HEALTH CONSULTATION

READING GRAY IRON SITE
READING, BERKS COUNTY, PENNSYLVANIA
Region III

Cost Recovery Number: 3AT8
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U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry
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Background and Statement of Issues

On September 23, 2002, the Agency for Toxic Substances and Disease Registry (ATSDR) received a request from its Division of Regional Operations (DRO), Region III office in Philadelphia, Pennsylvania, to assess the public health implications of the Reading Gray Iron site (Charles Walters, Division of Regional Operations, ATSDR, Region 3, to Susan Moore, Division of Health Assessment and Consultation, ATSDR. Health Consultation Request, 2002). The request was in support of a petition ATSDR received on March 6, 2002 (Letter to ATSDR from a resident in Reading, Pennsylvania, 2002). In the petition, ATSDR was asked to evaluate the impact to the public's health resulting from potential exposure to residual contamination left behind at the site in conjunction with a planned project to redevelop the site. The residual contamination at the site is comprised of both chemical substances and radiologic materials known to have been used and/or disposed of at the site. A nonprofit industrial development corporation known as the Greater Berks Development Fund (GBDF) is the major stakeholder of a group planning to redevelop the site for commercial and industrial use. Most of the environmental information (e.g., sampling, site description, and environmental concerns) cited in this public health consultation was acquired from a baseline environmental report (BER) of the Reading Gray Iron site prepared for GBDF (Synergy, 2002). The Office of Regional Operations also asked ATSDR to specify any special actions that should be taken during and after site redevelopment if the site is assessed to impact public health. The findings discussed in this health consultation emphasize issues associated with environmental exposures to chemical substances or metals. ATSDR also identified potential physical hazards at the site.

Site Description

At the time of the BER (year 2002), the Reading Gray Iron site in Reading, Pennsylvania, consisted of two abandoned industrial properties: the former Reading Iron Company property (Reading Iron property) and the former Reading Gray Iron Castings property (Gray Iron property). Together, these properties comprised approximately 51 acres. The Reading Iron property housed the Oley Street storeyard, Pennsylvania Lines LLC, and Metropolitan Edison Company parcels. The Reading Iron property represented approximately 92% of the total site, while the Gray Iron property represented the remaining portion, approximately 8% (see Figures 1 and 2, Appendix C).

The Reading Gray Iron site is located in an area of mixed industrial and residential use in Reading, Berks County, Pennsylvania. City streets (Clinton and Tulpehocken Streets) border the eastern side of the site, while rail lines border the northern, western, and southern sides of the site. The Gray Iron property is located adjacent to and southeast of the Reading Iron property.

The Reading Gray Iron site was graded into three nearly level terraces that were separated by steep slopes and retaining walls. There were no surface water bodies (streams or ponds) at the site; however, the Schuylkill River flows near the northern and western edges of the site. The Schuylkill River is approximately 250 feet from the site at its closest point (along the site's north/northwestern boundary). At the western edge of the site, the distance to the Schuylkill River ranges from approximately 350 feet to 600 feet.

The major portion of the Reading Gray Iron site was comprised of what was known as the Oley Street storeyard (which occupied the main portion of the Reading Iron property). The storeyard was used to store truck frames, tools, and raw materials for industrial use. In 2002 (time of BER), a small office/maintenance building was located in the western portion of the site (lowest terrace level). The building was still serviced by municipal utilities (water, gas, and electricity). Sanitary sewage from the office/maintenance building was treated and disposed of at the site by a septic system with a tank and drainfield immediately west of the building. Remnants of old foundry operations were located on the south and southeastern corner of the site (highest elevation). At that time (2002), the remainder of the site was covered by a combination of gravel, pavement, miscellaneous fill, stockpiled truck bodies, old tools and machinery, old rail lines, railroad ties, debris from demolished building, railroad tracks, high voltage power lines, and vegetation. Figure 3 shows an aerial view of the site in 2002.

Access to the Reading Gray Iron site is restricted by chain link fences and locked gates. The Reading Iron property is surrounded by a chain link fence along its boundary with the Gray Iron property, its boundary with an adjacent elementary school to the northeast, and along the extent of its eastern Clinton Street boundary. Access to the Reading Iron property is gained through a locked gate at River Road. The portion of the Gray Iron Property that was used for manufacturing (west of Tulpehocken Street) is completely surrounded by a chain link fence, except for portions on its southern boundary that border rail lines. A small parking area west of Clinton Street and a larger parking area east of Tulpehocken Street at the Gray Iron Property are also not secured by fencing.

Synergy, an environmental consulting firm contracted by GBDF to conduct a baseline remedial investigation (BRI) of the Reading Gray Iron site and document their findings in the BER, observed and noted the following environmental concerns at the site during the course of its investigation:

- aboveground storage tanks (ASTs)
- underground storage tanks (USTs)
- drums of liquid material
- drums of solid material
- stained soils
- piles of foundry sand and slag
- piles of railroad ties, and
- piles of construction/demolition debris.

Site History

In its review of property deeds, Synergy found information indicating that industrial activities occurred at the Reading Gray Iron site for more than 100 years (Synergy, 2002). This information documented that the Schuylkill Valley Iron Company purchased a portion of the site in 1865 and that two anthracite furnaces were present on a portion of the site transferred to the Keystone Furnace Company in 1874. The names of other past property owners—Reading Iron Company, Parish Pressed Steel Company, Dana Corporation, and Reading Gray Iron Castings—also indicate that industrial operations occurred at the site. The Redevelopment Authority of the City of Reading is the current owner of the Gray Iron property. The Greater Berks Development Fund, Metropolitan Edison Company, and Pennsylvania Lines LLC are the current owners of the Reading Iron property (see Figure 2).

Gray Iron Property

The Gray Iron Property was owned by Reading Gray Iron Castings, Incorporated, and was developed as a brass and iron foundry prior to 1904. It continued operation as a foundry until the company filed for bankruptcy in 1990. Most of the buildings were demolished in 1995, but the demolished building debris remained on the property and covered most of the southeastern portion of the site even up to the time of the BER (2002). One large foundry building and a few smaller auxiliary buildings also remained on the property, but they had been extensively damaged by past fires and did not appear to be structurally sound.

Reading Iron Property

The Reading Iron property was owned by the Reading Iron Company. During its time as an iron foundry, the Reading Iron Company contained three distinct manufacturing operations—the Keystone Furnace, the Roe Puddling Mills, and the Oley Street Mill (see Figure 4). The Keystone Furnace, which was located in the southern portion of the Reading Gray Iron site, along the rail line bordering the site to the south, was the first portion of the Reading Iron property to be developed. Records indicate that the Keystone Furnace was probably constructed prior to 1887. The Oley Street Mill was the next portion of the Reading Iron Property to be developed. It was probably constructed in the late 1800s and was located on the lowest terrace (western portion of the site). The last area of the Reading Iron property to be developed, probably in the early 1900s, was the Roe Puddling Mills, which was located on the middle terrace (eastern portion of the site along Clinton Street, between West Greenwich and West Oley streets).

