Health Consultation

Pioneer Metal Finishing Inc.

Public Health Implications of Exposures to Soil and Sediment Contamination

(USEPA Facility ID: NJD002360188)

Franklinville, Gloucester County, New Jersey

Prepared by the

New Jersey Department of Health Environmental and Occupational Health Surveillance Program

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Under a Cooperative Agreement with the
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Office of Capacity Development and Applied Prevention Science

Health Consultation: A Note of Explanation

A health consultation is a verbal or written response from ATSDR or ATSDR's Cooperative Agreement Partners to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR or ATSDR's Cooperative Agreement Partner which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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Summary

Introduction

On September 1, 2020, the United States Environmental Protection Agency (EPA) proposed to add the Pioneer Metal Finishing Inc. site (Pioneer), Franklinville, Gloucester County, New Jersey, to the National Priorities List (NPL). The NPL is the list of sites of national priority among the known releases or threatened releases of hazardous substances, pollutants, or contaminants throughout the United States and its territories. The NPL is intended to guide EPA in determining which sites warrant further investigation. The Pioneer site was added to the NPL on September 8, 2021. This health consultation was prepared in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund), which requires sites proposed or listed to the NPL be evaluated for public health implications using available environmental data.

The New Jersey Department of Health (NJDOH) prepared this health consultation under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). This document evaluates available environmental data collected from the site to assess the potential for human health effects from exposures to site contaminants. The top priority of NJDOH and ATSDR is to ensure that the community around the site is protected from site contaminants and has the best information possible to safeguard its health.

Pioneer began operation as an electroplating facility in 1955. It released untreated waste from the facility from that time until the mid- to late-1970s. Wastes reportedly consisted of metallic salts, untreated process sludge, rinse water, cleaning solutions, and plating wastes that were released into an unlined trench leading to an adjacent wetland southeast of the plant. The primary contaminants of concern are metals, including chromium, hexavalent chromium, copper, nickel, and cyanide.

Electroplating activities stopped around 2005. The building is currently used as a powder coating facility. Powder coating is a type of coating that is applied as a free-flowing dry powder. It is typically applied electrostatically and then cured under heat or with ultraviolet light.

This document evaluates the potential public health implications of exposure to soil, dust, and sediment from historical operations based on data collected to date by EPA. As EPA continues to characterize the nature and extent of contamination from the site, NJDOH and ATSDR will evaluate additional data as it becomes available.

Conclusions

NJDOH and ATSDR have reached the following conclusions for the Pioneer site:

Conclusion 1	Past, current, and future exposure to hexavalent chromium is a health concern for site workers and adult trespassers ages 21 years and older.
Basis for Conclusion	Results from the limited soil samples available indicate that site workers and adult trespassers exposed to hexavalent chromium in soil have an increased theoretical risk for cancer. This theoretical cancer risk is based on workers being exposed to hexavalent chromium for five days per week for 17 years, and adult trespassers and hunters being exposed two days per week for six months per year for 40 years. In other words, this is a hypothetical risk, and is not a prediction that cancer will occur. This risk should be interpreted with caution because of the small number of soil samples available and because we had to estimate hexavalent chromium concentrations from total chromium concentrations. The theoretical cancer risk for older teenage trespassers (ages 16 to <21 years) exposed to hexavalent chromium was determined to be low and is not a health concern. Noncancer health effects are not expected for site workers and trespassers from exposure to hexavalent chromium based on the comparison of calculated exposure doses to available toxicological information.
Next Steps	NJDOH and ATSDR will review and evaluate additional data as it becomes available as EPA continues to characterize the nature and extent of contamination from the Pioneer site. This might include but is not limited to biota, surface water, and sediment. NJDOH and ATSDR recommend that EPA speciate (separate) hexavalent chromium from total chromium data.
Conclusion 2	Past, current, and future exposures to copper, nickel, cyanide, and polychlorinated biphenyls (PCBs) are not expected to harm the health of site workers or trespassers.
Basis for Conclusion	The calculated exposure doses for copper, nickel, cyanide, and polychlorinated biphenyls (PCBs) were below health guideline values for noncancer health effects. Theoretical cancer risks for PCBs were determined to be low and not a health concern.
For More Information	Copies of this report will be available at the township library and on the NJDOH's website. NJDOH will work with the local health department to notify area residents that this report is available for their review and provide a copy upon request. Questions about this health consultation should be directed to NJDOH at (609) 826-4984.

Statement of Issues

On September 1, 2020, the United States Environmental Protection Agency (EPA) proposed to add the Pioneer Metal Finishing, Inc. (Pioneer) site located in Franklinville, Gloucester County, New Jersey to the National Priorities List (NPL). The site was added to the NPL on September 8, 2021. The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the Superfund Amendments and Reauthorization Act (SARA) of 1986, require that the federal Agency for Toxic Substances and Disease Registry (ATSDR) conduct public health assessment activities for sites listed or proposed to the NPL.

The New Jersey Department of Health (NJDOH) prepared this document under a cooperative agreement with ATSDR. This health consultation evaluates soil, dust, and sediment data collected from the site to assess the potential for human health effects from exposures to site contaminants. The top priority of NJDOH and ATSDR at this site is to ensure that the community around the site has the best information possible to safeguard its health.

This document evaluates exposures to contaminated soil, dust, and sediment on and next to the site based on limited data available at the time of this evaluation. Due to the limited data available, ATSDR recommended that interior dust and exterior sediment data be combined with soil data for the purposes of this evaluation. Therefore, soil and dust data were combined to evaluate exposures inside the building, and soil and sediment data were combined to evaluate exposures outside the building.

The data were collected during the initial EPA removal investigations between August 2018 and September 2019. NJDOH and ATSDR will evaluate additional data as it becomes available as EPA continues to characterize the nature and extent of contamination (remedial investigation) at this site.

EPA began the remedial investigation in July 2022. The remedial investigation phase is projected to be completed in January 2025. This will be followed by a feasibility study to determine the best way to clean up the site to protect public health and the environment. EPA has stated that it will request chromium speciation data for future human health risk assessment, and request that hexavalent and trivalent chromium toxicity values be used for risk estimates.

Background

Site Description and Operational History

The Pioneer Metal Finishing Inc (Pioneer) site is a former electroplating facility located at 2034 Coles Mill Road, Franklinville, Gloucester County, New Jersey (See Appendix A - Figure 1.) As shown in Appendix A - Figure 2, the site building includes the following:

- an office
- a former laboratory
- a storage area
- a former blower exhaust room

- a former plating and current powder coating operations room
- a boiler room
- a holding tank area
- a settling and treatment tank area
- a former wastewater treatment room
- two outdoor storage trailers located immediately northeast of the building

The site is bordered by Coles Mill Road to the north. Residential properties and undeveloped land are located across the street from the site on Coles Mill Road. Undeveloped wetlands and forests surround the rest of the site property. Scotland Run is a stream located to the east and southeast of the property. An area of dead plants, showing the effect of runoff from the site on nearby vegetation, is located immediately to the east and southeast of the site building (See Appendix A – Figure 3).

Notable features along the 15-mile surface water pathway that drains from the site include confined portions of Scotland Run. These include Timothy Lake, Malaga Lake, and Willow Grove Lake, which are used for recreational boating and fishing. Timothy Lake is also used for a summer camp, with a private swimming area on the lake. Delsea Regional High School and Delsea Regional Middle School are located between the site and Timothy Lake (See Appendix A - Figure 4). Approximately eight miles downstream of the site, along the Maurice River, is the Union Lake Wildlife Management Area, which supports a fishery.

Pioneer began operation as an electroplating facility in 1955. It released untreated waste from the facility from that time until the mid- to late-1970s. Wastes reportedly consisted of metallic salts, untreated process sludge, rinse water, cleaning solutions, and plating wastes that were released into an unlined trench leading to an adjacent wetland southeast of the plant.

From the mid- to late-1970s to 1981, the facility treated its effluent before releasing it. A closed loop system was installed in 1981 and the discharge of wastewater stopped. Only non-contact cooling water has been discharged since 1981 under a New Jersey Pollutant Discharge Elimination System (NJPDES) permit. Electroplating activities ended around 2005 and the facility is currently used for powder coating operations. Powder coating is a type of coating that is applied as a free-flowing dry powder. It is typically applied electrostatically and then cured under heat or with ultraviolet light.

Regulatory and Remedial History

In July 2018, the New Jersey Department of Environmental Protection (NJDEP) asked EPA for help addressing contamination at the site. In response, EPA documented conditions at the site and collected samples from eight of approximately 500 containers observed throughout the facility for field characterization testing. This included testing for pH and flammability. Photographs were taken of the containers that were sampled. Information on the container type, size, condition, volume, and location was also collected. The containers sampled were located in several areas of the building. These included the storage area near the entrance to the current powder coating operation area (former plating area), the boiler room, the former wastewater treatment room, and the former laboratory. Field characterization results indicated that

flammables, acids, and corrosive materials were in the containers stored in the facility.

From August 2018 to August 2019, EPA removed more than 100 tons of hazardous waste and cyanide-contaminated debris from the facility, which included approximately 20,000 gallons of liquid waste. The EPA removal action was confined to waste materials from the interior of the Pioneer facility and did not include removal of contaminated soil from around the building or sediment from the adjacent wetland.

Demographics

According to the 2010 U.S. Census, 1,551 people live within 1 mile of the site. The population in this area increased by 10% since the 2000 census. Although the area around the site is not very populated, people use the many downstream surface water bodies for recreation (swimming, fishing, etc.). Therefore, people living more than 1 mile from the site could be exposed to site contaminants that have traveled downstream. (Appendix B provides more detailed demographic information about the people in the area.)

Community Concerns

After the site was proposed to the NPL, the Franklin Township Environmental Commission wanted residents to be aware that the site might pollute private wells and to avoid contact with site contaminants by not trespassing on the site. The Environmental Commission is also concerned about downstream surface water and groundwater effects from the site. NJDOH is available to review additional data collected by EPA as they continue to characterize the extent of contamination at the site.

Environmental Contamination

An evaluation of site-related 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 site-specific exposures. First, maximum concentrations of detected substances are compared with media-specific screening levels called comparison values. If concentrations exceed the media-specific (soil, water) comparison value, these substances are referred to as potential contaminants of concern and are selected for further evaluation. If media-specific comparison values are unavailable, contaminants are selected for further evaluation.

Environmental Guideline Comparison

Various media-specific comparison values are available for screening environmental contaminants to identify contaminants of concern. These include ATSDR's environmental media evaluation guides (EMEGs) and reference media evaluation guides (RMEGs). EMEGs are based on ATSDR's minimal risk levels. EMEGs are estimated contaminant concentrations in water or soil that are not expected to result in adverse noncarcinogenic health effects. RMEGs are based on EPA's reference dose. They represent the concentration in water or soil 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 that would be expected to cause no more than one excess cancer in a million (expressed exponentially as 10^{-6}) persons exposed over their lifetime (78 years).

If an ATSDR media-specific comparison value is not available, other comparison values may be used to evaluate contaminant levels in environmental media. These include the EPA regional screening levels and the NJDEP soil remediation standards.

Building Interior – Soil and Dust

In August 2018, EPA collected three dust samples from within the Pioneer facility. Analytical results of the dust samples showed the presence of the following chemicals:

- chromium (776–13,900 mg/kg),
- hexavalent chromium (0.209 mg/kg [estimated concentration] to 52.7 mg/kg),
- copper (224–8,230 mg/kg), and
- nickel (123–15,700 mg/kg).

In July 2019, three soil samples were collected by EPA from trenches inside the building. EPA notes that for Hazard Ranking System scoring purposes, the contamination beneath the building was likely deposited in a different way than was the soil contamination outside the building. [Weston 2020]. Table 1 describes the contaminants found inside the building in surface soil and indoor dust. As noted in the table, the comparison values used to screen for contaminants of potential concern are for adult exposures. This is because only adult workers occupy the site building. Other comparison values will be used later to screen for contaminants of potential concern for child trespassers (teenagers).

