFAQs/ToxFAQsLanding.aspx). Potential health effects are summarized in this section for the potential COCs. The chance that a health effect will occur is dependent on the amount, frequency, and duration of exposure and the individual susceptibility of exposed persons.

Antimony is a silvery-white metal that is found in the earth's crust. Antimony ores are mined and then mixed with other metals to form antimony alloys or combined with oxygen to form antimony oxide. As an alloy, it is used in lead storage batteries, solder, sheet and pipe metal, bearings, castings, and pewter. Antimony oxide is added to textiles and plastics as a fire retardant. It is also used in paints, ceramics, and fireworks, and as enamels for plastics, metal, and glass.

Antimony is released to the environment from natural sources and from industry. In the air, antimony is attached to very small particles that may stay in the air for many days. Most antimony particles settle in soil, where it attaches strongly to particles that contain iron, manganese, or aluminum.

Breathing high levels for a long time can irritate eyes and lungs and can cause heart and lung problems, stomach pain, diarrhea, vomiting, and stomach ulcers. In short-term studies, animals that breathed very high levels of antimony died. Animals that breathed high levels had lung, heart, liver, and kidney damage. In long-term studies, animals that breathed very low levels of antimony had eye irritation, hair loss, lung damage, and heart problems.

Ingesting large doses of antimony can cause vomiting. Other effects of ingesting antimony are unknown. Long-term animal studies have reported liver damage and blood changes when animals ingested antimony. Antimony can irritate the skin if it is left on it.

Arsenic is a naturally occurring element widely distributed in the earth's crust. In the environment, arsenic is combined with oxygen, chlorine, and sulfur to form inorganic arsenic compounds. Arsenic in animals and plants combines with carbon and hydrogen to form organic arsenic compounds.

Inorganic arsenic compounds are mainly used to preserve wood. Breathing high levels of inorganic arsenic can give you a sore throat or irritated lungs. Ingesting high levels of inorganic arsenic can result in death. Lower levels of arsenic can cause nausea and vomiting, decreased production of red and white blood cells, abnormal heart rhythm, damage to blood vessels, and a sensation of "pins and needles" in hands and feet.

Ingesting or breathing low levels of inorganic arsenic for a long time can cause a darkening of the skin and the appearance of small "corns" or "warts" on the palms, soles, and torso. Skin contact with inorganic arsenic may cause redness and swelling.

Organic arsenic compounds are used as pesticides, primarily on cotton plants. Organic arsenic compounds are less toxic than inorganic arsenic compounds. Exposure to high levels of some organic arsenic compounds may cause similar effects as those caused by inorganic arsenic.

Several studies have shown that inorganic arsenic can increase the risk of lung cancer, skin cancer, bladder cancer, liver cancer, kidney cancer, and prostate cancer. The United States Department of Health and Human Services (USDHHS), and the EPA have determined that inorganic arsenic is a human carcinogen.

Lead is a naturally occurring metal found in small amounts in the earth's crust. Lead can be found in all parts of our environment. Much of it comes from human activities including burning fossil fuels, mining, and manufacturing. Lead has many different uses. It is used in the production of batteries, ammunition, metal products (solder and pipes), and devices to shield X-rays. Because of health concerns, lead from gasoline, paints and ceramic products, caulking, and pipe solder has been dramatically reduced in recent years. People may be exposed to lead by eating food or drinking water that contains lead, spending time in areas where lead-based paints have been used and are deteriorating, and by working in a job or engaging in a hobby where lead is used. Small children are more likely to be exposed to lead by swallowing house dust or soil that contains lead, eating lead-based paint chips or chewing on objects painted with lead-based paint.

Lead can affect many organs and systems in the body. The most sensitive is the central nervous system, particularly in children. Lead also damages kidneys and the reproductive system. The effects are the same whether it is breathed or swallowed. At high levels, lead may decrease reaction time, cause weakness in fingers, wrists, or ankles, and possibly affect the memory. Lead may cause anemia, a disorder of the blood. It can also damage the male reproductive system. The connection between these effects and exposure to low levels of lead is uncertain.