The rail line transecting the property and owned by Pennsylvania Lines LLC has existed as long as the Reading Gray Iron site, perhaps more than 100 years. In 2002 (time of BER), the existing rail line on the property was out of service.

In 1941, the Reading Iron Company sold a portion of the Reading Iron Property to the Metropolitan Edison Company, an electrical utility company for the Reading metropolitan area.

The Metropolitan Edison Company later developed this land with high-voltage power transmission lines and associated supporting structures. The existing power lines on this portion of the site are proposed to remain even after the site is redeveloped.

Manufacturing operations by the Reading Iron Company appear to have ceased in 1950. Records indicate that Dana Corporation, the next property owner, used the property for storage beginning in the early 1950s. The company stored obsolete tools, raw materials used in manufacturing truck bodies, and truck bodies manufactured at its nearby plant on the property. This portion of the site is known as the Oley Street storeyard. The Dana Corporation also leased portions of the property owned by the Metropolitan Edison Company and used that property to store truck frames and obsolete tools. Although Dana Corporation ceased operations at the Reading Iron Property in 2000, some truck bodies and obsolete tools still remained on the property at the time of the BER (2002).

Synergy's review of maps and historic aerial photographs indicated that the only development in the northern and northeastern portions of the Reading Iron property included specified areas for the existing power transmission and railroad lines, for truck frame and obsolete tool storage, and for some small garden plots (evident in the historic aerial photographs and internal property plans for Dana Corporation). Local residents told Synergy that the area containing small garden plots was called "Victory Gardens."

Demographics/Land Use/Natural Resources Use

The 2000 U.S. Census indicates a total population of 29,358 persons living within 1 mile of the site (see Figure 5). Whites comprise approximately 55% of the population and blacks approximately 17%. As a group, approximately 2% of the population is composed of American Indians or Alaska Natives, Asians, and Pacific Islanders. The remaining 26% of the population is mostly of unknown origin, because one group classifies themselves as some other race (22% of the population) and another group classifies themselves as a combination of two or more races (4% of the population). Approximately 38% of the population is of Hispanic origin. Children of 6 years and younger make up approximately 12% of the population. Individuals older than 64 years make up approximately 13% of the local population. Moreover, females of child bearing age (15 to 44 years), make up approximately 22% of the population. The socioeconomic status of the population living on the east side of the Schuylkill River and adjacent to the site is considered middle to lower-middle income.

As mentioned previously, the Reading Gray Iron site is located in a mixed industrial and residential area. Directly south of the site is a property that was previously used for a foundry and steel mill operation. This property was formerly owned by the American Chain and Cable Company. ATSDR plans to assess the public health implications of this property in a subsequent health consultation after completing the health consultation for the Reading Gray Iron site. Other former industrial properties (Excelsior Brass and Reading Recycling) are located south/southeast of the Reading Gray Iron site, but at this time ATSDR has no plans to assess public health implications related to these properties. Property use east of the Reading Gray Iron site consists primarily of residential dwellings (row houses) with some commercial and manufacturing facilities interspersed among them. A recreational facility called the Olivet Boys and Girls Club is adjacent to the eastern border of the site. This facility includes a swimming pool and some undeveloped land. An elementary school is also adjacent to the site at its northeast border, and a municipal park is located farther northeast of the site, next to the school.

Public utility lines (water, stormwater, sewer, gas, and electrical power lines) both surround and transect the Reading Gray Iron site. Some of the electrical power lines that transect the site are high voltage power lines owned by the Metropolitan Edison Company. A large water main for the city of Reading transects the site from east to west, from the intersection of Clinton and West Douglas streets (eastern side of the site) to the intersection of River Road and West Douglas Street (western side of the site). Moreover, water mains and gas mains surround the site, located within the boundaries of both Clinton and Tulpehocken streets. The Gray Iron property was serviced by public sewers owned by the city of Reading; however, the locations of these sewer lines are unknown. It is believed some sewer lines may have entered the Gray Iron Property near the property gates located at the end of Clinton Street and along Tulpehocken Street. Municipal stormwater lines enter the site near the intersection of Clinton and West Greenwich and direct stormwater runoff into a drainage swale on the east side of the Pennsylvania Lines railroad line that transects the site. Other small sections of subsurface stormwater lines exist in various areas of the site to control stormwater runoff and direct it into other surface swales and/or drainage ditches at the site.

Discussion

Environmental Sampling and Chemical Analyses

ATSDR reviewed chemical analyses of soil and groundwater samples collected from on-site locations. Because the site operated primarily as an iron foundry, a majority of the collected samples were submitted for general characterization purposes and analyzed for a priority pollutant list that consisted of semivolatile organic compounds (PPL SVOCs) and metals (PPL metals) (Synergy, 2002). Site observations and review of company records were also indicative of the use of petroleum, solvents, and polychlorinated biphenyls (PCBs). Thus, depending on field observations, some samples were also analyzed for volatile organic compounds (PPL VOCs), cyanide, and PCBs or some subset thereof. Cyanide analysis was included with the suite of metal analyses because historic use of gas furnaces in foundry operations can create the potential for compounds containing cyanide (cyanide compounds are by-products of coal and oil gasification processes).

In addition, ATSDR reviewed site data for other environmental sampling and analyses. ATSDR noted that the BER included an inventory of drummed materials and stockpiled foundry waste (i.e., sand used in the manufacturing processes) at the Gray Iron Property (see Figure 6). Samples were collected for three different forms of drummed solids and two different types of stockpiled sands. Collection of the samples was necessary to evaluate potential hazards associated with these materials and to characterize the materials for disposal purposes. Characterization employed EPA's toxicity characteristic leaching procedure (TCLP) and the samples were submitted for laboratory analysis for TCLP VOCs, TCLP SVOCs, TCLP metals, and TCLP PCBs, plus ignitability, reactivity, percent solids, and total petroleum hydrocarbons. Asbestos-containing materials (ACMs) were suspected to be scattered throughout the building debris on the Gray Iron Property. If the ACMS are left on the property and are later disturbed, they could pose a direct threat to neighboring residents, to remediation workers contracted to clean up the property, and to future users of the property. Therefore, the piles of building debris were sampled for asbestos to evaluate the potential risk for related asbestos exposures.

Soil

The soil investigation consisted of the installation of 105 soil borings (note, ten borings were converted to monitoring wells), from which 98 samples were submitted for PPL VOCs analysis (or some subset thereof), 121 were submitted for PPL SVOCs analysis (or some subset thereof), 156 were submitted for PPL metals analysis (or some subset thereof), 95 were submitted for cyanide analysis, and 53 were submitted for PCB analysis. Figure 2 shows the soil boring locations.

