Public Health Assessment for

CEDARTOWN INDUSTRIES, INC.
CEDARTOWN, POLK COUNTY, GEORGIA
EPA FACILITY ID: GAD095840674
DECEMBER 21, 2005

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
Agency for Toxic Substances and Disease Registry

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment was prepared by ATSDR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6)), and in accordance with our implementing regulations (42 C.F.R. Part 90). In preparing this document, ATSDR has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate.

In addition, this document has previously been provided to EPA and the affected states in an initial release, as required by CERCLA section 104 (i)(6)(H) for their information and review. The revised document was released for a 30-day public comment period. Subsequent to the public comment period, ATSDR addressed all public comments and revised or appended the document as appropriate. The public health assessment has now been reissued. This concludes the public health assessment process for this site, unless additional information is obtained by ATSDR which, in the agency's opinion, indicates a need to revise or append the conclusions previously issued.

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PUBLIC HEALTH ASSESSMENT

CEDARTOWN INDUSTRIES, INC.
CEDARTOWN, POLK COUNTY, GEORGIA

EPA FACILITY ID: GAD095840674

Prepared by:

Georgia Department of Human Resources
Division of Public Health
Under a cooperative agreement with
Agency for Toxic Substances and Disease Registry

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Glossary of Acronyms

ATSDR	Agency for Toxic Substances and Disease Registry
COC	Contaminants of Concern
CREG	Cancer Risk Evaluation Guide
CSF	Cancer Slope Factor
CVs	Comparison Values
EMEG	Environmental Media Evaluation Guide
EPA	United States Environmental Protection Agency
GEPD	Georgia Environmental Protection Division
GDPH	Georgia Division of Public Health
IARC	International Agency for Research on Cancer
IRIS	Integrated Risk Information System
LOAEL	Lowest Observed Adverse Effects Level
mg/kg/day	milligrams per kilogram per day
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MRL	minimal risk level
NOAEL	No Observed Adverse Effects Level
NPL	National Priorities List
NTP	National Toxicology Program
ppb	parts per billion
ppm	parts per million
ROD	Record of Decision
RfC	Reference Concentration
RfD	Reference Dose
RMEG	Reference Dose Media Evaluation Guide
SVOC	semi-volatile organic compound
ug/kg	micrograms per kilogram
ppb	micrograms per liter
ug/m^3	micrograms per cubic meter
VOC	Volatile Organic Compound

Summary

The Cedartown Industries, Inc. (Cedartown Industries) site was originally used as a foundry and machine shop. From February 1978 to May 1980, a secondary lead smelter was located on the site. The Agency for Toxic Substances and Disease Registry (ATSDR) conducted a public health assessment of Cedartown Industries that was published January 29, 1990. At that time, ATSDR concluded that this site posed an indeterminate public health hazard to humans exposed to known concentrations of hazardous substances on-site. ATSDR reached this conclusion because a comprehensive evaluation determining the extent of on/off-site contamination had not been conducted. The Georgia Division of Public Health (GDPH) is providing a follow-up public health assessment of Cedartown Industries. GDPH has reviewed extensive soil, groundwater, surface water, site remediation, and monitoring data that have been generated since 1990.

This public health assessment contains information about the extent of contaminated soil, groundwater, surface water, air, and conclusions about the health risks posed to the public. A public health assessment is specifically designed to provide information about the public health implications of a specific site and to identify populations for which further health actions or health studies are needed. It is not intended to serve the purpose of or influence any other environmental investigation such as risk assessment or selection of remedial measures, or to address liability or other non-health issues.

GDPH has determined that this site poses **no public health hazard**. Human exposure to contaminated media occurred in the past, but the exposure was below a level of health hazard. Remediation at the site was completed in 1997 and all exposure pathways have been eliminated.