Children are more vulnerable to lead poisoning than adults. A child who swallows large amounts of lead, for example by eating old paint chips, may develop blood anemia, severe stomachache, muscle weakness, and brain damage. A large amount of lead might get into a child's body if the child ate small pieces of old paint that contained large amounts of lead. If a child swallows smaller amounts of lead, much less severe effects on blood and brain function may occur. Even at much lower levels of exposure, however, lead can affect a child's mental and physical growth. Exposure to lead is more dangerous for young children and fetuses. Fetuses can be exposed to lead through their mothers. Harmful effects include premature births, smaller babies, decreased mental ability in the infant, learning difficulties, and reduced growth in young children. These effects are more common if the mother or baby was exposed to high levels of lead.

The USDHHS has determined that two compounds of lead (lead acetate and lead phosphate) may reasonably be anticipated to be carcinogens based on studies in animals. There is inadequate evidence to clearly determine whether lead can cause cancer in people.

Polycyclic Aromatic Hydrocarbons (PAHs) Polycyclic aromatic hydrocarbons (PAHs) includes benzo[a]pyrene (one of the potential COCs) and are a group of over 100 different chemicals that are formed during the incomplete burning of coal, oil and gas, garbage, or other organic substances like tobacco or charbroiled meat. PAHs are usually found as a mixture containing two or more of these compounds, such as soot. These include benzo[a]anthracene, benzo[b] fluoranthene, benzo[a] pyrene, benzo[(g,h,i]perylene, indeno[1,2,3-cd]pyrene, phenanthrene, and naphthalene.

Some PAHs are manufactured. These pure PAHs usually exist as colorless, white, or pale yellow-green solids. PAHs are found in coal tar, crude oil, creosote, and roofing tar, but a few are used in medicines or to make dyes, plastics, and pesticides. Mice that were fed high levels of one PAH during pregnancy had difficulty reproducing and so did their offspring. These offspring also had higher rates of birth defects and lower body weights. It is not known whether these effects occur in people. Animal studies have also shown that PAHs can cause harmful effects on the skin, body fluids, and ability to fight disease after both short- and long-term exposure. But these effects have not been seen in people.

The USDHHS has determined that some PAHs may reasonably be expected to be carcinogens. Some people who have breathed or touched mixtures of PAHs and other chemicals for long periods of time have developed cancer. Some PAHs have caused cancer in laboratory animals when they breathed air containing them (lung cancer), ingested them in food (stomach cancer), or had them applied to their skin (skin cancer).

Polychlorinated biphenyls (PCBs) are mixtures of up to 209 individual chlorinated compounds (known as congeners). There are no known anthropogenic sources of PCBs. PCBs can exist as oily liquids, solids or vapor in air. Many commercial PCB mixtures are known by the trade name Aroclor. Most PCBs were used in dielectric fluids for use in transformers, capacitors, and other electrical equipment. Since PCBs build up in the environment and can cause harmful health effects, PCB production was stopped in the U.S. in 1977.

PCBs enter the environment during their manufacture, use, and disposal. PCBs can accumulate in fish and marine mammals, reaching levels that may be many thousands of times higher than in water. The most commonly observed health effects associated with exposures to large amounts of PCBs are skin conditions such as acne and rashes. Studies in exposed workers have shown changes in blood and urine that may indicate liver damage. PCB exposures in the general population are not likely to result in skin and liver effects. Most of the studies of health effects of PCBs in the general population examined children of mothers who were exposed to PCBs.

Animals administered with large PCB dose for short periods of time had mild liver damage and some died. Animals that ate smaller amounts of PCBs in food over several weeks or months developed various kinds of health effects, including anemia; acne-like skin conditions; and liver, stomach, and thyroid gland injuries. Other effects of PCBs in animals include changes in the immune system, behavioral alterations, and impaired reproduction. PCBs are not known to cause birth defects.

Few studies of workers indicate that PCBs were associated with certain kinds of cancer in humans, such as cancer of the liver and biliary tract. Rats that ate food containing high levels of PCBs for two years developed liver cancer. The Department of Health and Human Services (DHHS) has concluded that PCBs may reasonably be anticipated to be carcinogens. EPA and the International Agency for Research on Cancer (IARC) have determined that PCBs are probably carcinogenic to humans.

Women who were exposed to relatively high levels of PCBs in the workplace or ate large amounts of fish contaminated with PCBs had babies that weighed slightly less than babies from women who did not have these exposures. Babies born to women who ate PCB-contaminated fish also showed abnormal responses in tests of infant behavior. Some of these behaviors, such as problems with motor skills and a decrease in short-term memory, lasted for several years.