Table 1. Summary of interior surface soil and dust

Contaminant	Number of samples*	Number of detections	Minimum (mg/kg)	Maximum (mg/kg)	Comparison value (mg/kg)†	Contaminant of potential concern
Chromium (total)	6	4	Not detected	23,000	1,200,000 (adult RMEG)	No
Hexavalent chromium	6	4	Not detected	52.7	0.22 (CREG)	**Yes**
Copper	6	6	224	8,230	16,000 (adult EMEG)	No
Nickel	6	5	Not detected	23,000	16,000 (adult RMEG)	**Yes**
Cyanide	3	3	31	171	500 (adult RMEG)	No

Abbreviations: CREG = ATSDR cancer risk evaluation guide; EMEG = ATSDR environmental media evaluation guide; mg/kg = milligram of contaminant per kilogram of soil; RMEG = ATSDR reference media evaluation guide.
*Represents three surface soil samples 0–6 inches below ground surface and three surface dust samples.
†Adult exposure EMEG and RMEG for soil were used for workers exposed to indoor building contaminants, as dust comparison values are not available; total chromium was screened as trivalent (chromium III).

Building Exterior Soil and Sediment

The soil contamination at the Pioneer facility is likely associated with poor housekeeping practices and venting of dust from the interior of the Pioneer facility. In September 1978, EPA observed that Pioneer stored open vats containing nickel waste sludge and other pollutants outside the plant with no controls in place to prevent pollutants from contaminating the surrounding environment.

In March 1980, NJDEP observed that approximately 110 drums of plating sludge were being stored outside in an unpaved, uncontained area east of the building. NJDEP also observed that the metal polishing area was ventilated by a large fan that forced air and dust out to the rear of the building, and that the ground surface behind the plant, to the south, was covered by this dust. The blower exhaust was located near the southwestern corner of the facility building.

In 1984, EPA observed that drums were being stored outside along the southern end of the facility. Analysis of a composite soil sample collected next to the drums indicated the presence of chromium (17,500 mg/kg), copper (440 mg/kg), nickel (1,200 mg/kg), lead (11,300 mg/kg), and zinc (430 mg/kg). In 1986, NJDEP noted that the containment channels under Pioneer's plating tanks had an accumulation of grit and chemical residue.

As part of its removal action in July 2019, EPA collected 42 soil samples from 15 soil borings and five test pits located throughout the Pioneer property. This includes background samples, samples from contaminated areas, and the three soil borings from trenches inside the building mentioned above. Soil sample depths ranged from 0–26 inches below ground surface (bgs). Results in the contaminated areas of the property showed the presence of chromium, copper, nickel, cyanide, hexavalent chromium, and polychlorinated biphenyls (PCBs) at concentrations above background levels (see Appendix A - Figure 5).

In September 2019, EPA collected 45 sediment samples from three clusters within the adjacent wetland. Sample depths ranged from 0–24 inches bgs. Sediment sampling results indicated that chromium, copper, and nickel were reported at concentrations above background levels in samples collected from locations along all three clusters (see Appendix A - Figure 6).

Chromium: The samples collected during EPA's removal action were analyzed for total chromium and speciated for hexavalent chromium (chromium VI). In other words, chromium VI was analyzed separately from total chromium. Chromium (VI) and chromium (III) are used for chrome plating, dyes and pigments, leather tanning, and wood preserving [ATSDR 2012].

What happens to chromium in soil is greatly dependent upon the type of chromium (species). In most soils, the form of chromium most likely to be found is trivalent, referred to as chromium (III). This naturally occurring form has very low solubility and low reactivity, resulting in low mobility in the environment and low toxicity in living organisms [ATSDR 2012].

ATSDR and NJDOH evaluated data for 47 exterior surface soil and sediment samples to determine the potential for public health impacts, as these samples represent exposures to

potential contaminants of concern. Of the 11 exterior surface soil and sediment samples in which total chromium was reported, three soil samples were speciated for hexavalent chromium. Hexavalent chromium results were not reported for any surface sediment samples because the samples did not meet EPA's criteria for an observed release of hexavalent chromium. In other words, the results did not exceed three times the background level.

For the samples where hexavalent chromium was reported, we applied the percent hexavalent chromium in those samples to the remaining samples. Two of the three surface soil samples had hexavalent chromium speciated from total chromium. The percentage of hexavalent chromium to total chromium for these samples was 1.27% and 4.42%. Therefore, we applied the higher percentage of 4.42% to estimate hexavalent chromium concentrations for all surface soil and sediment samples. We applied 0.92% to the test pit samples (see Table 2).

Table 2. Calculated hexavalent chromium based on total chromium (building exterior)

Sample type	Total chromium (mg/kg)	Percent hexavalent to total chromium (%)	Estimated hexavalent chromium (mg/kg)
Sediment - 1	11,395	4.42	504
Sediment - 2	30,930	4.42	1,368
Sediment - 3	1,705	4.42	75
Sediment - 4	425	4.42	19
Sediment - 5	8,372	4.42	370
Sediment - 6	620	4.42	27
Surface soil - 1*	1,450	4.42	64
Surface soil - 2	470	4.42	21
Surface soil - 3*	312	4.42	14
Test pit - 1*	9,100	0.92	84
Test pit - 2	242	0.92	2

Abbreviation: mg/kg = milligrams of contaminant per kilogram of soil.
*These samples had hexavalent chromium and total chromium data, which were used to calculate the percent hexavalent chromium concentration that was applied to the remaining samples; samples represent surface soil 0–6 inches below ground surface (bgs), except test pit-1, which is 1–8 inches bgs. Example calculation: 11,395 mg/kg x 4.42/100 = 504 mg/kg.

Table 3 summarizes the exterior surface soil and sediment data collected during EPA's removal action in 2019 which were used in our evaluation. The additional samples collected by EPA were collected at deeper depths. These samples were not included in this table because these samples do not represent exposures. These data were screened using ATSDR's recommended comparison value. As noted in Table 1, the adult EMEG for copper is 16,000 mg/kg, and therefore is not a contaminant of potential concern for adults. Therefore, copper is not evaluated further for adult scenarios in this evaluation. As noted in Table 3, the child EMEG for copper is the applicable comparison value for the building exterior because child trespassers are being included as a potentially exposed population.

Table 3. Building exterior – surface soil and sediment

Contaminant	Number of samples *	Number of detections	Minimum (mg/kg)	Maximum (mg/kg)	Comparison value for soil (mg/kg)	Contaminant of potential concern
Chromium (total)†	11	11	242	30,930	78,000 (child RMEG)	No
Hexavalent chromium‡	11	11	2.2	1,368	0.22 (CREG)	**Yes**
Copper	18	18	161	9,120	1,000 (child EMEG)	**Yes**
Nickel	10	10	339	6,680	1,000 (child RMEG)	**Yes**
Cyanide	4	4	2.3	36.5	33 (child RMEG)	**Yes**
PCBs (Aroclor 1260)	1	1	1.3	1.3	0.19 (CREG)	**Yes**

Abbreviations: CREG = cancer risk evaluation guide; EMEG = environmental media evaluation guide; mg/kg = milligram of contaminant per kilogram of soil; PCBs = polychlorinated biphenyls; RMEG = reference media evaluation guide.
*Represents surface soil or sediment samples 0–6 inches below ground surface (bgs) with the exception of one test pit sample representing 1–8 inches bgs.
†Total chromium was screened as trivalent (chromium III).
‡Hexavalent chromium was calculated for eight samples based on three samples that had hexavalent chromium speciated from total chromium.

Discussion

The method for assessing whether a health hazard exists for a community is to determine whether there is a completed exposure pathway from a contaminant source to an exposed population and whether exposures to contamination are high enough to be of health concern [ATSDR 2022]. Site-specific exposure doses can be calculated and compared with health guidelines, such as ATSDR's minimal risk level (MRL). If site doses exceed the health guideline, those doses can be compared with levels determined to cause harmful effects in animal and human studies.

Assessment Methodology – Identifying Exposure Pathways

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

1. Source of contamination;
2. Environmental media and transport mechanisms;
3. Point of exposure;
4. Route of exposure; and
5. Receptor population.

Generally, the ATSDR considers three exposure pathway categories:

1. Completed exposure pathways — all five elements of a pathway are present;
2. Potential exposure pathways — one or more of the elements might not be present, but information is insufficient to eliminate or exclude the element; and
3. Eliminated exposure pathways — one or more of the elements will always be absent.

Exposure pathways are used to evaluate specific ways in which people were, are, or will be exposed to environmental contamination in the past, present, and future (See Table 4).

Table 4. Exposure pathways at the Pioneer site

Pathway	Environmental medium	Exposure route	Exposure point	Exposed population	Pathway classification
Surface soil/Wetland sediment	Building exterior soil and sediment	Ingestion/Skin contact	Site property; adjacent wetland	Site worker/Trespasser	Past, current, future – complete*
Surface Soil/Interior Dust	Building interior soil and dust	Ingestion/Skin contact	Site property	Site worker	Past, current, future – complete*
Subsurface soil	Soil	Ingestion/Skin contact	Site property	Site worker / Trespasser	Past, current – eliminated Future – potential
Surface water / Sediment	Water/Sediment	Ingestion/Skin contact	Off-site surface water bodies	Recreational swimmer	Potential
Biota	Biota (fish, shellfish, etc.)	Ingestion	Off-site surface water bodies	Recreational fisherman	Potential
Groundwater	Water	Ingestion/Skin contact/Inhalation	Future homes / Commercial buildings if site use changes	Future residents/Workers if site use changes	Potential

* Site workers might be exposed during time spent outside the building (eating, smoking, etc.) and past exposures to interior soil and dust. According to EPA, school students trespassing by cutting through the property to get to nearby schools is not likely. The trespasser scenario (older teenagers and adults) will be included due to community interest and evidence of "garbage picking" for copper. Trespassers also include hunters, who have been noted to use the area near the Pioneer facility.

Completed Exposure Pathways

- *Ingestion of and skin contact with contaminated surface soil and wetland sediment (past, current, and future)* - There is a completed exposure pathway for site workers and adult/teenaged trespassers (including hunters) accessing the site and being exposed to contaminated soil and wetland sediment.
- *Ingestion of and skin contact with contaminated surface soil and dust inside the site building (past, current, and future)* - There is a completed exposure pathway for site workers being exposed to contaminated surface soil and dust while working inside the building.

Eliminated Exposure Pathways

- *Ingestion of and skin contact with contaminated subsurface soil (past and current)* - Ingestion exposure to subsurface soil is eliminated due to the nature of the business at this site. Workers are not likely to contact subsurface soil because soil disturbance is unlikely. This pathway is eliminated for past and current exposures to site workers. If land use changes in the future, the subsurface soil exposure pathway will be evaluated.

Potential Exposure Pathways

- *Ingestion of and skin contact with contaminated sub-surface soil (future residential / commercial if property is re-developed)* - If the site were to be developed into residential or commercial properties where future residents and/or workers might contact contaminated soil, these populations might be exposed to previously subsurface soil and sediment contaminants.

- *Ingestion of and skin contact with contaminated surface water and sediment (past, present, future)* - There is a potential for people swimming in downstream surface water to be exposed to contaminants from the site. Surface water data are not available to evaluate this potential pathway. NJDOH and ATSDR will evaluate such data when they become available as EPA continues to characterize the nature and extent of contamination from this site.

- *Ingestion of biota (fish) from downstream surface water (past, current, future)* - There is a potential for people who fish in the downstream lakes to be exposed to site contaminants, particularly PCBs, that might be present in fish consumed from these surface water bodies. Biota data are not available to evaluate this pathway. NJDOH and ATSDR will evaluate any available biota data as EPA continues to characterize the nature and extent of contamination from the site.

- *Ingestion, inhalation, and skin contact with contaminated groundwater (future)* - If the site use changes, future residents and/or workers could be exposed to contaminated groundwater through private drinking water wells.