Chemical analyses of the collected soil samples detected the presence of 17 VOCs, 23 SVOCs, 2 PCB isomers, 13 metals, and cyanide (see Tables 1 thru 4, Appendix B). Metals are natural constituents of most soils and are also released into the environment from anthropogenic sources, such as mining and metallurgic operations. Because the Reading Gray Iron site was formerly the location of an iron/foundry mill, the presence of metals and cyanide in the soil was to be expected.

ATSDR compared the detected levels of the priority pollutants with soil comparison values (CVs). A further discussion of CVs and their use in assessing public health impacts at sites containing hazardous substances is provided in Appendix A. A further discussion of the rationale used for the selective screening of substances detected in the soil at the Reading Gray Iron site for further public health evaluation is provided in the Exposure Pathways Section. Such a rationale is highly dependent upon site-specific conditions of exposure. Of the substances detected in the soil samples, 17 were selected for further public health evaluation because either the detected levels exceeded soil CVs or no available soil CVs exist for the detected substances. The substances selected for further public health evaluation included 5 metals (arsenic, cadmium, copper, lead, and thallium), 10 polycyclic aromatic hydrocarbon (PAH) isomers (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, acenaphthylene, benzo(g,h,i)perylene, phenanthrene), 1 PCB isomer (PCB-1260), and 1 other SVOC (3,3'-dichlorobenzidine). Arsenic was the only metal that did not meet ATSDR's selective screen to be selected for further public health evaluation. It was still selected for further public health evaluation because some of the arsenic levels detected in the soil at the site exceeded the environmental regulatory standard for arsenic as set by the Pennsylvania

Department of Environmental Protection (Non-Residential Direct Contact Medium Specific Concentration value of 53 milligrams per kilogram for arsenic levels within zero and two feet below ground surface).

Groundwater

Ten groundwater monitoring wells were completed and sampled at the Reading Gray Iron site (wells MW-1 through MW-7, plus MW-8S, MW-9, and MW-12). The locations of the monitoring wells are shown on Figure 2. The installation of four other monitoring wells was attempted, but they were abandoned without sampling because no saturated conditions were encountered (MW-13); the monitoring well could not be completed due to collapsing bedrock (MW-8d); or the monitoring wells displayed signs of both collapsing bedrock and a lack of saturated conditions (MW-10 and MW-11). Except for MW-7, two rounds of groundwater samples were collected from each well. MW-7 contained an immiscible layer during the first sampling event and therefore was not sampled at that time although it was sampled in the second sampling event. The groundwater samples were analyzed for PPL VOCs, PPL SVOCs, PCBs, PPL metals, and cyanide.

Chemical analyses of groundwater samples indicated the presence of 16 metals and other chemical constituents (see Tables 5 thru 8). Of these, benzene, tetrachloroethene, trichloroethene, vinyl chloride, bis(2-ethylhexyl)phthalate, antimony, and lead were present at levels that exceeded drinking water CVs. However, these metals and other chemical substances were not selected for further public health evaluation because the underlying groundwater is not used as a source of drinking water.

Monitoring wells were constructed to intercept the overburden and bedrock aquifers. Based on the equipotential lines, the direction of groundwater flow in the bedrock and overburden aquifers is generally to the west and toward the Schuylkill River (see Figures 7 through 12). The groundwater flow path in the overburden aquifer is, however, distorted by what appears to be a localized equipotential high (i.e., groundwater mounding) at MW-8S (see Figures 9 and 11). With this groundwater anomaly, groundwater is expected to flow radially away from MW-8S, then turn and flow toward the Schuylkill River in a westerly direction (i.e., toward the northwest, west, and southwest). If the elevation data for MW-8S is disregarded (Figures 10 and 12), the equipotential data still show groundwater to flow to the west (Synergy 2002). Therefore, any groundwater migrating off site will most likely flow toward the Schuykill River and away from the homes adjacent to the site.

Other Environmental Sampling and Analysis

Five samples were collected from drummed solids and sands stockpiled at the Gray Iron property for hazardous waste characterization. A summary of the analytical results of this sampling is shown in Table 9. This summary shows that none of the materials exhibited characteristics that would classify them as hazardous under EPA's guidelines and regulations for hazardous waste characterization under the TCLP method.

Suspected asbestos-containing materials (ACM) seemed to be homogeneously mixed throughout the building debris piles on the Gray Iron property. Eleven samples of roofing materials, six samples of Transite, and one sample of paperboard were collected and submitted for laboratory analysis. The laboratory was directed to analyze the materials with a "positive stop." This directive means that once one sample of a homogeneous material is confirmed to contain asbestos, the laboratory does not analyze any of the other samples of the same material submitted for analysis. The analytical results of this sampling are summarized in Table 10. Table 10 shows that some of the suspected ACMs exhibited characteristics of containing asbestos, requiring the removal of these materials from the property to facilitate redevelopment of the site.

Exposure Pathways

This section summarizes the exposure pathways ATSDR considered in evaluating public health implications posed by chemical substances in the immediate vicinity of the Reading Gray Iron site. An exposure pathway is defined as the process of how people are exposed to or come into contact with chemical substances. An exposure pathway has five parts: A source of contamination; an environmental media and transport mechanism; a point of exposure; a route of exposure; and a receptor population. When all five parts are present, the exposure pathway is termed a completed exposure pathway. However, if a completed exposure pathway does exist, it does not mean that a public health hazard exists. Rather, specific exposure conditions and exposure doses must be evaluated more closely to determine the implications of any exposure.

Rationale for the Selective Screening of Substances in Soil

The first step in any public health assessment is the application of conservative screening values to the available environmental monitoring data, to eliminate from consideration those site-specific substances which would not pose a public health hazard under virtually any plausible exposure scenario. The substances that are selected in such a screening process are then subjected to a more detailed toxicological evaluation of their public health implications, under site-specific conditions of exposure (ATSDR 1992a). It is in this second phase of the process that potential public health hazards (if they exist) are actually identified. The preliminary screening phase does not identify toxic exposures; it merely eliminates obviously nontoxic exposures, so that the more intensive toxicological evaluation can then be focused efficiently on a reduced list of substances.

The conclusions presented in this health consultation are based on ATSDR's review of potential exposures to current levels of substances detected at the Reading Gray Iron site. This former industrial site will undergo remediation, as a prelude to redevelopment. It is expected that current sources of significant chemical exposure will be either eliminated or reduced to acceptable levels in a matter of months. Therefore, CVs designed for screening chronic exposures of lifelong duration would not be appropriate at the Reading Gray Iron site. (This includes cancer risk evaluation guides (CREGs) and other cancer-based values, all of which are predicated upon chronic, essentially lifelong, exposure.) Nor would screening values specific for very young children (whether or not they exhibit pica behavior) be appropriate for screening at the Reading Gray Iron site, because this industrial site is fenced off completely from all nearby residential areas and schools. Of course, fences will not be 100% effective at excluding determined adolescent or adult trespassers, but they do effectively exclude very young children who, as a general rule, do not play unsupervised on industrial properties.