Other studies suggest that the immune system was affected in children born to and nursed by mothers exposed to increased levels of PCBs. There are no reports of structural birth defects caused by exposure to PCBs or of health effects of PCBs in older children. The most likely way infants will be exposed to PCBs is from breast milk. Transplacental transfers of PCBs were also reported. In most cases, the benefits of breast-feeding outweigh any risks from exposure to PCBs in mother's milk.

Appendix C – Pica Exposures

Evaluation of Exposures to Children with Soil-Pica Behavior

One of the most important activities of the public health assessment process is to evaluate the extent to which people may be exposed to hazardous substances in soil, groundwater, surface water, air, and food. With the growing number of sites where levels of soil contamination may be of public health concern, it is necessary to assess the exposures to vulnerable populations, particularly children who exhibit soil-pica behavior (ATSDR 2021). Soil-pica is the recurrent ingestion of unusually high amounts of soil (i.e., on the order of 1,000-5,000 milligrams per day, 3 times/week). Children aged 6 years and younger and individuals who are developmentally delayed are at risk of exposures associated with soil-pica behavior.

Environmental Guideline Comparison

Intermediate and acute exposure comparison values (CVs) for children with soil-pica behavior are available (i.e., environmental media evaluation guide, or EMEG) for screening contaminants to identify potential COCs (ATSDR 2005). Maximum concentration of substances exceeding acute or intermediate CVs are identified as potential COCs for children with soil-pica behavior and evaluated further to determine whether these contaminants pose a health threat to exposed or potentially exposed children. As indicated earlier, soil samples were collected from each property and were analyzed for metals, PCBs, VOCs and SVOCs. The maximum concentration of contaminants in soil in each property were compared with the corresponding intermediate or acute CVs (see Tables C1 and C2); the exceedances are shown in bold font.

It should be noted that none of the antimony concentrations exceeded the acute EMEG (i.e., 5,300 ppm) and arsenic does not have an intermediate EMEG. Therefore, arsenic is the only contaminant detected that may have an acute health effect on children with soil-pica behavior.

When assessing an exposure risk to a contaminant of concern, ATSDR recommends using the 95 percent upper confidence limit (95% UCL) of the arithmetic mean to determine the exposure point concentrations (EPC) for site-related contaminants (ATSDR 2019). The EPCs were calculated for each potential COCs (see Table C3) for each residence and were compared with the corresponding intermediate and acute environmental CVs. The exceedances are shown in bold font in Table C3. It should be noted that all arsenic EPCs were less than the acute pica EMEG (i.e., 27 mg/kg), and, therefore, intermediate exposures for a child with soil-pica behavior are evaluated in the subsequent analysis.

Noncancer Health Effects

The possibility of noncancer health effects can be assessed using intermediate and acute minimal risk levels (MRL) for contaminants that are commonly found at hazardous waste sites (ATSDR 2005). MRLs are usually extrapolated doses from observed effect levels in animal or human toxicological studies and are adjusted by a series of factors (or safety) factors or using statistical models (EPA 2011). The effect levels include NOAEL and LOAEL or equivalent toxicity values (e.g., BMDL). As the exposure dose increases beyond the MRL towards effect levels, the likelihood of adverse health effects also increases. The likelihood of noncancer health effects is assessed by comparing the exposure dose to MRL via hazard quotient (HQ). As the HQ increases above 1, the potential for harmful effects increases. Contaminants with a HQ exceeding a value of 1 were evaluated further to determine whether these contaminants pose a health threat. ATSDR's exposure dose guidance for soil ingestion and EPA's Exposure Factor Handbook were used to calculate exposure doses (ATSDR 2018, EPA 2011).

The EMEG for screening contaminant for soil-pica behavior were developed based on exposures to "1 to <2 years" age group. This age range has been selected because exposures will be the highest in this group of children. Since the site-specific exposure factors (i.e., typical residential backyard scenario) and exposure factors associated with soil-pica EMEGs are the same, the intermediate HQs may be estimated by dividing on-site soil EPC by EMEG (see Table C4). The calculated intermediate HQs of aluminum, antimony, cadmium, chromium, copper, vanadium, fluoranthene and Aroclor 1254 exceeded 1. The calculated intermediate soil HQ ranges of contaminants are given in Table C5.