Public Health Implications of Completed Exposure Pathways

After it has been determined that people have or are likely to have contact with site-related contaminants (a completed exposure pathway), the next step in the public health assessment process is to calculate site-specific exposure doses for contaminants that exceed comparison values. If site-specific doses exceed a health guideline, we will conduct a more thorough toxicological evaluation to determine if residents are at risk of harmful effects.

Health guideline values are based on data from the epidemiologic and toxicologic studies. Those values often include uncertainty or safety factors to ensure that they are amply protective of human health. Noncancerous effects are not expected when doses are below health guidelines

such as ATSDR's MRL.

Determining the Exposure Concentration for Potential Contaminants of Concern

When estimating exposure to a potential contaminant of concern, ATSDR recommends using the 95 percent upper confidence limit (95% UCL) of the arithmetic mean when data are sufficient to determine the exposure point concentrations (EPC) for site-related contaminants [ATSDR 2019]. The 95% UCL is considered a "conservative estimate" of average contaminant concentrations in an environmental medium.

EPCs were calculated for the following potential contaminants of concern: hexavalent chromium, copper, nickel, cyanide, and PCBs (Aroclor 1260). Using ATSDR guidance [ATSDR 2019], the 95% UCL was used for soil contaminants with eight or more samples and for samples with 20% or more detections. Maximum concentrations were used as the EPCs for contaminants with seven or fewer samples or less than 20% of detections. Duplicate samples were averaged and counted as one sample. The maximum estimated concentration from Table 2 was used as the EPC for hexavalent chromium. This is because the calculated EPC using the data from Table 2 was higher than this maximum concentration.

Noncancer Health Effects

To assess noncancer health effects, ATSDR has developed MRLs for contaminants that are commonly found at hazardous waste sites. An MRL is an estimate of the daily human exposure to a hazardous substance that is not likely to have an appreciable risk of adverse, noncancer health effects. MRLs are developed for a route of exposure, such as swallowing or breathing, over a specified period. Exposure periods are classified by duration, as follows:

- Acute (less than 14 days)
- Intermediate (15–364 days)
- Chronic (365 days or more)

MRLs are based largely on toxicological studies in animals and sometimes on reports of human occupational (workplace) exposures. MRLs are usually doses estimated (extrapolated) from observed effect levels in animal toxicological studies or occupational studies. MRLs are adjusted by a series of uncertainty (or safety) factors or through the use of statistical models. In toxicological literature, effect levels are categorized as

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

A NOAEL is the highest tested dose of a substance that has been reported to have no harmful health effects on people or animals. A LOAEL is the lowest tested dose of a substance that has been reported to cause harmful health effects in people or animals. Using current ATSDR guidance, calculated exposure doses are compared to effect levels (LOAEL) rather than no effect levels (NOAEL). As the exposure dose increases beyond the MRL to the level of the

LOAEL, the likelihood of adverse health effects increases. 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.

To ensure that MRLs are sufficiently protective, the extrapolated MRLs can be several hundred times lower than the observed effect levels in experimental studies. When MRLs for specific contaminants are unavailable, other health guidelines, such as the EPA reference dose (RfD), are used. The RfD is an estimate of a daily oral exposure to the human population (including sensitive subgroups) that is likely to not have an appreciable risk of harmful effects during a lifetime.

Site Soil and Sediment Ingestion and Skin Contact – Site Workers and Trespassers

Assessments of exposures to site workers and trespassers are based on the incidental ingestion of contaminated surface soil for adult workers and teenage trespassers ages 16 years and older. Adult trespassers were also considered as an exposed population. Noncancer exposure doses were calculated using the following formula:

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

Where,

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

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

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

A hazard quotient above 1.0 means that the health guideline is exceeded. Contaminants of concern with a hazard quotient exceeding a value of one were evaluated further to determine whether these contaminants pose a health threat to exposed or potentially exposed populations.

Exposure doses were calculated for three soil ingestion scenarios using the ATSDR Public Health Assessment Tool (PHAST). Dermal exposure doses were also calculated using PHAST and added to the ingestion doses to create a combined dose from oral and dermal exposures. The dermal dose was minimal compared to the ingestion exposure pathway. Dermal exposures doses were calculated using the following formula:

$$\textit{Dermal Absorbed Dose (mg/kg/day)} = \frac{C \times AF \times EF \times CF \times ABS_d \times SA}{BW \times ABS_{GI}}$$

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 (unitless),
CF = conversion factor (10^{-6} kg/mg),
ABS_d = dermal absorption fraction to skin (unitless),
SA = skin surface area available for contact (cm^2),
BW = body weight (kg), and
ABS_{GI} = gastrointestinal absorption factor (unitless).

Exposure Dose Assumptions for Site Workers and Trespassers

ATSDR's exposure dose guidance for soil and sediment ingestion was used to calculate exposure doses for site workers and adult and teenage trespassers older than 16 years accidentally swallowing contaminated soil on the site [ATSDR 2018]. Exposure doses were calculated using the ATSDR Public Health Assessment Tool (PHAST).

For people with typical, or average soil ingestion rates, NJDOH used a "central tendency exposure" (CTE) scenario. For people with above average ingestion rates, a "reasonable maximum exposure" (RME) scenario was used. The RME refers to people with above average exposures but still within a realistic exposure range. Exposure doses for site workers uses an "indoor worker" scenario and an outdoor "low soil contact" scenario.

For CTE and RME scenarios, the age range for children who might trespass on the site is considered to be 16 years to less than 21 years. Younger children are not expected to trespass because of the features and location of the property. The adult scenario for site workers and trespassers is for people 21 years of age and older. According to EPA, hunters have been noted to use the area near the site. Therefore, the trespasser scenario includes hunters who might hunt from age 21 years through age 61 years (40 years). Table 5 shows the exposure parameters and assumptions used to calculate exposure doses for both scenarios.

Table 5. Exposure parameters and assumptions used in dose calculations

Exposed population	Soil ingestion rate (mg/day)	Body weight (kg)	Exposure frequency
Teenage trespasser (ages 16 to <21 years)	30 (CTE); 100 (RME)	71.6	Two days/week, 25 weeks/year for five years
Adult trespasser (≥21 years)	30 (CTE); 100 (RME)	80	Two days/week, 25 weeks/year for 40 years*

Exposed population	Soil ingestion rate (mg/day)	Body weight (kg)	Exposure frequency
Adult site worker (indoor)	30	80	250 days/year for 17 years†
Adult site worker (outdoor – low intensity soil contact)	100	80	250 days/year for 17 years†

Abbreviations: CTE = central tendency exposure; kg = kilograms; mg/day = milligrams of soil ingested per day; RME = reasonable maximum exposure.
*Trespassers include hunters, who have been noted to use the area near the Pioneer facility. NJDOH is conservatively assuming a person would hunt from age 21 years through age 61 years, for a duration of 40 years.
†Electroplating activities stopped in 2005; therefore, a 17-year duration was used for current site workers (2005–2022).

Exposure Dose Calculations - Soil and Sediment Ingestion and Skin Contact – Site Workers

Exposure doses (ingestion and skin contact) were calculated for site workers using two scenarios as described in Table 5 above. The first scenario is for workers inside the building (See Table 6). The second scenario is for those same workers who might spend time outdoors (See Table 7). Workers on the site might spend time outdoors smoking or eating and therefore would be considered to have "low intensity soil contact" with contaminants. These calculated exposure doses were then added together to obtain a total exposure dose and total hazard quotient for each contaminant to determine the likelihood for adverse noncancer health effects for site workers (See Table 8).

Nickel was only a contaminant of concern inside the building. PCBs were only found in one surface soil sample and were a contaminant of concern only outside the building. Hexavalent chromium was a contaminant of concern inside and outside the building. Nickel and cyanide detected outside the building were below comparison values for adult workers and therefore are not included in the outdoor worker scenario in Table 7.

Table 6. Exposure dose calculations and hazard quotients – indoor workers

Contaminant	EPC (mg/kg)*	Exposure dose (mg/kg/day)	Health guideline value (mg/kg/day)	Hazard quotient†	Potential for noncancer health effects
Hexavalent chromium	52.7	0.000057	0.0009 (MRL)	0.06	No
Nickel	23,000	0.018	0.02 (RfD)	0.89	No

Abbreviations: EPC = exposure point concentration; mg/kg = milligrams of contaminant per kilogram body weight; MRL = ATSDR chronic minimal risk level; RfD = EPA reference dose.
*EPC represents maximum concentration of interior surface soil and dust detected inside the building. Surface soil represents depth of 0-6 inches below ground surface.
†Hazard quotient = exposure dose/health guideline value.

Table 7. Exposure dose calculations and hazard quotients – outdoor workers

Contaminant	EPC (mg/kg)*	Exposure dose (mg/kg/day)	Health guideline value (mg/kg/day)	Hazard quotient†	Further health evaluation needed
Hexavalent chromium	1,368	0.0023	0.0009 (MRL)	**2.5**	**Yes**
PCBs (Aroclor 1260)‡	1.3	0.0000015	0.00002 (RfD)	0.08	No

Abbreviations: EPC = exposure point concentration; mg/kg = milligrams of contaminant per kilogram body weight; MRL = ATSDR chronic minimal risk level; RfD = EPA reference dose.

*EPC represents the maximum concentration of exterior surface soil and sediment outside the building. Soil and sediment data represent a depth of 0-6 inches below ground surface (bgs), except for one test pit soil sample collected at 1–8 inches bgs.

†Hazard quotient = exposure dose/health guideline value.

‡Aroclor 1260 does not have an MRL, therefore, the EPA RfD for Aroclor 1254 was used. Aroclor 1260 was the only polychlorinated biphenyl found in surface soil and it was only detected in one sample.

Table 8. Site workers – total noncancer health effects – indoors and outdoors

Contaminant	Hazard quotient (indoor workers)	Hazard quotient (outdoor workers)	Total hazard quotient	Further health evaluation needed
Hexavalent chromium	0.06	2.5	**2.6**	**Yes**
Nickel	0.89	NA	0.89	No
PCBs (Aroclor 1260)*	NA	0.08	0.08	No

Abbreviations: NA = not applicable; PCBs = polychlorinated biphenyls.

*Aroclor 1260 does not have a minimum risk level (MRL), therefore, the EPA reference dose (RfD) for Aroclor 1254 was used. Aroclor 1260 was the only PCB found in surface soil. It was only detected in one sample.

Hexavalent chromium has an elevated hazard quotient for combined worker exposures. The combined exposure dose for site workers is 0.0024 mg/kg/day (total dose from indoor and outdoor worker exposures). The study used to derive the oral chronic MRL for hexavalent chromium used four groups of 50 male and 50 female mice that were exposed to sodium dichromate dihydrate in drinking water for two years, with estimated doses of hexavalent chromium between 0 to 5.9 mg/kg/day.

The lowest LOAEL identified in this study was 0.38 mg/kg/day of hexavalent chromium in female mice. Benchmark dose modeling yielded a $BMDL_{10}$ of 0.09 mg/kg/day. A benchmark dose model is a statistical dose-response model applied to experimental toxicological or epidemiological data to calculate a benchmark dose. A benchmark dose level 10 ($BMDL_{10}$) is the dose at the 95% lower confidence limit on a 10% response for the observed harmful health effect. The observed harmful effect was diffuse epithelial hyperplasia of the duodenum (gastrointestinal effects). This benchmark dose was divided by a safety factor of 100 to account for the extrapolation from animals to humans and for human variability to get the MRL of 0.0009 mg/kg/day.

The maximum hexavalent chromium concentration was used to calculate both the indoor and outdoor worker exposure dose. The calculated total exposure dose for workers exposed to hexavalent chromium in site surface soil, sediment and indoor dust was approximately 38 times lower than the benchmark dose level calculated to result in a small risk of gastrointestinal effects. **Therefore, adverse noncancer health effects are not expected because the estimated dose in**

workers with low soil and dust intake is well below harmful levels. The hexavalent chromium data for soil and sediment outside the building is limited because of the small number of samples. In addition, we assumed that all the chromium was hexavalent chromium because speciated chromium data was limited. Additional outdoor soil samples with hexavalent chromium speciation data are needed to more accurately characterize the risk for site workers.