There are no recommendations at this time. If additional data become available, the information will be reviewed by GDPH, and appropriate actions will be taken. GDPH will also respond to all requests for information regarding health issues associated with the landfill

Purpose and Health Issues

The Cedartown Industries, Inc. site (Cedartown Industries) was put on the National Priorities List (NPL) by the U.S. Environmental Protection Agency (EPA) in February 1990. Since 1986, the Agency for Toxic Substances and Disease Registry (ATSDR) has been required by law to conduct a public health assessment at each of the sites on the NPL. The aim of these evaluations is to find out if people have been exposed to hazardous substances and, if so, whether that exposure is harmful and should be stopped or reduced. ATSDR published a public health assessment for Cedartown Industries on January 29, 1990 [1]. At that time, ATSDR concluded that this site posed an indeterminate public health hazard to humans exposed to known concentrations of on site hazardous substances. ATSDR reached this conclusion because a comprehensive evaluation determining the extent of on/off-site contamination had not been conducted.

The Georgia Division of Public Health (GDPH) is providing a follow-up public health assessment of Cedartown Industries. GDPH has reviewed extensive soil, groundwater, surface water, site remediation, and monitoring data that have been generated since 1990. The information in this public health assessment is specifically designed to provide the community with information about the public health implications from exposure to hazardous substances at this site, and to identify populations for which further health actions are needed. It is not intended to serve the purpose or to influence any other environmental investigation such as a risk assessment, or to address liability, remediation, or other non-health issues.

Background

Site Description

The Cedartown Industries site is located at 404 South Furnace Street in Cedartown, Polk County Georgia, about one-half mile west of the downtown area (Figure 1). The site is 6.8 acres where a secondary lead smelting business operated for approximately two years. Currently, three buildings are located on the property. One of these buildings houses the offices of a trucking company, which leases the site for the parking and maintenance of vehicles. Maintenance of tractor-trailers in conducted in two of the buildings located onsite. The site is bordered by Cedar Creek to the west and a chain link fence to the north, south, and east. A levee, constructed in 1980, borders the site to the west, north, and south to protect the site from a 100-year flood. The chain link fence on the north side of the property does not continue to the bank of the river, but stops short of the levee. This gap may provide entry way onto the property for trespassers. Immediately north of the site is a narrow strip of land with railroad tracks, and beyond the tracks is a junkyard that has been in existence since at least the 1940's. Across the street to the east is a farm supply store that is now out of business and to the south is a large, partially wooded area owned by the current owner of the Cedartown Industries site. In general, land use in the vicinity of the site, especially to the south and west, is largely agricultural and commercial. The site is fenced on three sides to prevent access, with the fourth side inaccessible due to the steep topography of the levee and the presence of Cedar Creek.

Gap along the northwest fence line ending at the levee adjacent to Cedar Creek west of the property. Entrance to property may be gained from the railroad tracks running along the northern property boundary. A groundwater monitoring well can be seen in the upper right area of the photo.

Figure 1

Map of Cedartown Industries and surrounding area

Site Operations and History

The Cedartown Industries site was initially operated as an iron foundry under the name Cherokee Furnace. The foundry opened in the 1870's with a capacity for 50 tons per day. At the turn of the century, the furnace was processing about 100 tons per day. Ore was reportedly shipped to the furnace along a narrow gauge railway that crossed Cedar Creek just south of the present CSX rail line [2].

Company ownership changed twice in the 1930's and was renamed Cedartown Foundry. From 1978 to 1980, Sanders Lead Company, Inc. (Sanders Lead) used the site for a secondary lead smelting business. The secondary lead smelting operation purchased raw lead materials from various suppliers and recycled these materials through various melting and skimming processes. Although a battery cutting operation including a surface impoundment was partially constructed on site, the operation was terminated before batteries were broken on site [2].

The current property owner purchased the site in August 1984. The site has been leased to the H&W Transfer Company for parking and maintenance of vehicles, mainly tractor-trailers. The property east of the site was reportedly a coke smelter at the time the Cedartown Foundry was operating. The property southeast of the site was reportedly the Cedartown municipal landfill, which was closed in the late 1930's or early 1940's [2].

H&W Transfer Company where Cedartown Industries was once located. The site is located approximately 100 yards west of South Furnace St.