Considering that the most plausible exposure scenarios at the Reading Gray Iron site will involve primarily intermittent exposures, over an intermediate period of time (i.e., less than one year), in adolescent trespassers and adults, ATSDR's acute and intermediate environmental media evaluation guides (EMEGs) for adults and nonpica children were selected as the most appropriate CVs for screening the substances detected at this site. Screening values that would not be applicable to this particular site include those that are predicated on pica behavior or on chronic, essentially lifelong, exposures (e.g., chronic EMEGs, minimal risk levels [MRLs], reference doses [RfDs], risk-based concentrations [RBCs] and CREGs).

As ATSDR uses it, the term pica behavior refers to excessive soil consumption and is not to be confused with the practice of virtually all toddlers to put almost everything in their mouths. ATSDR defines a pica child as one who may consume as much as 5 grams (5,000 milligrams) of soil per day (ATSDR 2000c; Gough 1991). ATSDR child comparison values are uniformly based on a default body weight of 10 kilograms (kg) or 22 pounds. However, virtually all children weigh more than 22 pounds by the time they are 2 years old (Lane 2000). Because children this young will not have unsupervised access to this industrial site, a default body weight of 30 kg (instead of 10 kg) was used, to exclude very young children of pica age, i.e., toddlers and preschoolers aged 6 years or less (Lane 2000). Existing child EMEGs can be adjusted for a 30-kg body weight by simply multiplying the CV by 3.

When no acute or intermediate EMEGs were available for comparison, screening values for chronic exposures were used instead. When no noncancer CVs of any kind were available for a substance, comparisons were made with either (1) a screening value for a closely related substance or (2) concentrations that translate into exposure doses well below all of the established lowest-observed-adverse-effect levels (LOAELs) and no-observed-adverse-effect levels (NOAELs) for all species, including humans, reported in the ATSDR toxicological profile for that substance.

On another note, the public is generally exposed to only the top few inches of soil; therefore, ATSDR has defined surface soil as the top 3 inches (ATSDR 1994). For the Reading Gray Iron site, soil samples were collected from zero to 2 feet below ground surface (bgs), and then on continuous 2-foot intervals to a depth of 15 feet bgs. Below 15 feet bgs, samples were collected at the approximate center of 5-foot intervals until a maximum depth of 30 feet bgs was reached or the soil sampling equipment was unable to collect a sample. Further evaluation of the sampling data by ATSDR health scientists noted that most of the soils samples were analyzed for depths of

1 foot or greater. Thus, a majority of the soil contamination is probably in subsurface soils, implying that the public probably has no direct contact with such contamination at the site. Because the Reading Gray Iron site is scheduled for redevelopment, the potential still exists that such contamination in subsurface soils can appear at the surface through regrading, excavation, and other redistribution operations. Being conservative and erring on the side of public health, ATSDR decided to include all measured soil levels at all depths for the purpose of screening. Soil depth was only considered if a substance was selected for further public health evaluation in determining any public health implications as discussed in the Public Health Implications section of this health consultation.

Soil Exposure Pathway

Human exposure points to soil would mainly include the site itself and areas of close proximity surrounding the site. Site workers probably will be exposed to contaminated soil through three probable routes of exposure: (1) direct dermal contact, (2) inadvertent ingestion, and/or (3) inhalation. Moreover, residents who trespass onto the site will also probably be exposed to contaminated soil through these same routes of exposure. Residents living in close proximity to the site will probably be exposed to contaminated soil through the inhalation of airborne soil particles from the site of less than 10 microns (µm), especially if fugitive dust controls are not implemented at the site during remediation and/or redevelopment. At the time of the BER, airborne soil particles from the site were not a concern because a high percentage of the site property was either overgrown with vegetation or covered with nonerodible elements (e.g., building debris, abandoned motor vehicles and parts, pebbles, rocks, and stones) that inhibited soil particles from becoming airborne (see Figure 3). Moreover, there was little to no mechanical disturbance of the soil at the site, another action that helps to increase the concentration of airborne soil particles. (This won't be the case when remediation and/or redevelopment begins.) Furthermore, much of the industrial activity and major operations at the site property have ceased, which also helps to decrease the amount of soil particles being released into the atmosphere.

Soil concentration values for the chemicals and metals exceeding soil CVs (refer to Tables 1 through 4) were used to estimate combined average daily doses of exposure (i.e., aggregate dose due to ingestion, dermal, and inhalation exposures). The estimated doses are listed in Tables D-3 thru D-5 in Appendix D. The equations and assumptions used in making the estimates are discussed further in Appendix D. The exposure scenarios used by ATSDR environmental health scientists are listed in the following paragraphs. Please note that these dose estimates are extremely conservative and are only used as precursors to a more comprehensive public health study if needed. For instance, the estimated inhalation dose represents the exposure an individual will have from an area of contamination at its center. This even applies for off-site exposures, which is totally unrealistic; however, the degree of an off-site exposure is only limited to the average soil concentration for the contaminated area.

Exposure Scenario 1 – Child Trespassing On Site: Assume a child who does not exhibit pica behavior frequently trespasses at the site, at least ⅓ of the year, because of the site's proximity within an urban residential neighborhood (EPA 1997). Also, assume a default body weight of 30 kg (instead of 10 kg) to exclude very young children of pica age (i.e., toddlers and preschoolers aged 6 years or less).

Exposure Scenario 2 – Child Not Trespassing On Site: Assume a child does not frequently trespass at the site and lives in close proximity to the site in the nearby residential neighborhood. Also assume a default body weight of 10 kg because very young children of pica age (i.e., toddlers and preschoolers aged 6 years or less) cannot be excluded from this scenario.

Exposure Scenario 3 – On-Site Worker: Assume an adult works at the site and also lives in the nearby residential neighborhood.

Exposure Scenario 4 – Non-Worker Adult: Assume an adult does not work at the site, but does live in the nearby residential neighborhood.