Exposure Dose Calculations - Soil and Sediment Ingestion and Skin Contact – Trespassers

Exposure doses (ingestion and skin contact) were calculated for teenage and adult trespassers using the parameters from Table 5 above. For simplicity, only the RME dose (based on above average ingestion rates) is presented in Tables 9 and 10, as this represents the most conservative scenario.

As shown in Tables 9 and 10, the calculated hazard quotients for all contaminants of concern except for hexavalent chromium were below one. Hexavalent chromium has an elevated hazard quotient for teenage trespassers. The same approach used to evaluate the potential for noncancer health effects for site workers was used for teenage trespassers. As discussed above for the site workers, the $BMDL_{10}$ of 0.09 mg/kg/day was compared to the calculated exposure dose of 0.0015 mg/kg/day for teenage trespassers. The calculated exposure dose for teenage trespassers is based on the maximum hexavalent chromium concentration, which is a conservative estimate of exposure. This calculated dose is approximately 60 times lower than the $BMDL_{10}$ which resulted in a small risk of gastrointestinal effects. **Therefore, harmful noncancer health effects are not expected for children and adults who might trespass on the site.**

Table 9. Dose calculations and hazard quotients – teenage trespassers (ages 16 to < 21 years)

Contaminant	EPC (mg/kg)	RME exposure dose (mg/kg/day)	Health guideline value (mg/kg/day)	Hazard quotient*	Potential for noncancer health effects
Copper†	4,691‡	0.0011	0.02 (MRL)	0.06	No
Nickel	4,703‡	0.0036	0.02 (RfD)	0.18	No
Hexavalent chromium	1,368§	0.0015	0.0009 (MRL)	1.7	**Yes**
Cyanide	36.5§	0.0000078	0.00063 (RfD)	0.01	No
PCBs (Aroclor 1260)¶	1.3§	0.0000007	0.00002 (RfD)	0.03	No

Abbreviations: EPC = exposure point concentration; mg/kg = milligrams of chemical per kilogram of soil; MRL = ATSDR minimal risk level, RfD = EPA reference dose; RME = reasonable maximum exposure.

*Hazard quotient = exposure dose/health guideline value.

†Copper does not have a chronic MRL, so the provisional intermediate MRL was used.

‡EPC represents 95% upper confidence limit of the mean of exterior surface soil and sediment. Soil and sediment data represents depth of 0–6 inches below ground surface (bgs) except for one test pit soil sample collected at 1–8 inches bgs.

§EPC represents the maximum concentration of exterior surface soil and sediment.

¶Aroclor 1260 does not have an MRL; therefore, the EPA RfD for Aroclor 1254 was used. Aroclor 1260 was the only polychlorinated biphenyl found in surface soil and it was only detected in one sample.

Table 10. Dose calculations and hazard quotients – adult trespassers (ages 21 years and older)

Contaminant	EPC (mg/kg)	RME exposure dose (mg/kg/day)	Health guideline value (mg/kg/day)	Hazard quotient*	Potential for noncancer health effects
Hexavalent chromium	1,368§	0.0007	0.0009 (MRL)	0.79	No
PCBs (Aroclor 1260)‡	1.3§	0.00000038	0.00002 (RfD)	0.02	No

Abbreviations: EPC = exposure point concentration; mg/kg = milligrams of chemical per kilogram of soil; mg/kg/day = milligrams of contaminant per kilogram body weight per day; MRL = ATSDR minimal risk level, RfD = EPA reference dose. RME = reasonable maximum exposure.

§EPC represents the maximum concentration of exterior surface soil and sediment. Soil and sediment data represents depth of 0–6 inches below ground surface.

*Hazard quotient = exposure dose/health guideline value.

‡Aroclor 1260 does not have an MRL, therefore, the EPA RfD for Aroclor 1254 was used. Aroclor 1260 was the only polychlorinated biphenyl found in surface soil and it was only detected in one sample.

The PHAST spreadsheets showing the calculated hazard quotients and exposure parameters can be found in Appendix C.

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 1,000,000 people are exposed to a cancer-causing substance at a certain level for a certain period of time, then one cancer above the background number of cancers might develop in those 1 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 might develop cancer instead of the expected 460,000 over the course of their lifetime (78 years). Note that this 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. This theoretical cancer risk is not a prediction that cancer will occur.

NJDOH considers estimated cancer risks of less than one additional cancer case among 1 million (1,000,000) persons exposed as an unlikely increased cancer risk (expressed exponentially as less than 10^{-6}). ATSDR's comparison values, which are used to screen contaminants for further evaluation, are typically developed for carcinogens based on one excess cancer case per 1 million persons exposed. Because they exceeded the cancer CV, hexavalent

chromium and PCBs were selected for further evaluation to assess the cancer risk from contact with soil. As noted previously, PCBs were only found in one surface soil sample.

Cancer Classification for Contaminants of Concern

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

- Known human carcinogen
- Reasonably anticipated to be a carcinogen
- Not classified

Polychlorinated biphenyls (PCBs): The U.S. Department of Health and Human Services has concluded that PCBs might reasonably be anticipated to be carcinogens. EPA and the International Agency for Research on Cancer have determined that PCBs are probably carcinogenic to humans.

Hexavalent chromium: The U.S. Department of Health and Human Services, the International Agency for Research on Cancer, and EPA have determined that hexavalent chromium compounds are known human carcinogens. In workers, inhalation of hexavalent chromium has been shown to cause lung cancer. Hexavalent chromium also causes lung cancer in animals. An increase in stomach tumors was observed in humans and animals exposed to hexavalent chromium in drinking water.

LECRs were calculated for PCBs and hexavalent chromium. Cancer exposure doses were calculated using the following formula:

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

Where,

mg/kg/day = milligrams of contaminant per kilogram of body weight per day,
C = exposure point concentration of contaminant in soil (mg/kg),
IR = soil ingestion rate (mg/day),
EF = exposure factor representing the site-specific exposure scenario,
CF = conversion factor (10^{-6} kg/mg),
ED = exposure duration (scenario specific),
AT = averaging time of 78 years, and
BW = body weight (kg).

The site-specific assumptions and exposure factors used to calculate the LECR are the same as those used to assess noncancer health effects. The LECR was calculated by multiplying the cancer exposure dose by EPA's cancer slope factor (CSF). The CSF 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, shown as $(mg/kg/day)^{-1}$. The CSF is used to estimate the risk of cancer associated with exposure to a substance known or suspected to cause cancer. LECRs for soil exposures were calculated using the cancer calculator in ATSDR's PHAST and the following formula [EPA 2009]:

LECR = Cancer Exposure Dose x CSF

where,

CSF = cancer slope factor $(mg/kg/day)^{-1}$

Cancer Risk – Site Workers

Table 11 summarizes the total LECR for site workers as approximately three extra cancer cases for every 10,000 similarly exposed workers. Workers were assumed to be exposed for 17 years to hexavalent chromium and PCBs in soil. **This is considered to be an increase in theoretical cancer risk and is a health concern.** This risk is driven by the estimated hexavalent chromium concentration.

There is uncertainty with this conclusion for several reasons. The site has a small number of soil samples, so we estimated the hexavalent chromium concentrations from total chromium concentrations. Therefore, it is uncertain whether the cancer risk estimates are overestimated or underestimated. Additional soil samples are needed that provide hexavalent chromium speciation data to more accurately characterize this theoretical cancer risk.

Table 11. Total cancer risk – site workers (indoor and outdoor exposures)

Contaminant	Total EPC* (mg/kg)	Total RME dose† (mg/kg/day)	Exposure duration (years)	CSF $(mg/kg/day)^{-1}$	Total LECR
Hexavalent chromium	1,421	0.0024	17	0.5	3×10^{-4}
PCBs (Aroclor 1260)‡	1.3	0.0000015	17	2	7×10^{-7}
Total worker LECR	—	—	—	—	**3×10^{-4}§**

Abbreviations: EPC = exposure point concentration; CSF = cancer slope factor; LECR = lifetime excess cancer risk; mg/kg = milligrams per kilogram; PCBs = polychlorinated biphenyls; RME = reasonable maximum exposure.
*Total EPC represents sum of EPCs for indoor and outdoor workers.
†Total RME dose represents sum of doses for indoor and outdoor workers.
‡PCBs were found in one outdoor surface soil sample.
§Rounded to one significant figure.

Cancer Risk – Teenage and Adult Trespassers

Table 12 summarizes the total LECR for teenaged trespassers. The total LECR for teenage trespassers is approximately five extra cancer cases in 100,000 similarly exposed persons. Teenagers were assumed to go onto the property two days per week, 25 weeks per year, for five years. This represents a low theoretical cancer risk and is not a health concern.

As shown in Table 13, the total LECR for adult trespassers (hunters) is approximately two extra cancer cases in 10,000 similarly exposed persons. Adults (hunters) were assumed to go onto the property two days per week, 25 weeks per year, for 40 years. **This represents an increased theoretical cancer risk and is a health concern.**

As with site workers discussed above, the LECRs for trespassers are based upon exposures to hexavalent chromium. **Therefore, these risks should be interpreted with caution due to the lack of chromium speciation data available at the time of this evaluation.**

Table 12. Cancer risk — teenage trespassers (ages 16 to <21 years)

Contaminant	EPC (mg/kg)	RME dose (mg/kg/day)	Exposure duration (years)	CSF $(mg/kg/day)^{-1}$	LECR
Hexavalent chromium	1,368	0.0015	5	0.5	5×10^{-5}
PCBs (Aroclor 1260)*	1.3	0.0000007	5	2	9×10^{-8}
Total LECR	—	—	—	—	**5×10^{-5}†**

Abbreviations: CSF = cancer slope factor; EPC = exposure point concentration; LECR = lifetime excess cancer risk; mg/kg = milligrams of contaminant per kilogram of soil; PCBs = polychlorinated biphenyls; RME = reasonable maximum exposure.
*PCBs were found in one outdoor surface soil sample.
†Rounded to one significant figure.

Table 13. Cancer risk – adult trespassers (ages 21 years and older)

Contaminant	EPC (mg/kg)	RME dose (mg/kg/day)	Exposure duration (years)	CSF $(mg/kg/day)^{-1}$	LECR
Hexavalent chromium	1,368	0.0007	40	0.5	2×10^{-4}
PCBs (Aroclor 1260)*	1.3	0.00000038	40	2	4×10^{-7}
Total LECR	—	—	—	—	**2×10^{-4}†**

Abbreviations: CSF = cancer slope factor; EPC = exposure point concentration; LECR = lifetime excess cancer risk; mg/kg = milligrams of contaminant per kilogram of soil; PCBs = polychlorinated biphenyls; RME = reasonable maximum exposure.
*PCBs were found in one outdoor surface soil sample.
†Rounded to one significant figure.

The PHAST spreadsheets showing the calculated LECRs and exposure parameters can be found in Appendix C.

Conclusions

NJDOH and ATSDR have reached the following conclusions regarding the Pioneer site:

1. **Past, current, and future exposures to hexavalent chromium is a health concern for site workers and adult trespassers ages 21 years and older**. Results from the limited soil samples available indicate that site workers and adult trespassers exposed to hexavalent chromium in soil have an increased theoretical risk for cancer. This theoretical cancer risk is based on workers being exposed to hexavalent chromium for five days per week for 17 years, and adult trespassers and hunters being exposed two days per week for 6 months per year for 40 years. In other words, this is a hypothetical risk, and is not a prediction that cancer will occur. **This risk should be interpreted with caution because of the small number of soil samples available and because we had to estimate hexavalent chromium concentrations from total chromium concentrations.** The theoretical cancer risk for older teenage trespassers (ages 16 to <21 years) exposed to hexavalent chromium was determined to be low and is not a health concern. Noncancer health effects are not expected for site workers and trespassers from exposure to hexavalent chromium based on the comparison of calculated exposure doses to available toxicological information.