When the lead smelting operation ceased in 1980, waste material remained on site. On January 7, 1986, the Georgia Environmental Protection Division (GEPD) conducted an investigation and environmental sampling at the site. A Site Inspection Report prepared by GEPD in 1986 cited the presence of approximately 5,000 cubic yards of slag material and 32,000 gallons of wastewater in the inactive surface impoundment. Also, lead and cadmium were detected both in on-site waste piles and soil. The only compound reported above environmental regulatory levels during the investigation was lead [2].

The Cedartown Industries site was proposed for listing on the NPL by EPA in 1988 and finalized in February 1990. In June 1990, Sanders Lead entered into an Administrative Order on Consent with EPA to determine the nature and extent of contamination at the site and the associated health risks, and to evaluate alternatives for eliminating those threats. Sanders Lead, under EPA's oversight, completed the remedial investigation/feasibility study in December 1992.

Also under EPA oversight, removal of slag and coke storage piles, contaminated debris, soil, wastewater, and impoundment sediment from the site was completed in May 1990. A total of 6,700 cubic yards of solid hazardous materials (approximately 8,380 tons) were removed and transported to a permitted hazardous waste landfill. A total of 62,225 gallons of liquid waste was transported to an industrial wastewater treatment system designed and permitted to treat metal-containing liquid waste. When waste removal was completed, no visible waste material was present at the site. Soils which exceeded a lead concentration value of 500 mg/kg were excavated for onsite treatment. A Record of Decision (ROD) was signed on May 7, 1993. The ROD called for the excavation and onsite treatment of impacted soil by stabilization/solidification, and subsequent onsite disposal of treated soils as a final remedy. The ROD also called for monitoring the natural attenuation of cadmium in groundwater [3].

Partially constructed above grade buildings intended for use in the recycling operation were demolished for treatment by an onsite ex-situ solidification and stabilization process. Vegetative wastes were chipped, solidified, and placed with the treated material in the onsite excavations. Demolition debris was encased within the treated material in the excavation areas. Areas which received treated material were then covered with either pavement or a vegetated soil layer [3]. Site remediation was completed in May 1997.

For impacted groundwater, EPA provided two primary objectives of the natural attenuation remedy. These were: (1) to monitor the progress of the natural attenuation of cadmium-impacted groundwater, and (2) to assess the effectiveness of the soil remedial action in preventing leaching of contaminants of concern (COCs) to the uppermost aquifer [3].

Based on these objectives, a groundwater monitoring program was designed and implemented that consisted of quarterly monitoring which began in the third quarter of 1996 until the second quarter of 1999. Thereafter semi-annual groundwater sampling was conducted, which continues to the present time [3].

Groundwater monitoring activities were conducted at the four down-gradient monitoring wells (MW-1, MW-2, MW-3, MW-4) and one background monitoring well (MW-6) identified in Figure 2. Groundwater samples were analyzed for antimony, arsenic, beryllium, cadmium, and lead. Results for each of the quarterly and semi-annual monitoring events have been documented and submitted to EPA for review.

Demographics

The population within 1 mile of Cedartown Industries is approximately 6,000 people, with the closest residences located within a few hundred feet of the site. Using 2000 Census data, the

ATSDR has calculated population information for individuals residing within a 1-mile radius of the site using an area-proportion special spatial analysis technique (Figure 3).

Natural Resources

The site is located within the floodplain of Cedar Creek. As is typical with alluvial floodplain deposits, the topography of the site is essentially flat, sloping slightly towards the west and Cedar Creek. The site is separated from the creek by a levee, which rises approximately 5 to 10 feet above the site [4].

Cedar Creek is used for fishing downstream from the property. A large well that supplies the sole source of drinking water for Cedartown is located within a half-mile north of Cedartown Industries, and the Polk County water system is within 3 miles of Cedartown Industries [4]. Although a large proportion of the land surrounding the site is considered to be agricultural, groundwater is not used for irrigation in the vicinity of the site [1].

Cedar Creek directly west and adjacent to Cedartown Industries where surface water was sampled.