Information included in Table D-3 and Table D-5 shows that most of the combined average daily exposure is attributable to ingestion (i.e., assuming little to no contribution by dermal exposure) because the estimated values in both tables are approximately the same. Table D-4 shows that inhalation exposures alone, probably the most likely route of exposure, won't cause any real impact to public health. First, the estimated inhalation doses are well below the health guidelines listed in Table D-4. Second, the estimated inhalation doses for all the substances listed in Table D-4 are also well below any reported exposures known to cause adverse health effects (refer to the Public Health Implications section). (Note, the estimated inhalation doses were reverted to doses for oral exposure simply because most reported exposures are usually stated in the oral form of mg/kg/day, which makes for an easier comparison.) Therefore, the release of soil particles into the atmosphere during remediation and/or redevelopment may be more of a public nuisance for residents living adjacent to the site than an environmental agent impacting their health. Because it can be a potential public nuisance, every precaution should be taken in prohibiting such an occurrence from happening by mitigating or preventing the release of fugitive dust from the site during remediation and/or redevelopment (i.e., implement fugitive dust controls). Chemical concentrations in the soil for certain areas, as cited in the environmental baseline assessment, exceeded environmental regulatory standards for the state of Pennsylvania. These areas are slated for remediation (i.e., excavation and off-site disposal) prior to site redevelopment (Paul H. Hayden, Arc Environmental, Inc., to Manuel S. Nzambi, Pennsylvania Department of Environmental Protection, Proposed Remediation Work Plan, March 25, 2003). Thus, such a remedial action could only lower any potential exposures experienced at or near the Reading Gray Iron site.

Groundwater Exposure Pathway

Chemical constituents in groundwater samples found to exceed drinking water CVs are listed in Tables 5 thru 8. These chemicals were not selected for further public health evaluation because residents in the residential neighborhood adjacent to the Reading Gray Iron site do not use area groundwater as a drinking water source (David S. Sutton, Division of Health Assessment and Consultation, ATSDR, to Anthony J. Consentino, Reading Area Water Authority. Information request via phone call, September 22, 2003). Because there is no exposure, there can be no potential for adverse health effects. Therefore, ATSDR concludes that the groundwater exposure pathway should be eliminated because there is no indication of exposure to detected groundwater contaminants occurring and there is no potential or direct impact to public health through this exposure pathway.

Residents of the city of Reading are connected to the municipal water supply furnished by the Reading Area Water Authority (RWA). The RWA supplies water to area homes from one single source, Lake Ontelaunee. The lake is owned exclusively by the city and is located approximately 6 miles north of the city limits, indicating the on-site monitoring wells are far downgradient of the water supply source.

The RWA is regulated under the Safe Drinking Water Act which requires monitoring for organic, inorganic, synthetic organic, and radiologic components in the drinking water at least annually and in some cases, monthly. In this way, potential contamination of the municipal water supply would be addressed by the RWA, the Berks County Department of Health and Human Services, the Pennsylvania Department of Health, and the Pennsylvania Department of Environmental Protection. Currently, the overall water quality of the municipal water supply meets all federal drinking water guidelines, ensuring that it is safe for public use.

Other Areas and Issues of Public Health Concern

Even though some sampled materials (drummed solids and stockpiled sands) at the Gray Iron property were not considered hazardous, ATSDR cannot readily ascertain if the materials pose a threat to public health without more information. Good prudent public health practice dictates that contact between these materials and the public should be minimized because such remnants left behind from industrial activities may pose physical hazards to the public. Actions of minimizing such contact may include, but are not limited to, the following: securing the site and restricting access, and at the earliest opportunity, disposing of potentially hazardous materials at an appropriate disposal facility off site. The removal of materials suspected of containing asbestos (ACMs) should be conducted in accordance with all applicable regulations for the appropriate handling, transportation, and disposal of such materials, so as not to promote the release of asbestos fibers into the air.

Public Health Implications

This section discusses the health effects that could plausibly result from exposures to site chemicals. While the relative toxicity of a chemical is important, the response of the human body to a chemical exposure is actually determined by several additional factors, including the magnitude (how much), the duration (how long), and the route of exposure (breathing, eating, drinking, or skin contact). Lifestyle factors (e.g., occupation and personal habits) have a major impact on these three elements of exposure. After exposure has occurred, individual characteristics such as age, sex, nutritional status, overall health, and genetic constitution will affect how a chemical is absorbed, distributed, metabolized, and eliminated from the body. Together, all these factors help determine the individual's physiological response to chemical exposures and what, if any, adverse health effects he or she may suffer as a result of the chemical exposures.

Substances Without Comparison Values

No noncancer CVs exist for the following PAHs (the percentages in parentheses indicate the approximate detection frequency of each substance): acenaphthylene (6%), benzo(a)anthracene (23%), benzo(a)pyrene (22%), benzo(b)fluoranthene (31%), benzo(g,h,i)perylene (20%), benzo(k)fluoranthene (15%), chrysene (27%), dibenzo(a,h)anthracene (4%), ideno(1,2,3-cd)pyrene (21%), or phenanthrene (25%) (Table 2). However, all known effects levels for all PAHs in any species are greater than 1 mg/kg/day (ATSDR 1995). A 30-kg child would have to ingest 200 milligrams (mg) of soil containing 150,000 parts per million (ppm) PAHs in order to get a dose of 1 mg PAH/kg/day. The latter concentration is about 350 times greater than the highest single concentration of any PAH detected in any soil sample at the Reading Gray Iron site (see Table 2). Due to the variable distribution and limited frequency of detection, actual exposures will be even lower. It is also relevant that, for a number of reasons, PAHs in soil are not particularly toxic, anyway (ATSDR 1995). Therefore, intermittent exposure to PAHs in on-site soils is not expected to pose any health hazard to adolescent or adult trespassers.

Similarly, neither ATSDR nor EPA have any noncancer CVs for 3,3'-dichlorobenzidine (Table 2). However, 3,3'-dichlorobenzidine was detected in only 1 of 110 samples (suggesting that opportunities for exposure will be extremely limited), and that single detect was only 5 ppm. All of the established LOAELs and NOAELs for all noncancer effects in all species tested are at least an order of magnitude greater than 1 mg/kg/day (ATSDR 1998). For a 30-kg child ingesting 200 mg of soil per day, a dose of 1 mg/kg/day would translate into 150,000 ppm in soil, which is 30,000 times higher than the single detect of 5 ppm. Therefore, in the unlikely event that someone came into regular contact with the single soil sample that contained detectable levels of 3,3'-dichlorobenzidine, that exposure would be of no toxicological significance, i.e., it would pose no hazard to public health.

Aroclor 1260 and Aroclor 1254 were each detected in only one of 53 soil samples (<2%) from the Reading Gray Iron site; the concentration for Aroclor 1260 was 0.59 ppm (Table 3). No PCBs of any kind were detected in the remaining 51samples (Table 3). The relative rarity of detectable PCB contamination in on-site soils would greatly reduce the opportunity for (and the frequency of) exposure. And the contacts, if any, that might occur anyway would be of no public health significance. Although no noncancer comparison value was available for Aroclor 1260, the single detect of 0.59 ppm is below ATSDR's intermediate soil EMEG (2 ppm) for Aroclor 1254, a closely related PCB. (The difference between the two PCB mixtures is that Aroclor 1254 is 54% chlorinated while Aroclor 1260 is 60% chlorinated.) In addition, no known adverse health effects of any kind are known to be produced in any species (including humans) by doses of any PCB lower than 0.001 mg/kg/day (ATSDR 1997, 2000b). By comparison, a 30-kg child ingesting 200 mg of soil per day containing 0.59 ppm PCBs would receive a dose of only 0.000004 mg/kg/day, or 250 times less. Therefore, PCBs in soil pose no hazard to public health at the Reading Gray Iron site.