2. **Past, current, and future exposures to copper, nickel, cyanide, and PCBs are not expected to harm the health of site workers or trespassers**. The calculated exposure doses for copper, nickel, cyanide, and PCBs were below health guideline values for noncancer health effects. Theoretical cancer risks for PCBs were determined to be low and not a health concern.

Conclusion Limitations

The conclusions listed above are based on the limited data available at the time of this evaluation and should be interpreted with caution. Of the 11 surface soil, sediment, and dust samples reporting total chromium, three met the observed release criteria and were speciated for hexavalent chromium. For the three samples where hexavalent chromium was reported, we applied the percent hexavalent chromium in those samples to the remaining samples. Therefore, uncertainty exists in the calculated concentration of hexavalent chromium used to determine the risk to site workers and trespassers. In addition, the theoretical cancer risk for PCBs is based on one outdoor surface soil sample.

NJDOH and ATSDR are aware that additional data will be collected to further characterize the contamination at this site. NJDOH and ATSDR will evaluate additional data as it becomes available.

Recommendations

1. NJDOH and ATSDR recommend that EPA collect additional data to characterize the nature and extent of contamination from the Pioneer site. This may include but is not limited to results from biota, surface water, and sediment.

2. NJDOH and ATSDR recommend that EPA speciate hexavalent chromium from total chromium data whenever soil or other media are sampled.

Public Health Action Plan

The purpose of a Public Health Action Plan is to ensure that this public health assessment not only identifies public health hazards, but also provides a plan of action designed to lessen and prevent adverse human health effects resulting from exposure to hazardous substances in the environment. Included is a commitment on the part of NJDOH to follow-up on this plan to ensure that it is implemented. The public health actions to be implemented by NJDOH are as follows:

Public Health Actions Taken

NJDOH and ATSDR have used available information to prepare this health consultation, which evaluates the potential public health implications from exposures to site contaminants.

Public Health Actions Planned

1. NJDOH and ATSDR will evaluate additional data as it becomes available.

2. NJDOH and ATSDR will prepare additional documents as needed to evaluate the public health implications of exposures to site-related contaminants.

3. NJDOH and ATSDR will work with the local health department and EPA to notify the site workers and the community about this document and schedule a public meeting to discuss the findings if necessary.

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Report Preparation

The New Jersey Department of Health (NJDOH) prepared this health consultation for the Pioneer Metal Finishing Site, located in Franklinville, Gloucester County, New Jersey. This publication was made possible by a cooperative agreement (program #CDC-RFA-TS23-0001) with the federal Agency for Toxic Substances and Disease Registry (ATSDR). NJDOH evaluated data of known quality using approved methods, policies, and procedures available at the date of publication. ATSDR reviewed this document and agrees with its findings based on the information presented by NJDOH.

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Appendices

Appendix A - Figures

Figure 1. Pioneer Metal Finishing Inc. site location in Gloucester County, New Jersey (Source: NJDOH)

Figure 2. Pioneer Metal Finishing site building

Source: Weston Solutions, Inc. 2018. Removal assessment report: Pioneer Metal Finishing site, Franklinville, Gloucester County, New Jersey. Edison, NJ: Weston Solutions; August 2018. Available from: semspub.epa.gov/work/02/500783.pdf

Figure 3. Pioneer Metal Finishing site property boundary
Source: Weston Solutions, Inc. 2018. Removal assessment report: Pioneer Metal Finishing site, Franklinville, Gloucester County, New Jersey. Edison, NJ: Weston Solutions; August 2018. Available from: semspub.epa.gov/work/02/500783.pdf

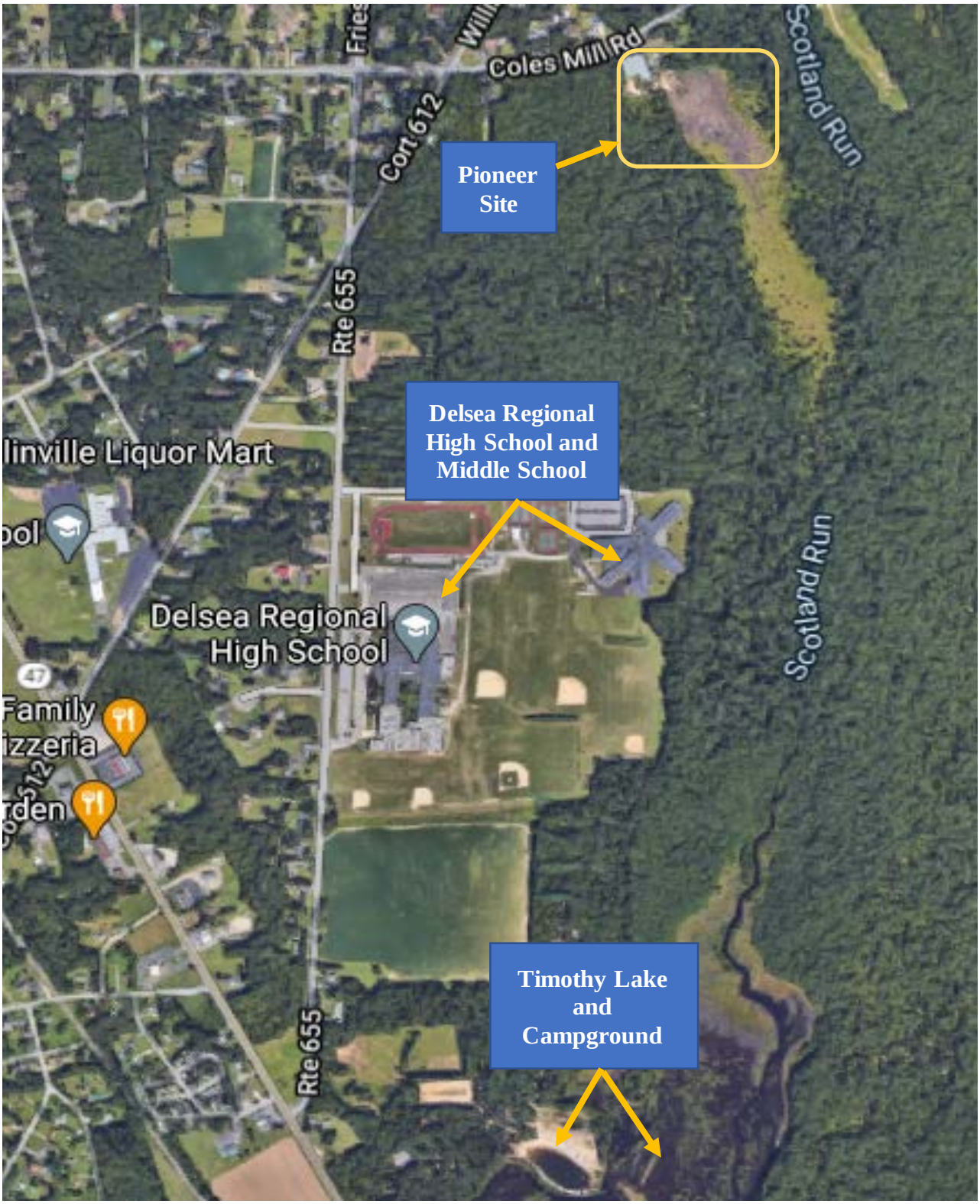


Figure 4. Area downstream of Pioneer Metal Finishing site (Source: Google Maps)

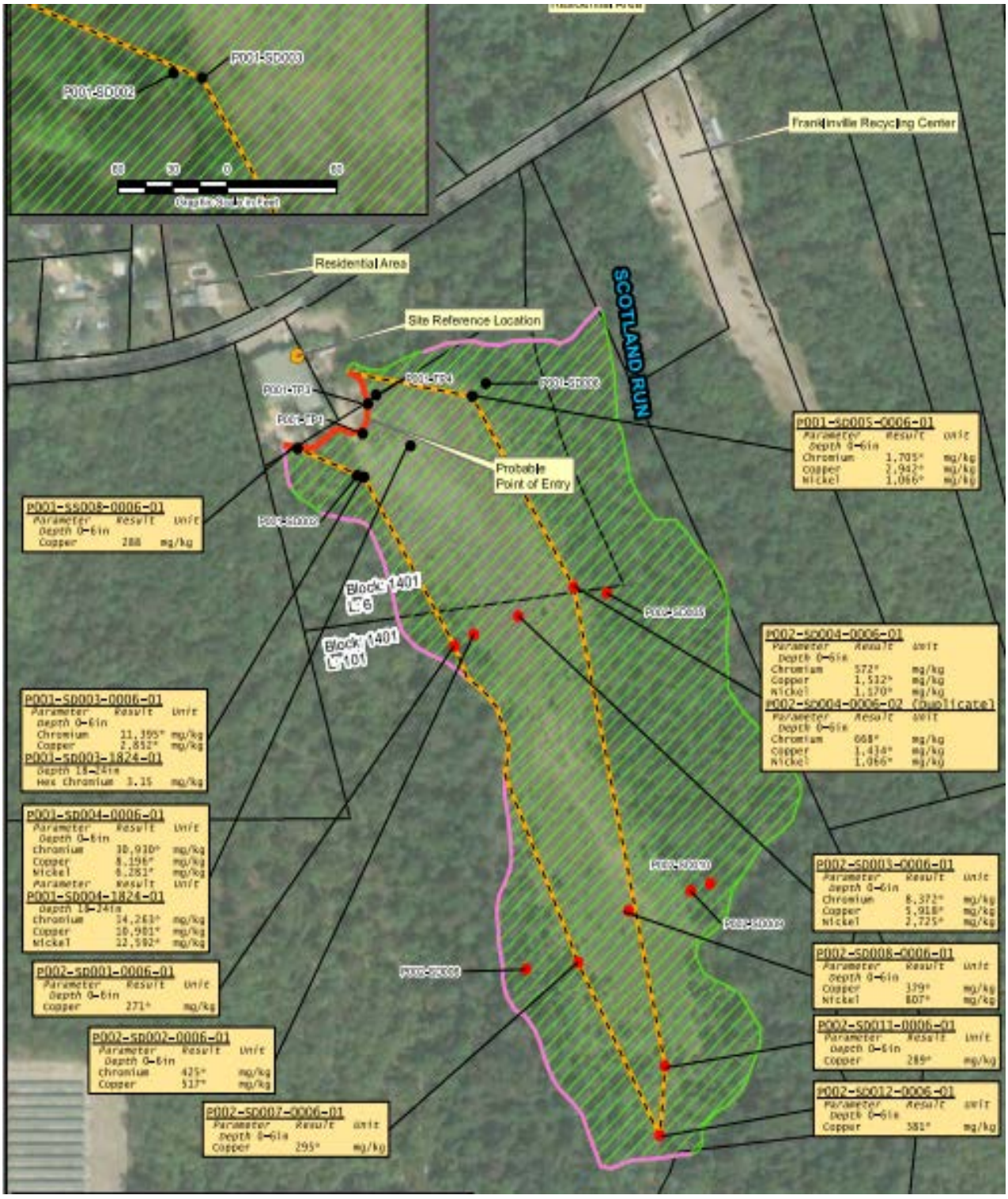


Figure 5. Soil sample locations – Pioneer Metal Finishing site
Source**:** Weston Solutions. 2020. Hazard Ranking System (HRS) Package. Pioneer Metal Finishing Inc., Franklinville, Gloucester County, New Jersey. Washington, DC: Environmental Protection Agency; September 2020. Available from: semspub.epa.gov/work/HQ/400002.pdf