The calculated exposure doses were compared to observed adverse effect levels (e.g., NOAEL or LOAEL or BMDL) to provide additional perspective on contaminants with HQs greater than 1. The contaminant specific noncancer adverse effect levels (i.e., LOAEL or NOAEL or BMDL associated with MRL derivation), product of uncertainty and modifying factor, MRL and the highest HQ were given in Table C6. The table also provides the ratio of adverse effect levels to observed exposure dose (hereinafter referred to as the margin of safety). The margin of safety compares the magnitude of the observed dose with reference to adverse health effect levels. For example, for cadmium, the MRL is 100 times lower than the effect level whereas the actual dose is about 93 times lower than the effect level. As such, noncancer adverse health effects in pica child group "1 to <2 years" from exposure to cadmium in the surface soil at this residence is unlikely. Using the same approach, it is evident that the adverse health effects in pica child group "1 to <2 years" from exposure associated with aluminum, cadmium, chromium, copper, vanadium, fluoranthene and Aroclor 1254 in the surface soil at these residences are unlikely. Since the margin of safety for antimony (i.e., 2.07) is very close to the product of uncertainty and modifying factors, antimony exposures are evaluated as follows:

Antimony: Based on the highest EPC (i.e., 154.4 ppm), the intermediate exposure HQs for the child age group "1 to <2 years" is estimated as 48.4. As mentioned earlier, an intermediate-duration oral MRL of 0.0006 mg/kg/day for antimony is based on a NOAEL of 0.06 mg/kg/day and an uncertainty factor of 100. The pica intermediate exposure dose (i.e., 48 X 0.0006 mg/kg/day = 0.029 mg/kg/day) is about 2 times lower than the NOAEL for antimony (i.e., 0.06 mg/kg/day) or the margin of safety is about 2. As such, noncancer adverse health effects in pica child group "1 to <2 years" from exposure to antimony in the surface soil at this residence is possible. The margin of safety of the next age group "2 to <6 years" at the same residence can be easily estimated by multiplying the 2.07 (i.e., margin of safety for "1 to <2 years") by the ratio of the body weight of the two child age groups (2.07 *17.4/11.4=), i.e., 3.16. Since 3.16 is small compared to 100 (see Table C6), noncancer adverse health effects in pica child group "2 to <6 years" from exposure to antimony in the surface soil at this residence is also possible.

The next highest HQ 16.7 was calculated for residence #28. The margin of safety for pica child group "1 to <2 years" may be estimated as [0.06/(16.7*0.0006) = 5.98]. Since 5.98 is small compared to 100 (see Table C6), noncancer adverse health effects in pica child group "1 to <2 years" from exposure to antimony in the surface soil at this residence is also possible. The margin a safety of the next age group “2 to <6 years” can be easily estimated by multiplying the 5.98 (i.e., margin of safety for "1 to <2 years") by the ratio of the body weight of the two age groups (5.98 *17.4/11.4=), i.e., 9.15. Since 9.15 is small compared to 100 (see Table C6), noncancer adverse health effects in pica child group "2 to <6 years" from exposure to antimony in the surface soil at this residence is also possible.

The next highest HQ is 9.8, calculated for residence #1. The margin of safety for pica child group "1 to <2 years" may be estimated as [0.06/(9.8*0.0006) =] 10.26. Since 10.26 is small compared to 100 (see Table C6), noncancer adverse health effects in pica child group "1 to <2 years" from exposure to antimony in the surface soil at this residence is also possible. The margin a safety of the next age group “2 to <6 years” can be estimated by multiplying the 10.26 (i.e., margin of safety for "1 to <2 years") by the ratio of the body weight of the two age groups (10.26 *17.4/11.4=), i.e., 16.17. Since 16.17 is small compared to 100 (see Table C6), noncancer adverse health effects in pica child group "2 to <6 years" from exposure to antimony in the surface soil at this residence is also possible.

In summary, noncancer adverse health effects in children aged 6 years and younger with soil-pica behavior at these specific residences is possible because estimated dose for children with soil-pica behavior is approaching health effects.

There are no human studies available to assess the toxicity of chronic exposure to antimony. The health guideline value for antimony is based on reduced longevity, decreased blood glucose, and altered cholesterol levels of a group of male and female rats in an oral bioassay study.