Substances Exceeding Comparison Values

Except in those rare instances when a single exposure is of sufficient magnitude to produce adverse health effects all by itself, average daily exposures, over a period of time, tend to be more toxicologically relevant than do maximum exposures. By the same token, average concentrations of a contaminant detected in a local environmental medium will tend to be more toxicologically relevant than maximum concentrations at isolated “hot spots.” Nevertheless, ATSDR's 1992 Public Health Assessment Guidance Manual specifically states that “for the purpose of selecting substances for further public health evaluation, the maximum concentration of a substance should be used” (ATSDR 1992a). Substances thus identified during the preliminary screening that need “further public health evaluation” are evaluated using “the best medical and toxicologic information available to determine the health effects that may result from exposure to site contaminants” (ATSDR 1992a). As discussed earlier in this document, a site-specific analysis of potential exposures to current levels of contaminants at the Reading Gray Iron site must take into account the fact that such exposures are likely to be limited to adolescent and adult trespassers and will occur only intermittently, over an intermediate period of time (<1 year). Thus, in the following analyses, emphasis is placed on estimated levels of subchronic exposure which may occur to the occasional trespasser who weighs 30 kg or more (i.e., is 6 years old or older).

Arsenic was detected in almost 68% of soil samples from the Reading Gray Iron site. The single highest concentration of arsenic detected in 142 soil samples taken at the Reading Gray Iron site was 230 ppm. However, these measures are reflective of total arsenic and not of the bioaccessible fraction, which is of most concern. As cited by ATSDR, “Estimates of the soluble, or bioaccessible, arsenic fraction have ranged from 3 to 50% for various soils and mining and smelter waste materials (Rodriguez et al. 1999; Ruby et al. 1996); these estimates are similar to in vivo estimates of the relative bioavailability of arsenic in these same materials (Ruby et al. 1999)” (ATSDR 2000a). Assuming 50% bioavailability of arsenic in soil, a 30-kg (66-lb) child who, twice a week, eats 200 mg of on-site soil containing 230 ppm inorganic arsenic will ingest on average 6.6 micrograms per day (µg/day) of arsenic for a dose of only 0.00022 mg/kg/day. That exposure would be lower than ATSDR's acute and chronic oral MRLs for arsenic of 0.005 and 0.0003 mg/kg/day, respectively (ATSDR 2000a). A dose of 0.00022 mg arsenic per kilogram per day (As/kg/day) would be comparable to the low end of the normal range of estimated total daily arsenic intake (6–63 µg/day, or about 0.0002–0.0021 mg/kg/day) for “unexposed” children 5–11 years of age (ATSDR 2000a). It would be less than the projected 12–50 µg/day nutritional requirement for dietary arsenic (Marcus and Rispin, 1988). Actual, site-specific exposure doses will be reduced even further by (1) larger body weights (e.g., those appropriate for teens and adults), (2) lower (i.e., more realistic) levels of average exposure, and (3) lower estimates of fractional bioavailability (e.g., those which are more likely to apply to aged contaminated soils like those at the Reading Gray site). These low estimates of fractional bioavailability are usually a result of diminished bioavailability of persistent toxic chemicals (e.g., metals) with increasing residence time in soils (Alexander 1995). Therefore, intermittent exposure to arsenic in on-site soils at the Reading Gray Iron site is not likely to pose any public health hazard to trespassing children or adults. In addition, on-site soils that contain 55–230 ppm arsenic at depths of 0–2 feet are scheduled for remedial removal.

Arsenic was initially selected as a chemical of concern at this site because its maximum detected concentration (230 ppm) exceeded the environmental regulatory standard for arsenic as set by the Pennsylvania Department of Environmental Protection (Non-Residential Direct Contact Medium Specific Concentration value of 53 milligrams per kilogram). Because ATSDR only considered acute and intermediate exposures to soil at this site, the maximum concentration level for arsenic did not exceed ATSDR's selective screening level of 300 ppm (ATSDR's acute EMEG for a child ingesting soil). (ATSDR has no intermediate EMEGs for arsenic in soil.) The maximum concentration level for arsenic, however, did exceed ATSDR's 200 ppm chronic soil EMEG for adults by 15% and was 11.5 times higher than ATSDR's 20 ppm chronic soil EMEG for children. Both chronic EMEGs, like the chronic MRL from which they were derived, contain a built-in threefold (or 300%) uncertainty (safety) factor.

However, ATSDR's chronic soil EMEGs for arsenic are based on a 0.0008 mg/kg/day NOAEL derived from an old (1968) drinking water study of a Taiwanese population which (a) likely had higher-than-estimated dietary arsenic exposures and (b) may also have suffered from compromised methylation status due to suboptimal nutrition (Tseng et al., 1968; ATSDR 2000a). (Methylation is the primary mechanism by which arsenic is detoxified in the body.) When total exposures are underestimated in a study, the risks attributed to those exposures will be proportionately overestimated. And when health risk estimates are based on effects observed in unhealthy or more susceptible populations, they will necessarily overestimate risks to healthier, less susceptible populations. The limited applicability of the Taiwanese drinking water study to Americans is demonstrated by the fact that none of the cancer incidences and health effects noted in the Taiwan studies have ever been seen in U.S. populations exposed to 100–200 parts per billion (ppb) (0.1–0.2 mg per liter [L]) arsenic in drinking water (ATSDR 2000a). A 70-kg adult consuming 2 L/d of drinking water containing 200 ppb inorganic arsenic would receive a daily dose of 0.0057 mg/kg/day. A 30-kg child consuming 1 L/d of drinking water containing 200 ppb inorganic arsenic would receive a daily dose of 0.0067 mg/kg/day. These doses are just under half the estimated LOAEL for dermal effects in the Taiwan study (0.014 mg/kg/day). The true margin of safety is likely to be significantly higher for populations in the United States. Just how much higher is impossible to tell, because the effects observed in the Taiwanese population have not been seen in this country (Lewis et al. 1999; ATSDR 2000a; Steinmaus et al. 2003; Lamm et al. 2004).

Due to the lower exposure to, and lower bioavailability of, arsenic in soil, the Taiwanese study will be even less relevant to soil ingestion exposures in the United States than to drinking water exposures. Depending on the form of arsenic, the type of soil, and the age of the combination, the bioavailability of arsenic may be several-fold less in soil than it is in water (ATSDR 2000a). Estimates of the soluble, or bioaccessible, arsenic fraction have ranged from 3% to 50% for various soils and mining and smelter waste materials, and these estimates are similar to in vivo estimates of the relative bioavailability of arsenic in these same materials (ATSDR 2000a). Due to both reduced intake and reduced bioavailability, the potential for toxic exposures from U.S. soils is much less than that from drinking water. Taking these factors into account, in addition to site-specific conditions of exposure, even maximum exposures to on-site soils at the Reading Gray Iron site are expected to be less than ATSDR’s chronic MRL for arsenic (0.0003 mg/kg/day).