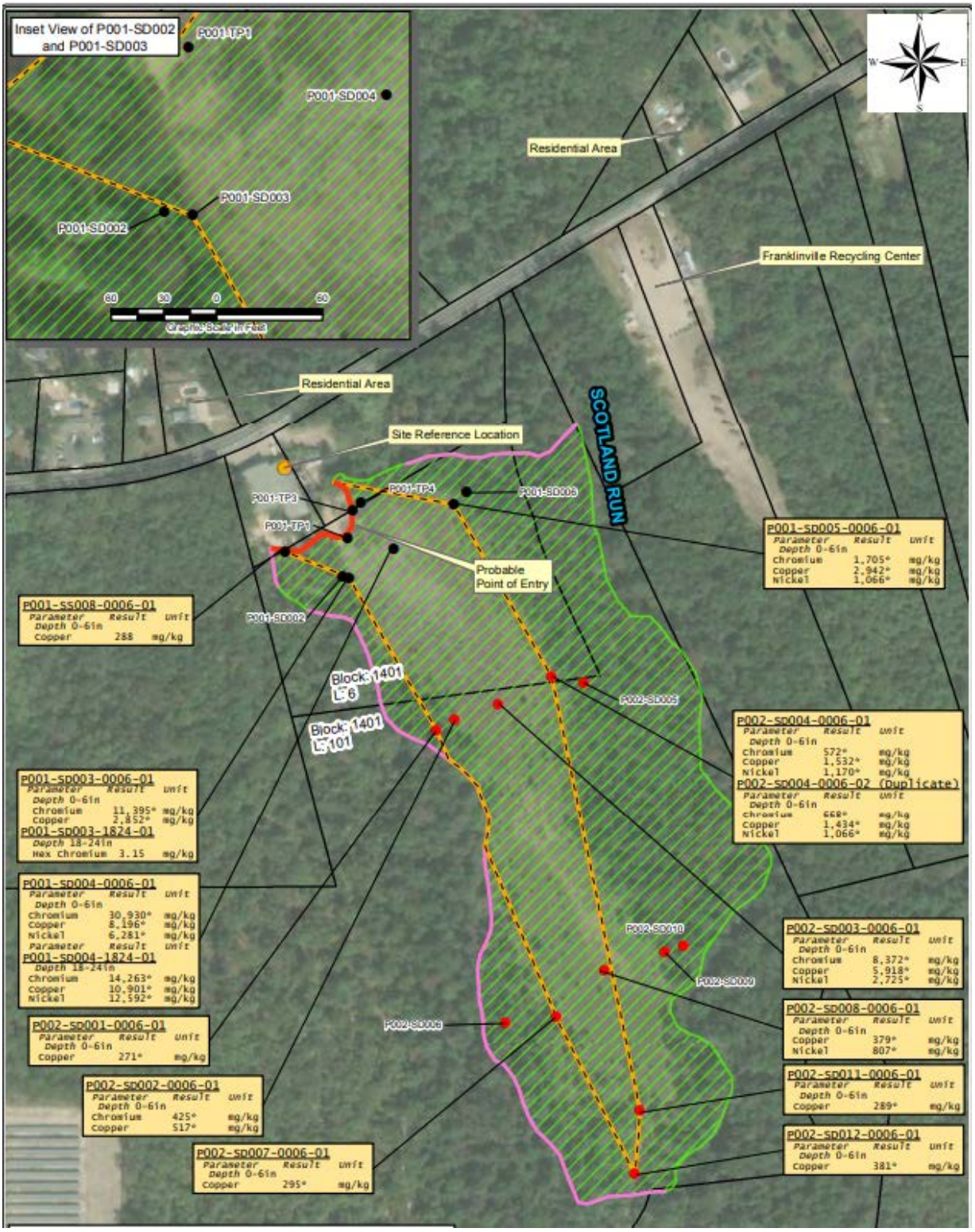


Figure 6. Sediment sample locations – Pioneer Metal Finishing site

Source**:** Weston Solutions. 2020. Hazard Ranking System (HRS) Package. Pioneer Metal Finishing Inc., Franklinville, Gloucester County, New Jersey. Washington, DC: Environmental Protection Agency; September 2020. Available from: semspub.epa.gov/work/HQ/400002.pdf

Appendix B - Demographic Maps

Pioneer Metal Finishing Inc

Franklinville, Gloucester County, NJ

GENERAL SITE PROFILE

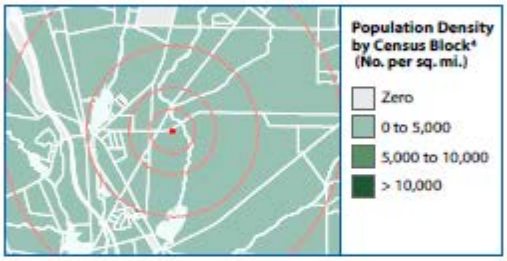
EPA FACILITY ID NJD002360188

INTRODUCTORY MAP SERIES

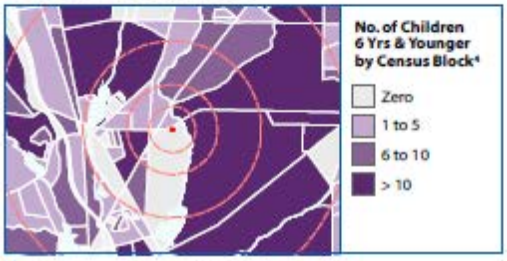
Site Vicinity Map

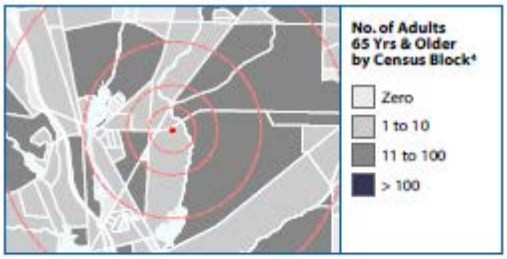
The **General Site Profile Map** depicts the hazardous waste site of interest, along with any airport, industrial, military, or park land uses. It also provides community demographic and housing statistics.

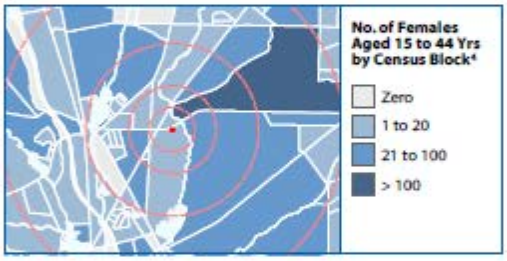
General Population Density



Sensitive Populations







Demographic Statistics[4,5]

Within 1 Miles buffer of site boundary

Measure	2000	2010	Change
Total Population	1,404	1,551	+10%
White Alone	1,320	1,437	+8%
Black Alone	55	64	+16%
Am. Indian & Alaska Native Alone	3	4	+33%
Asian Alone	7	14	+100%
Native Hawaiian & Other Pacific Islander Alone	0	0	+0%
Some Other Race Alone	11	11	+0%
Two or More Races	11	22	+100%
Hispanic or Latino[6]	26	62	+138%
Children Aged 6 and Younger	125	123	-1%
Adults Aged 65 and Older	134	174	+29%
Females Aged 15 to 44	322	314	-2%
Housing Units	484	560	+15%
Housing Units Pre 1950	176	95	-46%

Data Sources: [1]ATSDR GRASP Hazardous Waste Site Boundary Database. [2]ATSDR GRASP. [3]TomTom 2019Q1. [4]US Census 2010. **Notes:** [5]Calculated using area-proportion spatial analysis method. [6]Individuals identifying origin as Hispanic or Latino may be of any race.
Projection: Projection used for all map panels is NAD 1983 StatePlane New Jersey FIPS 2900 Feet.

PRJ 061718 QBNY 10/9/21

GRASP

Agency for Toxic Substances and Disease Registry

Office of Innovation and Analytics

ATSDR

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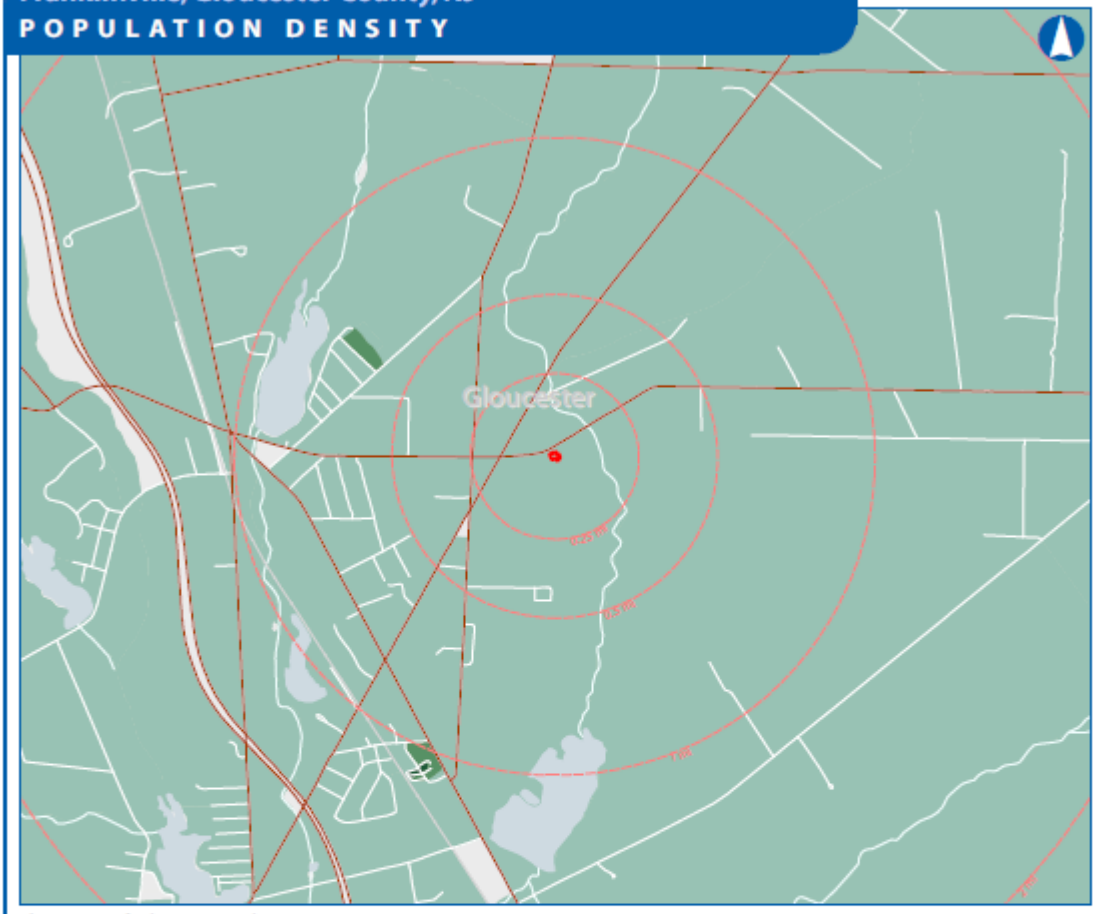
Pioneer Metal Finishing Inc

Franklinville, Gloucester County, NJ

POPULATION DENSITY

EPA FACILITY ID NJD002360188

INTRODUCTORY MAP SERIES



The **Population Density Map** depicts the site of interest and the distribution and number of people residing in the surrounding community. The distribution of population in and around a site is critical to understanding a community's potential for exposure to hazardous substances.

Based on US Census 2010 statistics, **34,522** individuals reside within a **5-mile buffer** of the site of interest.

Site of Interest

- Site of Interest[1]
- Site of Interest Buffers[2]

Population Density by Census Block[3] (No. per sq. mi.)