Geology/Hydrogeology

The soil at the Cedartown Industries site is primarily Etowah clay loam, reddish brown in color. Toccoa series soils are seen closer to Cedar Creek. These two soils have a fairly quick absorption rate, ranging between 15 to 45 minutes per inch, meaning that water moves relatively quickly through the soil eventually reaching groundwater [5]. The bedrock that underlies most of Cedartown is comprised of Newala Limestone; however, the Knox Group makes up the bedrock on the eastern side. Both types of bedrock weather to cherty clays over time, and they range from 25 to 150 feet in thickness [6].

The bedrock and upper aquifers are the two main hydrogeologic units at Cedartown Industries. The bedrock aquifer, otherwise known as the Newala Limestone aquifer, underlies the bedrock and is the more productive of the two. Water flow within this aquifer follows fractures and joints through the bedrock into the groundwater. The upper aquifer is the water table aquifer. Potentiometric data has shown that this aquifer flows towards Cedar Creek [5] and away from Cedartown Spring [7]. The spring receives its water from the Newala Limestone aquifer and produces an average of 3.9 million gallons per day [5].

Community Health Concerns

While this site was under investigation by EPA in the early 1990s, interviews were conducted with both public officials and citizens. During this time public meetings were held to address the concerns of the community. Some of the general concerns of the public were: air pollution, contamination of Cedar Creek, migration of the contaminants, and groundwater contamination. Health concerns regarding the contamination were also raised. During the meetings, some citizens recalled smelling odors released from the smelter during its operational years. The three main concerns were drinking water quality, water quality of Cedar Creek, future economic prosperity and property values. These concerns primarily involved the catching and eating of contaminated fish from Cedar Creek [8].

GDPH released the results of the current Cedartown Industries public health assessment for review and public comment from November 1 through December 1, 2005. No public comments regarding this public health assessment were received by GDPH.

Health Outcome Data

In March 2003, the GDPH Cancer Control Section analyzed current (1999-2001) cancer incidence data available for the 30125 zip code. Zip code areas are the smallest geographic units for which data are available. Analysis of a distribution of cancer cases in the 30125 zip code show that no cancer clusters and no significant numbers of cancer cases have been reported (Appendix A). No other health outcome data such as mortality or birth defects were evaluated. No site-specific health outcome data related to this site exist.

Discussion

Environmental Sampling Data

Several investigations were conducted at Cedartown Industries between 1986 and 2001 to characterize the extent of contamination released to environmental media (soil, groundwater, air, and surface water) from the site. Available data include surface and subsurface soil samples collected onsite, as well as background samples taken from west of the site. Groundwater samples were collected from shallow and deep groundwater monitoring wells in the water table and bedrock aquifer units on-site. Surface water samples were collected from eight locations on Cedar Creek and also from the on-site impoundment [2]. During the interim waste removal project in 1990, two high volume air samplers were used downwind of the waste piles to monitor potential airborne contaminants generated by remedial activities.

Pathway Analysis

GDPH identifies pathways of human exposure by identifying environmental and human components that might lead to contact with contaminants in environmental media. A pathways analysis considers five principle elements: a source of contamination, transport through an environmental medium, a point of exposure, a route of human exposure, and a receptor population. Completed exposure pathways are those of which all five elements are evident, and indicate that exposure to a contaminant has occurred in the past, is presently occurring, or will occur in the future. GDPH regards people who come into contact with contamination as exposed. For example, people who reside in an area with contaminants in air, or who drink water known to be contaminated, or who work or play in contaminated soil are considered to be exposed to contamination. Potential exposure pathways are those for which exposure seems possible, but one or more of the elements is not clearly defined. Potential pathways indicate that exposure to a contaminant could have occurred in the past, could be occurring now, or could occur in the future. However, key information regarding a potential pathway may not be available. It should be noted that the identification of an exposure pathway does not imply that health effects will occur. Exposures may, or may not be substantive. Thus, even if exposure has occurred, human health effects may not necessarily result [9].

GDPH reviewed the site's history, community concerns, and available environmental sampling data. Based on this review, GDPH identified exposure pathways that warranted consideration.