Cadmium (Cd) was detected in 69 of 137 soil samples taken at the Reading Gray Iron site. The highest detected concentration of cadmium (19 ppm) was well below ATSDR's chronic EMEG for adults (100 ppm). If a 30-kg child consumed 200 mg of on-site soil containing the maximum detected concentration of cadmium (19 ppm), that child would ingest about 0.00013 mg Cd/kg/day, which is less than ATSDR's chronic MRL of 0.0002 mg/kg/day. Cadmium was initially selected for evaluation because the maximum detected concentration (19 ppm) exceeded ATSDR’s chronic child EMEG of 10 ppm which (like the MRL on which it is based) contains a built-in tenfold uncertainty (safety) factor (ATSDR 1999a). However, all of ATSDR's child EMEGs are based on a default child body weight of only 10 kg. This, in effect, makes those EMEGs specific for children under 2 years of age (Lane 2000). To make that EMEG relevant to older children (e.g, 8–10 year olds), one would have to multiply it by a factor of 3 to adjust it for a default child weight of 30 kg (Lane 2000). The resulting adjusted EMEG (30 ppm) would be higher than any concentration of cadmium detected in soil at the Reading Gray Iron site. Therefore, cadmium in on-site soils does not pose any health hazard to children who may trespass on this site. (The on-site soil that contained 19 ppm cadmium at depths of 1–2 feet is scheduled for remedial removal because of its lead content, not its cadmium content.) As explained previously, exposures to contaminants at this site are likely to be of intermediate duration. However, because ATSDR has no CVs for intermediate exposure to cadmium, ATSDR's chronic EMEG is used in this illustration. Because intermediate EMEGs are generally higher than chronic EMEGs, the use of a chronic, rather than an intermediate, CV merely introduces an additional margin of safety into the analysis.

Copper (Cu), a natural constituent of soil and a required nutrient, was detected in all of the 137 soil samples taken at the Reading Gray Iron site. Using a site-specific body weight of 30 kg, a child eating 200 mg soil/day containing the maximum concentration of copper detected at the Reading Gray Iron site (2600 ppm) would ingest 0.0173 mg Cu/kg/day, which is less than ATSDR's acute and intermediate MRL of 0.02 mg/kg/day. That same child would have to eat 200 mg of soil containing 4,080 ppm copper in order to get a NOAEL dose of 0.0272 mg/kg/day. And, as with all metals, the bioavailability of copper in soil will be less than the bioavailability in drinking water (the vehicle used in the relevant toxicological studies on copper). Safe levels in soil will, therefore, be proportionately higher. Even the highest copper concentration detected in 137 soil samples at the Reading Gray Iron site would pose no health hazard to children or adults who may trespass on the site. Nevertheless, the on-site soil that contained 2,600 ppm copper at 0–2 feet is currently scheduled for remedial removal due to its arsenic content.

Copper was initially selected as a chemical of concern at this site because the highest detected concentration (2,600 ppm) exceeded by 30% ATSDR's acute/intermediate child EMEG of 2,000 ppm which contains a built-in uncertainty (safety) factor of 3 (or 300%) (ATSDR 2002). (Before dividing by the uncertainty (safety) factor of 3 to calculate the acute-intermediate MRL, the NOAEL exposure dose was almost doubled to take into account an additional average dietary copper intake of 0.0266 mg Cu/kg/day.) However, that soil EMEG was based on a 0.0272 mg/kg/day NOAEL for gastric distress in humans exposed for 2 weeks via drinking water, without taking into account the reduced bioavailability of metals in soil. Also, like all of ATSDR's child EMEGs, this comparison value was based on a body weight of 10 kg that is more appropriate for 2-year-olds than the teenagers and adults who might actually trespass on this industrial site.

EPA's standards for lead (Pb) in residential and industrial soils are 400 and 750 ppm, respectively (ATSDR 1999b). The average of the 146 detects (70 ppm) out of 150 samples is well below both standards. Those standards were actually exceeded in only 12 (8%) and 18 (12%) of 150 samples, respectively. Only 6 (4%) of 150 samples (1,700–2,900 ppm, depth 0.5 to 2 feet) exceeded Pennsylvania's standard of 1,000 ppm lead in soil, and all of the corresponding areas are scheduled for remediation. In the meantime, their relative rarity reduces the odds that trespassers will frequently come into contact with highly contaminated on-site soils before the soils are remediated. Because the on-site soils that contain very high concentrations of lead are relatively rare and will be remediated in the near future, lead is unlikely to pose a public health hazard to the occasional trespasser, i.e., as long as the highest soil lead levels to which people might plausibly be exposed are insufficient to produce acute lead poisoning. As discussed in the following paragraph, under the site-specific conditions of exposure, the potential for such acute effects is very low.

The highest concentration of lead in a potentially accessible Reading Gray Iron soil sample was 2,200 ppm. Assuming a 30-kg child consumes 200 mg of soil daily containing 2,200 ppm lead (the highest concentration detected at Reading Gray in soil samples from depths ranging from 0.5 to 1.5 feet), equates to this child ingesting 0.015 mg Pb/kg/day. At comparable levels (0.005–0.020 mg/kg/day), subtle effects (e.g., on certain enzyme activities) have been produced in a few studies, but only by administering the most highly soluble form of lead (i.e., lead acetate) in drinking water (two rat studies) or in capsules (two human studies) daily for weeks or months (ATSDR 1999b). However, the more soluble forms of lead (e.g., lead acetate) tend to leach out of soils, leaving behind only the relatively insoluble forms (e.g., lead sulfide). The relatively insoluble forms of lead that predominate in soil are much less readily absorbed by the body than are the soluble forms dissolved in water (ATSDR 1999b). Other factors that also tend to reduce the bioavailability of lead in soil are (a) competition with other metals and (b) the "aging" of metal complexes in soil. Both of these factors will be important at the Reading Gray Iron site because the facility operated as a foundry for several decades.

The next highest soil lead concentration in potentially accessible on-site soil (410 ppm) was detected in a sample from 0–2 feet. Assuming 100% absorption, daily consumption by a 30-kg child of 200 mg of this soil would yield a dose of 0.0027 mg Pb/kg/day. A high estimate of absorption of lead in soil (i.e., 40%) would reduce that dose to only 0.001 mg/kg/day (ATSDR 1999b). There are no known acute, intermediate, or chronic adverse health effects (subtle or serious) associated with such low doses of lead, regardless of form or route of administration (ATSDR 1999b). Therefore, considering the improbability of frequent contact with highly contaminated samples, it is unlikely that existing levels of lead in soils at the Reading Gray Iron site could, under site-specific conditions of exposure, ever produce any adverse health effects in trespassing children or adults, even if those soils were not remediated as planned.