- Zero
- 0 to 5,000
- 5,000 to 10,000
- > 10,000

Healthcare Facilities

- Hospitals[4]
- Urgent Care[5]

0 0.5 1

Miles

Total Population[3,6]

Within specified distance of site boundary

Distance	2000	2010	Change
0.25 mile	58	60	+3%
0.50 mile	304	334	+9%
1 mile	1,404	1,551	+10%
3 miles[7]	12,459	13,202	+5%
5 miles[7]	30,599	34,522	+12%

Data Sources: [1]ATSDR GRASP Hazardous Waste Site Boundary Database. [2]ATSDR GRASP. [3]US Census 2010. [4]HERE North America 2018R2. [5]Oak Ridge National Laboratory 2017.
Notes: [6]Calculated using area-proportion spatial analysis method. [7]Buffer not shown.
Projection: NAD 1983 StatePlane New Jersey FIPS 2900 Feet.

PRJ 06170 QBRN 10/6/21

GRASP

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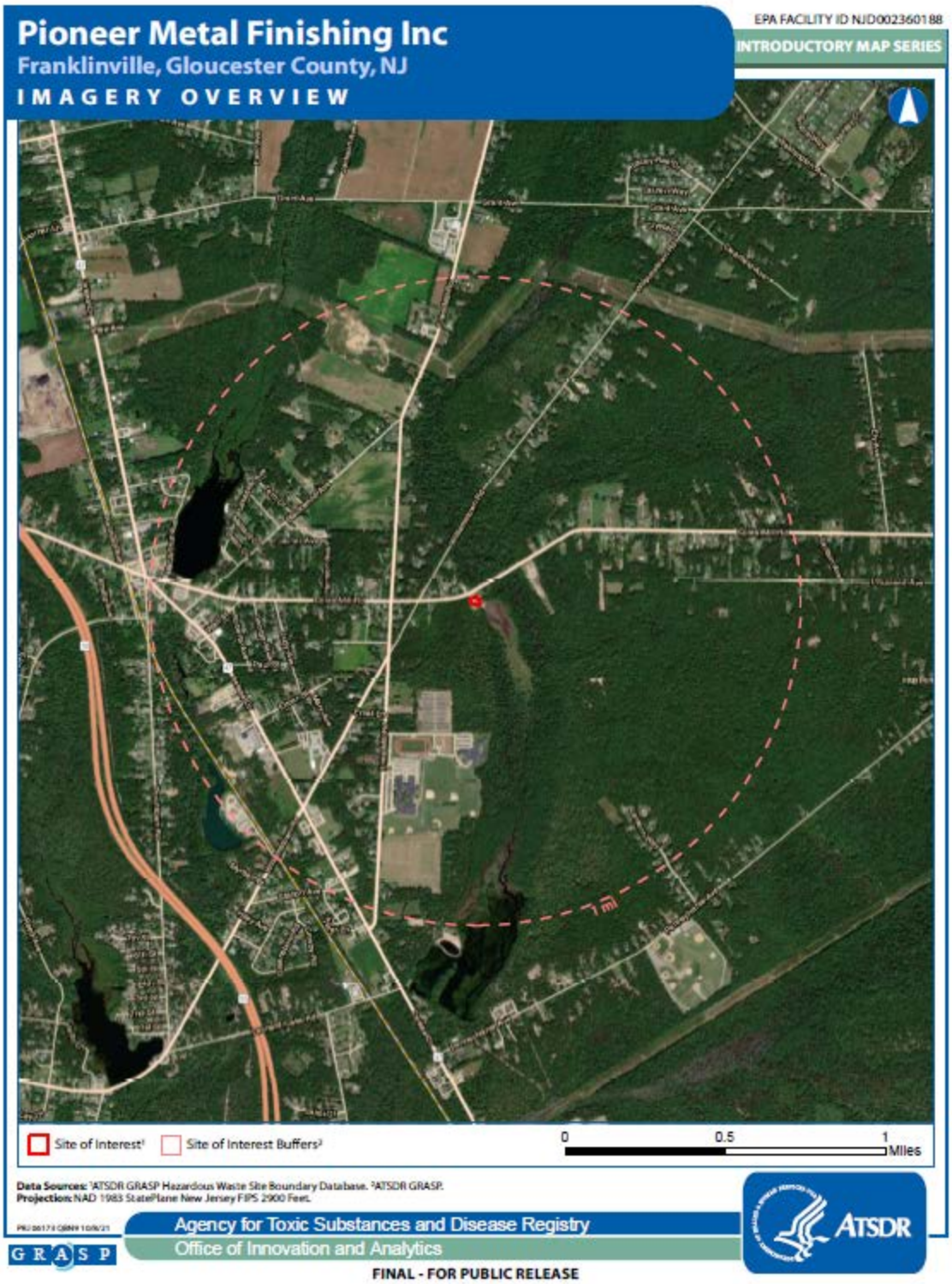
Pioneer Metal Finishing Inc
Franklinville, Gloucester County, NJ
IMAGERY OVERVIEW
EPA FACILITY ID NJD002360188
INTRODUCTORY MAP SERIES
Site of Interest¹
Site of Interest Buffers²
0
0.5
1
Miles
Data Sources: ¹ATSDR GRASP Hazardous Waste Site Boundary Database. ²ATSDR GRASP.
Projection: NAD 1983 StatePlane New Jersey FIPS 2900 Feet.
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Appendix C – ATSDR Public Health Assessment Tool (PHAST) Results

PUBLIC HEALTH ASSESSMENT SITE TOOL

PHAST spreadsheets showing the calculated hazard quotients and exposure parameters

Equations

Soil/Sediment Ingestion Exposure Dose Equation

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

Where: $D_{noncancer}$ = 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

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

Where: $ADD_{noncancer}$ = 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

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

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

Cancer Risk Equations

$$\textbf{CR} = D_{noncancer} \times \textbf{CSF} \times (\textbf{ED} \div \textbf{LY}) \qquad \textbf{Equation 4}$$

$$\textbf{ADAF-adjusted CR} = (D_{noncancer} \times \textbf{CSF}) \times (\textbf{ED} \div \textbf{LY}) \times \textbf{ADAF} \qquad \textbf{Equation 5}$$

Total CR = Sum of the CR for all exposure groups **Equation 6**

Where: 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 factors – outdoor worker – low soil contact

Duration category	Days per week	Weeks per year	Years	Exposure group specific $EF_{noncancer}$	Exposure group specific* EF_{cancer}
Acute	—	—	—	1	—
Intermediate	5	50	—	0.71	—
Chronic	5	50	17	0.68	= $EF_{noncancer}$ x Exposure Duration for $Cancer_{Exposure\ Group}$ (years) ÷ 78 years

Abbreviations: EF = exposure factor; NC = not calculated.
Note: The dermal (skin) absorbed dose equation includes 1 event/day EF parameter.
***** Cancer risk is averaged over a lifetime of exposure (78 years).

Site-specific exposure parameters – outdoor worker

Exposure group	Body weight (kg)	Exposure duration (years)	Intake rate (mg/day)	Adherence factor to skin (mg/cm^2/event)	Combined skin surface area (cm^2)	Notes
Workers – outdoor (low intensity soil contact)	80	17	100	0.07	3,470	—

Abbreviations: cm^2 = centimeters square skin; kg = kilograms; mg/cm^2/event = milligram chemical per centimeter square of skin per event; mg/day = milligram soil per day.

Contaminant information – exterior soil samples

Contaminant Name	Entered concentration	EPC type	Converted concentration*	Dermal absorption fraction	ABS_{GI}	Bioavailability factor
Chromium, hexavalent	1,368 mg/kg	Maximum	1,368 mg/kg	0.01	0.025	1
Polychlorinated biphenyls	1.3 mg/kg	Maximum	1.3 mg/kg	0.14	1	1

Abbreviations: ABS_{GI} = gastrointestinal absorption factor; EPC = exposure point concentration; mg/kg = milligram chemical per kilogram soil; mg/kg = milligrams per kilogram; UCL = upper confidence limit.
* Contaminant concentration converted to standard unit for calculating exposure.

Site-specific Soil Occupational Results
PHAST Report, v2.1.1.0, May 31, 2022

Soil Combined Chronic

Chromium, hexavalent

Table 1. Occupational: Site-specific combined ingestion (eating, drinking) and dermal (skin) exposure doses for chronic exposure to hexavalent chromium in soil at 1,368 mg/kg along with noncancer hazard quotients and cancer risk estimates*

Exposure group	Dose (mg/kg/day)	Noncancer hazard quotient	Cancer risk	Exposure duration (years)
Workers – outdoor (low intensity soil contact)	0.0023	2.5†	2.5E-4‡	17

Source: Weston EPA Hazard Ranking System Package, September 2020.
Abbreviations: mg/kg/day = milligram chemical per kilogram body weight per day; mg/kg = milligram chemical per kilogram soil.
*The calculations in this table were made using ATSDR's Public Health Assessment Tool (PHAST) v2.1.1.0. The noncancer hazard quotients were calculated using an exposure point concentration of 800 mg/kg and chronic (greater than 1 year) minimal risk level of 0.0009 mg/kg/day. The cancer risks were calculated using the cancer slope factor of 0.5 $(mg/kg/day)^{-1}$ and age-dependent adjustment factors.
†A shaded cell indicates the hazard quotient is greater than 1, which ATSDR evaluates further.
‡A shaded cell indicates that the cancer risk exceeds one extra case in a million people similarly exposed, which ATSDR evaluates further.

Polychlorinated biphenyls

Table 2. Occupational: Site-specific combined ingestion (eating, drinking) and dermal (skin) exposure doses for chronic exposure to polychlorinated biphenyls in soil at 1.3 mg/kg along with cancer risk estimates*

Exposure group	Dose (mg/kg/day)	Noncancer hazard quotient	Cancer risk	Exposure duration (years)
Workers – outdoor (low intensity soil contact)	1.5E-06	—	6.5E-7	17

Source: Weston EPA Hazard Ranking System Package, September 2020.
Abbreviations: mg/kg/day = milligram chemical per kilogram body weight per day; mg/kg = milligram chemical per kilogram soil.
* The calculations in this table were generated using ATSDR's Public Health Assessment Tool (PHAST) v2.1.1.0. The cancer risks were calculated using the cancer slope factor of 2 $(mg/kg/day)^{-1}$.

Soil Combined Intermediate

Chromium, hexavalent

Table 3. Occupational: Site-specific combined ingestion (eating, drinking) and dermal (skin) exposure doses for intermediate exposure to hexavalent chromium in soil at 1,368 mg/kg along with noncancer hazard quotients*

Exposure group	Dose (mg/kg/day)	Noncancer hazard quotient
Workers – outdoor (low intensity soil contact)	0.0024	0.48

Source: Weston EPA Hazard Ranking System Package, September 2020.
Abbreviations: mg/kg/day = milligram chemical per kilogram body weight per day; mg/kg = milligram chemical per kilogram soil.
* The calculations in this table were generated using ATSDR's Public Health Assessment Tool (PHAST) v2.1.1.0. The noncancer hazard quotients were calculated using the exposure point concentration of 800 mg/kg and intermediate (2 weeks to less than 1 year) minimal risk level of 0.005 mg/kg/day.

Site-specific exposure factors – indoor worker

Duration category	Days per	Weeks per year	Years	Exposure group specific $EF_{noncancer}$	Exposure group specific* EF_{cancer}
Acute	—	—	—	1	—
Intermediate	5	50	—	0.71	—
Chronic	5	50	17	0.68	= $EF_{noncancer}$ x Exposure Duration for $Cancer_{Exposure\ Group}$ (years) ÷ 78 years

Abbreviations: EF = exposure factor; NC = not calculated.
Note: The dermal (skin) absorbed dose equation includes 1 event/day EF parameter.
***** Cancer risk is averaged over a lifetime of exposure (78 years).

Site-specific exposure parameters

Exposure group	Body weight (kg)	Exposure duration (years)	Intake rate (mg/day)	Adherence factor to skin (mg/cm^2/event)	Combined skin surface area (cm^2)	Notes
Workers – indoor	80	17	30	0.07	3,470	—

Abbreviations: cm^2 = centimeters square skin; kg = kilograms; mg/cm^2/event = milligram chemical per centimeter square of skin per event; mg/day = milligram soil per day.