Table C1: Comparison of maximum metal concentration (in ppm) with acute and intermediate soil pica CV (in ppm)

Contaminant	Res# 1	Res# 2	Res# 3	Res# 4	Res# 5	Res# 6	Res# 7	Res# 8	Res# 9	Res# 10	Res# 11	Res# 12	Soil Pica Inter./acute CV
Aluminum	5,800[a]	6,500[a]	7,500[a]	5,100	-	-	-	-	388	4,940	6,830[a]	3,360	5,300/-
Antimony[b]	59[a]	0	5.7[a]	2.4	-	-	-	-	2.2	2.2	9[a]	317.8[a]	3.2/5,300
Arsenic[c]	10	5	9.4	6.3	-	-	-	-	17	35.5[a]	17.6	9.635	-/27
Cadmium	0.5	-	-	-	-	-	-	-	0.4	0.3	0.8	0.5	2.7/-
Chromium	38[a]	22	17	23	-	-	-	-	226	48.8[a]	26.8	15.8	27/-
Cobalt	2.6	2.1	2.1	2.2	-	-	-	-	1.8	2.2	7.9	4	53/-
Copper	52	13	23	47	-	-	-	-	30.2	63[a]	49.6	14.8	53/-
Vanadium	42	24	28	30	-	-	-	-	18	14	88[a]	43	53/-
Zinc	180	66	160	300	-	-	-	-	67.5	78.34	131.2	44.33	1,600/-

[a]indicates exceedance; [b]Based on intermediate PICA CV; [c]Based on acute PICA CV

Table C1: (Cont'd.)

Contaminant	Res# 13	Res# 14	Res# 15	Res# 16	Res# 17	Res# 18	Res# 19	Res# 20	Res# 21	Res# 22	Res# 23	Res# 24	Soil Pica Inter./acute CV
Aluminum	4,020	5,090	4,78	4,00	5,00	5,530[a]	4,460	9,610[a]	4,720	7,960[a]	3,160	6,620[a]	5,300/-
Antimony	5.54[a]	3.14	5.15[a]	5.7[a]	4.2[a]	3.44[a]	7.05[a]	3.2[a]	4.15[a]	5.26[a]	6.56[a]	4.3[a]	3.2/5,300
Arsenic	6.39	17.7	29.8[a]	8.3	20.2	11.7	32.9[a]	28.6[a]	35.7[a]	11	14.9	22.9	-/27
Cadmium	0.48	0.57	0.35	0.5	1.3	0.5	0.27	0.33	0.46	4.2[a]	0.38	1.5	2.7/-
Chromium	12.3	25.7	37.9[a]	30.3[a]	34.2[a]	30.3[a]	67.7[a]	53.9[a]	55.5[a]	26.3	25.8	39[a]	27/-
Cobalt	4.52	4.77	5.2	2.2	4	7.24	4.42	11.5	4.3	19.6	1.9	6.8	53/-
Copper	18.3	32.2	38	33.3	36.1	86.8[a]	56.4[a]	47.5	76[a]	41.2	51	47	53/-
Vanadium	16.3	55	67.7[a]	46.8	25.0	71.9[a]	42.8	129[a]	23	24.8	14.1	126.2[a]	53/-
Zinc	60.4	76.4	89.1	87.4	157	74.6	77.4	86.5	127	355	91.9	236.5	1,600/-

[a]indicates exceedance; [b]Based on intermediate PICA CV; [c]Based on acute PICA CV

Table C1: (Cont'd.)

Contaminant	Res# 25	Res# 26	Res# 27	Res# 28	Res# 29	Res# 30	Res# 31	Res# 32	Res# 33	Res# 34	Res# 35	Res# 36	Soil Pica Inter./acute CV
Aluminum	4,720	4,250	9,110[a]	4,630	6,850[a]	9,610[a]	3,710	10,200[a]	4,500	6,970[a]	14,800[a]	11,600[a]	5,300/-
Antimony	2.87	4.52[a]	4.66[a]	74.9[a]	5.84[a]	11.85[a]	15.8[a]	7.30[a]	5.05[a]	2.59	7.4[a]	3.60[a]	3.2/5,300
Arsenic	11.25	8.76	15.79	15.31	20.70	47[a]	27.2	17.10	7.96	19.08	14.5	8.60	-/27
Cadmium	0.26	0.24	1.26	0.28	0.68	4.2[a]	0.66	3.9[a]	0.85	0.48	1.5	2.9[a]	2.7/-
Chromium	24.91	18.96	48.18[a]	25.28	65.2[a]	67.7[a]	43[a]	36.3[a]	39.3[a]	42.78[a]	58.8[a]	93.3[a]	27/-
Cobalt	5.62	1.98	8.39	2.86	5.18	19.60	3.86	5.40	2.73	3.58	11.8	8.20	53/-
Copper	10.43	28.01	36.62	12.60	43.30	86.82[a]	63.8[a]	75.60[a]	15.72	13.57	213[a]	64[a]	53/-
Vanadium	88.85[a]	44.4	138.5[a]	29.55	116[a]	138.5[a]	48.99	74.9[a]	49.87	47.19	66.8[a]	52	53/-
Zinc	57.3	76.5	216.3	48.1	84.9	355.0	104.4	544.0	129.5	79.4	175	21	1,600/-