Evaluation Process

For each environmental medium (for example; air, soil, groundwater), GDPH examines the types and concentrations of contaminants of concern (COCs). In preparing this document, GDPH used ATSDR comparison values, to screen contaminants that may warrant further evaluation. Comparison values (CVs) are concentrations of contaminants that can reasonably (and conservatively) be regarded as harmless, assuming default conditions of exposure. The CVs generally include ample safety factors to ensure protection of sensitive populations. Because CVs do not represent thresholds of toxicity, exposure to contaminant concentrations above CVs will not necessarily lead to adverse health effects. CVs and the evaluation process used in this document are described in more detail in Appendix B. GDPH then considers how people may come into contact with the contaminants. Because the level of exposure depends on the route and frequency of exposure and the concentration of the contaminants, this exposure information is essential to determine if a public health hazard exists.

The contaminants identified for each exposure pathway related to the Cedartown Industries site are discussed in the following sections. Other contaminants not exceeding CVs were reviewed, but not selected for additional evaluation in this assessment. Tables 2 through 6 also include the chemical-specific CVs, which GDPH considered in the selection process.

When a contaminant exceeds a CV, the toxicological evaluation presented requires a comparison of calculated site-specific exposure doses (e.g., amount of the contaminant believed to enter the body at the person's body weight for an estimated duration of time) with an appropriate health guideline. The health guidelines are health-protective values that have incorporated various safety factors to account for varying human susceptibility and the use of animal data to evaluate human exposure. Health guidelines used include ATSDR's Minimal Risk Levels (MRLs) and EPA's Reference Dose (RfDs). MRLs and RfDs are described in more detail in Appendix C. Usually little or no information is available for a site to know exactly how much exposure is actually occurring, so health assessors sometimes assume worse case scenarios where someone received a maximum dose. Actual exposure is likely much less than the assumed exposure. In the event that the calculated, site-specific exposure dose for a chemical is greater than the established health guideline, it is then compared to exposure doses from individual studies documented in the scientific literature that have reported health effects. If a COC has been determined to be cancer causing (carcinogenic), a cancer risk is also estimated.

Exposure to contaminants could occur through a few routes at this site: ingestion, inhalation and/or dermal absorption. Ingestion is defined as direct ingestion, or actively and passively eating soil particles; and, indirect ingestion, or inhalation of dust particles that are then expelled from the respiratory tract and swallowed (ingested). Another route of exposure is inhalation. Inhalation is the act of drawing air into the lungs, which may be contaminated with very small particles and/or vapors. The last route of exposure possible at this site is dermal absorption, which is when contaminants are absorbed through direct contact with the skin.

At Cedartown Industries, soil, surface water, and air are completed exposure pathways that encompass the five principal elements of a pathway: a source of contamination, transport through an environmental medium, a point of exposure, a route of human exposure, and a receptor population. These three pathways were completed in the past before remediation took place onsite. All pathways have been eliminated through remediation and there are currently no completed exposure pathways at present or expected in the future. Groundwater is considered a potential past exposure pathway because contaminants may have migrated into the groundwater; however, on-site groundwater was never consumed as drinking water. Also, there are no drinking wells in the area, eliminating this point of exposure.

Table 1: Completed and Potential Exposure Pathways

Pathway	Exposure Pathway Elements					Time
	Sources	Medium	Point of Exposure	Route of Exposure	Exposed population	
Soil	Movement of contaminants from on-site waste accumulation piles into soil	Surface soils	Surface soil, dust on-site	Ingestion, Inhalation, Dermal Absorption	Workers, Trespassers	Past
Groundwater	Movement of contaminants from waste piles through the soil into groundwater	Groundwater	Contamination has not moved off-site. Exposure unlikely			Potential
Surface Water	Movement of contaminants from waste pile surface water runoff	Surface water	Wet periods with surface water accumulation on-site	Ingestion, Dermal Absorption	Workers, Trespassers	Past
Air	Movement of contaminants into air through smelting process or disturbance of soil	Airborne dust and soil	Air on and around the site	Inhalation, Ingestion	Workers, Trespassers	Past

Soil

Surface and subsurface soils over most of the site had elevated levels of heavy metals, most notably lead. In general, subsurface soils were not impacted at depths greater than four feet. However, in one location, elevated concentrations of lead were found at a maximum depth of eight feet.