Contaminant information – interior soil and dust samples

Contaminant name	Entered concentration	EPC type	Converted concentration*	Dermal absorption fraction	ABS_{GI}	Bioavailability factor
Chromium, hexavalent	52.7 mg/kg	Maximum	52.7 mg/kg	0.01	0.025	1
Nickel	23,000 mg/kg	Maximum	23,000 mg/kg	0.01	0.04	1

Abbreviations: ABS_{GI} = gastrointestinal absorption factor; EPC = exposure point concentration; mg/kg = milligram chemical per kilogram soil; mg/kg = milligrams per kilogram.
* Contaminant concentration converted to standard unit for calculating exposure.

Soil Combined Chronic

Chromium, hexavalent

Table 1. Occupational: Site-specific combined ingestion (eating, drinking) and dermal (skin) exposure doses for chronic exposure to hexavalent chromium in soil at 52.7 mg/kg along with noncancer hazard quotients and cancer risk estimates*

Exposure group	Dose (mg/kg/day)	Noncancer hazard quotient	Cancer risk	Exposure duration (years)
Workers – indoor	5.7E-05	0.064	6.3E-6[†]	17

Source: Weston EPA Hazard Ranking System Package, September 2020.
Abbreviations: mg/kg/day = milligram chemical per kilogram body weight per day; mg/kg = milligram chemical per kilogram soil.
*****The calculations in this table were generated using ATSDR's Public Health Assessment Tool (PHAST) v2.1.1.0. The noncancer hazard quotients were calculated using an exposure point concentration of 53 mg/kg and chronic (greater than 1 year) minimal risk level of 0.0009 mg/kg/day. The cancer risks were calculated using the cancer slope factor of 0.5 $(mg/kg/day)^{-1}$ and age-dependent adjustment factors.
[†]A shaded cell indicates that the cancer risk exceeds one extra case in a million people similarly exposed, which ATSDR evaluates further.

Nickel

Table 2. Occupational: Site-specific combined ingestion (eating, drinking) and dermal (skin) exposure doses for chronic exposure to nickel in soil at 23,000 mg/kg along with noncancer hazard quotients*

Exposure group	Dose (mg/kg/day)	Noncancer hazard quotient	Cancer risk	Exposure duration (years)
Workers – indoor	0.018	0.89	—	17

Source: Weston EPA Hazard Ranking System Package, September 2020.
Abbreviations: mg/kg/day = milligram chemical per kilogram body weight per day; mg/kg = milligram chemical per kilogram soil.
***** The calculations in this table were generated using ATSDR's Public Health Assessment Tool (PHAST) v2.1.1.0. The noncancer hazard quotients were calculated using the chronic (lifetime) reference dose of 0.02 mg/kg/day.

Soil Combined Intermediate

Chromium, hexavalent

Table 3. Occupational: Site-specific combined ingestion (eating, drinking) and dermal (skin) exposure doses for intermediate exposure to hexavalent chromium in soil at 52.7 mg/kg along with noncancer hazard quotients*

Exposure group	Dose (mg/kg/day)	Noncancer hazard quotient
Workers – indoor	6.0E-05	0.012

Source: Weston EPA Hazard Ranking System Package, September 2020.
Abbreviations: mg/kg/day = milligram chemical per kilogram body weight per day; mg/kg = milligram chemical per kilogram soil.
***** The calculations in this table were generated using ATSDR's Public Health Assessment Tool (PHAST) v2.1.1.0. The noncancer hazard quotients were calculated using an exposure point concentration of 53 mg/kg and intermediate (2 weeks to less than 1 year) minimal risk level of 0.005 mg/kg/day.

Site-specific exposure factors – trespasser

Duration category	Days per week	Weeks per year	Years	Exposure group specific $EF_{noncancer}$	Exposure group specific* EF_{cancer}
Acute	—	—	—	1	—
Intermediate	2	25	—	0.29	—
Chronic	2	25	40	0.14	= $EF_{noncancer}$ x Exposure Duration for $Cancer_{Exposure\ Group}$ (years) ÷ 78 years
Pica	2	—	—	0.29	—

Abbreviations: EF = exposure factor; NC = not calculated.
Note: The dermal (skin) absorbed dose equation includes 1 event/day EF parameter.
***** Cancer risk is averaged over a lifetime of exposure (78 years).

Site-specific exposure parameters – trespasser

Exposure group (ages)	Body weight (kg)	Exposure duration (years)	CTE intake rate (mg/day)	RME intake rate (mg/day)	Custom intake rate (mg/day)	Soil-pica intake rate (mg/day)	Adherence factor to skin (mg/cm^2/event)	Combined skin surface area (cm^2)	Notes
16 to <21 years	71.6	5	30	100	—	—	0.2	6,083	—
Adult (≥21 years)	80	40	30	100	—	—	0.07	6,030	—

Abbreviations: cm^2 = centimeters square; 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).

Contaminant information – exterior soil – trespasser

Contaminant name	Entered concentration	EPC type	Converted concentration*	Dermal absorption fraction	ABS_{GI}	Bioavailability factor
Copper	4,691mg/kg	95% UCL of the mean	4,691 mg/kg	0.01	0.57	1
Chromium, hexavalent	1,368 mg/kg	Maximum	1,368 mg/kg	0.01	0.025	1
Polychlorinated biphenyls	1.3 mg/kg	Maximum	1.3 mg/kg	0.14	1	1
Nickel	4,703 mg/kg	95% UCL of the mean	4,703 mg/kg	0.01	0.04	1
Cyanide	36.5 mg/kg	Maximum	36.5 mg/kg	0.01	1	1

Abbreviations: ABS_{GI} = gastrointestinal absorption factor; EPC = exposure point concentration; mg/kg = milligram chemical per kilogram soil; mg/kg = milligrams per kilogram; UCL = upper confidence limit.
* Contaminant concentration converted to standard unit for calculating exposure.

Site-specific Soil Trespasser/Recreational Results
PHAST Report, v2.1.1.0, June 1, 2022

Soil Combined Chronic

Chromium, hexavalent

Table 1. Trespasser/Recreational: Site-specific combined ingestion (eating, drinking) and dermal (skin) exposure doses for chronic exposure to hexavalent chromium in soil at 1,368 mg/kg along with noncancer hazard quotients and cancer risk estimates*

Exposure group (ages)	CTE dose (mg/kg/day)	CTE noncancer hazard quotient	CTE cancer risk	RME dose (mg/kg/day)	RME noncancer hazard quotient	RME cancer risk	Exposure duration (years)
16 to <21 years	0.0014	1.5	4.3E-5†	0.0015	1.7	4.9E-5†	5
Adult (≥21 years)	0.00055	0.61	1.4E-4†	0.00071	0.79	1.8E-4†	40

Source: Weston EPA Hazard Ranking System Package, September 2020.
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).
*The calculations in this table were generated using ATSDR's Public Health Assessment Tool (PHAST) v2.1.1.0. The noncancer hazard quotients were calculated using an exposure point concentration of 800 mg/kg and chronic (greater than 1 year) minimal risk level of 0.0009 mg/kg/day. The cancer risks were calculated using the cancer slope factor of 0.5 $(mg/kg/day)^{-1}$ and age-dependent adjustment factors.
†A shaded cell indicates that the cancer risk exceeds one extra case in a million people similarly exposed, which ATSDR evaluates further.

Polychlorinated biphenyls

Table 2. Trespasser/Recreational: Site-specific combined ingestion (eating, drinking) and dermal (skin) exposure doses for chronic exposure to polychlorinated biphenyls in soil at 1.3 mg/kg along with cancer risk estimates*

Exposure group (ages)	CTE dose (mg/kg/day)	CTE noncancer hazard quotient	CTE cancer risk	RME dose (mg/kg/day)	RME noncancer hazard quotient	RME cancer risk	Exposure duration (years)
16 to <21 years	5.0E-07	—	6.4E-8	6.7E-07	—	8.6E-8	5
Adult (≥21 years)	2.3E-07	—	2.3E-7	3.8E-07	—	3.9E-7	40

Source: Weston EPA Hazard Ranking System Package, September 2020.
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).
* The calculations in this table were generated using ATSDR's Public Health Assessment Tool (PHAST) v2.1.1.0. The cancer risks were calculated using the cancer slope factor of 2 $(mg/kg/day)^{-1}$.

Nickel

Table 3. Trespasser/Recreational: Site-specific combined ingestion (eating, drinking) and dermal (skin) exposure doses for chronic exposure to nickel in soil at 4,703 mg/kg along with noncancer hazard quotients*

Exposure group (ages)	CTE dose (mg/kg/day)	CTE noncancer hazard quotient	CTE cancer risk	RME dose (mg/kg/day)	RME noncancer hazard quotient	RME cancer risk	Exposure duration (years)
16 to <21 years	0.0030	0.15	—	0.0036	0.18	—	5

Source: Weston EPA Hazard Ranking System Package, September 2020.
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).
* The calculations in this table were generated using ATSDR's Public Health Assessment Tool (PHAST) v2.1.1.0. The noncancer hazard quotients were calculated using an exposure point concentration of 5,500 mg/kg and chronic (lifetime) reference dose of 0.02 mg/kg/day.

Cyanide

Table 4. Trespasser/Recreational: Site-specific combined ingestion (eating, drinking) and dermal (skin) exposure doses for chronic exposure to cyanide in soil at 36.5 mg/kg along with noncancer hazard quotients*

Exposure group (ages)	CTE dose (mg/kg/day)	CTE noncancer hazard quotient	CTE cancer risk	RME dose (mg/kg/day)	RME noncancer hazard quotient	RME cancer risk	Exposure duration (years)
16 to <21 years	2.9E-06	0.0047	—	7.8E-06	0.012	—	5

Source: Weston EPA Hazard Ranking System Package, September 2020.
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).
*****The calculations in this table were generated using ATSDR's Public Health Assessment Tool (PHAST) v2.1.1.0. The noncancer hazard quotients were calculated using an exposure point concentration of 37 mg/kg and chronic (lifetime) reference dose of 0.00063 mg/kg/day.

Soil Combined Intermediate

Copper

Table 5. Trespasser/Recreational: Site-specific combined ingestion (eating, drinking) and dermal (skin) exposure doses for intermediate exposure to copper in soil at 4,691 mg/kg, along with noncancer hazard quotients*

Exposure group (ages)	CTE dose (mg/kg/day)	CTE noncancer hazard quotient	RME dose (mg/kg/day)	RME noncancer hazard quotient	Soil-pica dose (mg/kg/day)	Soil-pica noncancer hazard quotient
16 to <21 years	0.00096	0.048	0.0023	0.11	—	—

Source: Weston EPA Hazard Ranking System Package, September 2020.
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).
*****The calculations in this table were generated using ATSDR's Public Health Assessment Tool (PHAST) v2.1.1.0. The noncancer hazard quotients were calculated using an exposure point concentration of 3,900 mg/kg and intermediate (2 weeks to less than 1 year) minimal risk level of 0.02 mg/kg/day.

Chromium, hexavalent

Table 6. Trespasser/Recreational: Site-specific combined ingestion (eating, drinking) and dermal (skin) exposure doses for intermediate exposure to hexavalent chromium in soil at 1,368 mg/kg, along with noncancer hazard quotients*

Exposure group (ages)	CTE dose (mg/kg/day)	CTE noncancer hazard quotient	RME dose (mg/kg/day)	RME noncancer hazard quotient	Soil-pica dose (mg/kg/day)	Soil-pica noncancer hazard quotient
16 to <21 years	0.0028	0.56	0.0032	0.64	—	—
Adult (≥21 years)	0.0011	0.23	0.0015	0.30	—	—

Source: Weston EPA Hazard Ranking System Package, September 2020.
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).
* The calculations in this table were generated using ATSDR's Public Health Assessment Tool (PHAST) v2.1.1.0. The noncancer hazard quotients were calculated using an exposure point concentration of 800 mg/kg and intermediate (2 weeks to less than 1 year) minimal risk level of 0.005 mg/kg/day.