[a]indicates exceedance; [b]Based on intermediate PICA CV; [c]Based on acute PICA CV

Table C2: Comparison of maximum SVOC concentration with acute and intermediate Environmental Guideline

Contaminant	Res# 5 (ppm)	Res# 6 (ppm)	Res# 28 (ppm)	Res# 36 (ppm)	PICA VALUE Intermediate (ppm)	PICA VALUE Acute (ppm)
Acenaphthene	-	68	-	-	3,200	-
Anthracene	-	150	-	-	53,000	-
Fluoranthene	-	2,900[a]	-	120	2,100	-
Fluorene	-	72	-	-	2,100	-
Naphthalene	-	50	-	-	3,200	3,200
Phenol	-	200	-	180	-	5,300
Aroclor 1254	0.3[a]	0.2[a]	0.3[a]	-	0.2	-

[a]indicates exceedance

Table C3: Exposure Point Concentration (ppm) at Residences

Contaminant	Res# 1	Res# 2	Res# 3	Res # 5	Res# 6	Res# 10	Res# 11	Res# 12	Res# 13	Res# 14	Res# 15	PICA Value Inter. (ppm)	PICA Value Acute (ppm)
Aluminum	4,878	6,500[a]	6,475[a]	-	-	-	3,562	-	-	-	-	5,300	-
Antimony	31.4[a]		5.7	-	-	-	4.7[a]	154.4[a]	2.9	-	2.3	3.2	5,300
Arsenic	-	-	-	-	-	18.7	-	-	-	-	10	-	27
Cadmium	-	-	-	-	-	-	-	-	-	-	-	2.7	-
Chromium	22.6	-	-	-	-	25.9	-	-	-	-	17.28	27	-
Copper	-	-	-	-	-	32.1	-	-	-	-	-	53	-
Vanadium	-	-	-	-	-	-	40.5	-	-	36.5	21.4	53	-
Fluoranthene	-	-	-	-	2,900[a]	-	-	-	-	-	-	2,100	-
Aroclor 1254	-	-	-	0.3[a]	0.2[a]	-	-	-	-	-	-	0.16	-

[a]indicates exceedance

Table C3: (Cont'd.)

Contaminant	#16	#17	#18	#19	#20	#21	#22	#23	#24	#25	#26	PICA Value Inter. (ppm)	PICA Value Acute (ppm)
Aluminum	-	-	4,477	-	**6,302**	-	3,906	-	4,738	-	-	5,300	-
Antimony	**8.5**	2.9	2.1	3.1	2.6	2.8	2.7	3	2.4	-	2.5	3.2	5,300
Arsenic	-	-	-	14.7	20.4	19.4	-	-	-	-	-	-	27
Cadmium	-	-	-	-	-	-	1.7	-	-	-	-	2.7	-
Chromium	20.9	23.5	19.5	8.8	**36**	**27.7**	-	-	**28.2**	-	-	27	-
Copper	-	-	51.2	8.5	-	37.1	-	-			-	53	-
Vanadium	-	-	42.3	-	**86.4**	-	-	-	**82.4**	**63.4**	-	53	-
Fluoranthene	-	-	-	-	-	-	-	-	-	-	-	2,100	-
Aroclor 1254	-	-	-	-	-	-	-	-	-	-	-	0.2	-

[a]indicates exceedance

Table C3: (Cont'd.)