Only 11 of 130 Reading Gray Iron soil samples from depths of 0–14 feet may have contained thallium in excess of ATSDR's thallium salt soil EMEGs of 4–5 ppm. And, only one of these, the 28 ppm maximum detected 9 feet deep near the railroad lines, was a clear detect. (This maximum excludes probable false positives resulting from high iron interference, and nondetects at higher detection limits in samples from depths of 1 foot, all of which comprise no more than 10% of the 130 samples analyzed.) No comparison values exist for elemental thallium in soil. However, the soil RMEGs for acetate, carbonate, nitrate, and sulfate salts of thallium are all 60 ppm for adults, and range from 4 ppm to 5 ppm for children (10 kg body weight assumed). The latter would be tripled (i.e., 12 ppm to 15 ppm) if they were adjusted for the more site-relevant body weight of 30 kg, but would still be about half the maximum detected concentration of 28 ppm, i.e., if one assumes 100% bioavailability. If, on the other hand, one assumes a more realistic 50% absorption of thallium from soil—the RMEGs are based on studies in which rats were exposed to thallium in aqueous solutions—the maximum concentration detected at the Reading Gray Iron site would not exceed ATSDR's RMEGs for thallium salts. Note that the RfDs for all of the thallium salts mentioned above assume chronic, essentially lifelong, exposure and include a 3,000-fold uncertainty (safety) factor (ATSDR 1992b). Due to the depth and relative rarity of thallium-contaminated soil samples (which minimizes the potential for contact), the reduced bioavailability of metals in soil (relative to that in drinking water) and the magnitude of the uncertainty (safety) factors incorporated into the relevant comparison values (3,000-fold in EPA's RfDs), those contacts (if any) that do occur with thallium-contaminated soils will, under site-specific conditions of exposure, pose no hazard to public health.

Child Health Considerations

ATSDR considers children in the evaluation for all environmental exposures and uses health guidelines that are protective for children. When evaluating any potential health effects via ingestion, children are considered a special population because, due to their lower body weight, the same exposure will result in a higher dose in children when compared to adults. Average body weight differences, as well as average differences in child-specific intake rates for various environmental media, are taken into account by ATSDR's child EMEGs (environmental media exposure guidelines).

As illustrated in Tables D-3 and D-5, the exposure scenario that may be of some concern is that of a child trespassing on site and ingesting a large amount of dirt. However, the compulsion to eat large amounts of nonnutritive substances such as dirt (known as pica behavior) is not common to all children. In one study of soil ingestion by children, 1 out of 320 children (0.3%) ingested as much as 5,000 milligrams (mg) of soil in a single day (ATSDR's default soil ingestion rate for pica children); 95% of the children studied ingested less than 100 mg of soil daily (i.e., an average soil ingestion rate of only 40 mg/day) (Gough 1991). By comparison, the default soil ingestion rate used by ATSDR for nonpica children is 200 mg/day. Also, the available data suggest that pica events (i.e., consumption of 5,000 mg of soil in a single day) do not occur daily, but on average only 40 times a year. Daily intake is assumed for screening purposes, however, to be more protective of public health (ATSDR 2000c; Gough 1991). Finally, pica behavior is exhibited most often in very young children of 2 to 3 years of age who are unlikely to have ready access to highly contaminated soils usually found at hazardous waste sites, such as the Reading Gray Iron site. Because the Reading Gray Iron site is a former industrial property and fenced off completely from all nearby residential areas and schools, ATSDR concluded that it is highly unlikely that very young children of pica age (i.e., toddlers and preschoolers aged 6 years or less) would even be present at the site.

Regardless of the source of contaminated soil (residential or industrial areas) and the total daily soil ingestion rate one uses, it is unlikely that a person is exposed to soil from the same maximally contaminated spot every day. Thus, actual average daily exposures to contaminants in soil are likely much less than those suggested by the worst case estimates previously discussed.

Considering that the estimates of potential exposures previously discussed represent the most reasonable worst-case scenarios and that even these exposures are well below levels known to cause any adverse health effects, ATSDR concludes that the levels of chemicals detected at the Reading Gray Iron site pose no public health hazard to children.

Conclusions

On the basis of the information reviewed in this health consultation, ATSDR concludes that, under site-specific conditions of exposure, exposures to the chemicals identified in the immediate vicinity of the Reading Gray Iron site are not at levels expected to cause adverse health effects and thus, no public health hazard exists for nearby residents. Because the potential for exposure exists, ATSDR has categorized this site as a No Apparent Public Health Hazard. This conclusion is supported by the following.

1. Residents who work or trespass, especially children, at the Reading Gray Iron site are not exposed to chemical substances or metals in soil at levels high enough to induce adverse health effects through the combined routes of exposure that include inadvertent ingestion, dermal contact, and inhalation.

2. Residents who live in the urban residential neighborhood adjacent to the Reading Gray Iron site and who do not frequently trespass at the site may be potentially exposed to site-related contaminants from fugitive dust emissions. However, the levels of these site-related contaminants in the fugitive dust particles are unlikely to induce adverse health effects through the inhalation route of exposure alone. At the time of the BER, fugitive dust emissions from the site were limited because a high percentage of the site property was either overgrown with vegetation or covered with nonerodible elements that inhibit soil particles from becoming airborne. These fugitive emissions may increase during remediation and/or redevelopment of the site when the soil is mechanically disturbed, potentially creating more of a public nuisance than an environmental health impact.

3. Residents are not exposed to contaminants in the groundwater because outlying residential homes are connected to the municipal water supply. There is no evidence of contamination of the municipal water supply.

4. Remnants of industrial use (e.g., building debris, abandoned motor vehicles and parts, abandoned storage/chemical drums, aboveground storage tanks, and material stockpiles) left behind at the site from previous industrial activities may have the potential of posing physical hazards to residents who live nearby or adjacent to the site.

Recommendations

1. A collection of industrial materials and remnants from past operations may still remain at the Reading Gray Iron site. To protect residents who may frequently trespass at the site from any unforeseen dangers (e.g., physical hazards), it is highly recommended that any materials still remaining at the site be sent to an appropriate off-site treatment, storage, and disposal facility prior to site redevelopment.

2. The release of soil particles into the atmosphere during remediation and/or redevelopment may still pose a public nuisance for residents living adjacent to the site. Thus, it is recommended that fugitive dust controls be implemented to reduce as much as possible the release of fugitive dust emissions from the site during remediation (i.e., soil excavation of designated areas) and/or redevelopment.

Public Health Action Plan

No actions due to public health concerns are recommended.

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