Contaminant	#27	#28	#29	#30	#31	#32	#33	#34	#35	#36	PICA Value Inter. (ppm)	PICA Value Acute (ppm)
Aluminum	5,880[a]	-	4,999	3,640	-	6,369[a]	-	5,574[a]	8,986[a]	6,932[a]	5,300	-
Antimony	3	53.6	4[a]	6.6[a]	7.7[a]	5.6[a]	3	-	3.2	2.1	3.2	5,300
Arsenic	-	-	-	13.3	17	-	-	-	-	-	-	27
Cadmium	-	-	-	0.2	-	2.7	-	-	1.2	2.9[a]	2.7	-
Chromium	34[a]	-	36.3[a]	15.6	22.9	22.1	28[a]	30.9[a]	29.1[a]	37.8[a]	27	-
Copper		-		10.7	38.7	54.6[a]	-	-	54.9[a]	33.9	53	-
Vanadium	93.6[a]	-	54.4[a]	19.7		47	-	-	34.7	52	53	-
Fluoranthene	-	-	-	-	-	-	-	-	-	-	2,100	-
Aroclor 1254	-	0.3[a]	-	-	-	-	-	-	-	-	0.2	-

[a]indicates exceedance

Table C4: HQ at various Residences

Contaminant	#1	#2	#3	#5	#6	#11	#12	#16	#20	#21	#24	PICA VALUES Inter. (ppm)	PICA VALUES Acute (ppm)
Aluminum	-	1.2	1.2	-	-	-	-	-	1.2	-	-	5,300	-
Antimony	9.8		1.8	-	-	1.4	48.2	2.7	-	-	-	3.2	5,300
Arsenic	-	-	-	-	-	-	-	-	-	-	-	-	27
Cadmium	-	-	-	-	-	-	-	-	-	-	-	2.7	-
Chromium	-	-	-	-	-	-	-	-	1.3	1	1	27	-
Copper	-	-	-	-	-	-	-	-	-	-	-	53	-
Vanadium	-	-	-	-	-	-	-	-	1.6	-	1.6	53	-
Fluoranthene	-	-	-	-	1.4	-	-	-	-	-	-	2,100	-
Aroclor 1254	-	-	-	2.1	1.4	-	-	-	-	-	-	0.2	-

Table C4: (Cont'd.)

Contaminant	#25	#27	#28	#29	#30	#31	#32	#33	#34	#35	#36	PICA VALUES Inter. (ppm)	PICA VALUES Acute (ppm)
Aluminum	-	1.1	-	-	-	-	1.2	-	1	1.7	1.3	5,300	-
Antimony	-	-	16.7	1.2	2	2.4	1.8	-	-	-	-	3.2	5,300
Arsenic	-	-	-	-	-	-	-	-	-	-	-	-	27
Cadmium	-	-	-	-	-	-	-	-	-	-	1.1	2.7	-
Chromium	-	1.3	-	1.3	-	-	-	1	1.1	1.1	1.4	27	-
Copper	-	-	-	-	-	-	-	-	-	1	-	53	-
Vanadium	1.2	1.8	-	1	-	-	-	-	-	-	-	53	-
Fluoranthene	-	-	-	-	-	-	-	-	-	-	-	2,100	-
Aroclor 1254	-	-	1.2	-	-	-	-	-	-	-	-	0.2	-

Table C5: Calculated soil intermediate HQ ranges of contaminants detected at the residential yard soil

Contaminant	HQ Range
Aluminum	1 - 1.7
Antimony	1.2 - 48.2
Cadmium	1 - 1
Chromium	1 - 1.4
Copper	1 - 1
Vanadium	1.- 1.8
Fluoranthene	1.4
Aroclor 1254	1.2 – 2

Table C6: Comparison of calculated exposure doses with observed effect levels (e.g., NOAEL, LOAEL)

Contaminant	LOAEL or NOAEL or BMDL (mg.kg-day)	UF*MF	MRL (mg/kg-day)	Highest HQ	LOAEL or NOAEL or BMDL/Dose
Aluminum	26	30	1	1.7	15.3
Antimony	0.06	100	0.0006	48.2	2
Cadmium	0.05	100	0.0005	1.07	93.5
Chromium	0.52	100	0.0052	1.4	71.4
Copper	0.042	3	0.01	1.04	4
Vanadium	0.12	10	0.01	1.8	6.8
Fluoranthene	120	300	0.4	1.4	217.4
Aroclor 1254	0.009	300	0.00003	24	145.64