A total of 50 surface soil samples were collected from 46 locations onsite and from four locations situated to the west of the site to assess background concentrations. Surface samples included five discrete samples per 100 ft^2 sampling grid at depths ranging between 0 and 0.5 feet borings. A total of 80 subsurface soil samples were collected from 20 soil boring locations that ranged from 6.5 to 12.4 feet deep [2].

Based on past site activities, it is not surprising that lead is a widespread soil contaminant. In surface soil samples, lead concentrations ranged from below the detection limit of 6 ppm (parts per million) in several samples to 260,000 ppm in one sample. Three “hotspots” of elevated lead were found in on-site soil. Background lead concentrations, determined by samples collected from west of the site, ranged from 19.1 to 78.6 ppm [2]. These background levels are consistent with typical background levels found nationwide.

A surface soil cadmium concentration of 46.2 ppm was found at one location. Cadmium was identified in three subsurface soils samples (ranging from 45.1 to 362 ppm), taken from within the boundaries of the former waste piles [2]. Background cadmium levels ranged from 0.46 to 0.64 ppm, which is consistent with typical background levels found nationwide.

Four samples with elevated antimony were identified in on-site surface soils, with the highest level being 330 ppm. Three of the four areas were within the boundaries of the former waste piles. No subsurface soil samples contained antimony at concentrations greater than 30 ppm. Concentrations of antimony in background samples ranged from below the detection limit of 2 ppm to 5.2 ppm [2].

The highest level of arsenic detected in surface soil was 285 ppm at one location. Arsenic was present at 142 ppm in one subsurface soil sample between 0-2 feet. Arsenic concentrations in background samples ranged from 3.2 to 6.4 ppm [2].

The soil contaminants associated with the Cedartown Industries site were elevated levels of lead, cadmium, arsenic, and antimony in surface and subsurface soils [2]. Present and future on-site exposure of employees and trespassers to COCs is not likely due to remediation processes which included excavation, treatment of contaminants, planting of vegetation, and the placement of a concrete cap onsite.

Table 2: Summary of soil sampling results for Cedartown Industries site [2].

Contaminant	No. of Samples	Range of Concentrations (ppm)	Health-Based Comparison Value (CV) ppm	Type of CV
Antimony	130	2.3 to 330	20	$RMEG_c$
Arsenic	130	3.2 to 285	0.5	CREG
Cadmium	130	0.46 to 362	10	$EMEG_c$
Lead	130	6 to 260,000	400*	N/A

ppm: parts per million
$RMEG_c$: Reference Dose Media Evaluation Guide (child)
CREG: Cancer Risk Evaluation Guide
$EMEG_c$: Environmental Media Evaluation Guide (child) based on chronic oral exposure
*Residential soil cleanup level based on EPA Region 9's Preliminary Remedial Goals (PRGs)
Source: ATSDR soil comparison values (expires 9/31/05)

Groundwater

During site clean up activities, shallow and deep groundwater monitoring wells were installed in the water table and bedrock aquifers to monitor water bearing zones underneath the site. Six shallow wells were installed to monitor water quality in the unconsolidated aquifer. To assess the characteristics of the deeper bedrock aquifer and whether the site has impacted this groundwater, four bedrock wells were installed onsite [2]. Deep wells were also installed to determine any interconnection between the water table and bedrock aquifers, since the objective of the remedial investigation was to assess the potential impact of the site on drinking water supply (Cedar Spring) for the City of Cedartown.

Historical monitoring results between 1990 and 2001 show that antimony, arsenic, beryllium, cadmium, and lead have been detected in at least one of six water table monitoring wells. Antimony, which has a National Primary Drinking Water Quality Standard[1] - maximum contaminant level (MCL) of 6 micrograms per liter (ug/l) was found to exceed the MCL in monitoring well-1 (MW-1) on 2 occurrences (9.4 ug/l in 1997, and 8 ug/l in 2001). Arsenic was found to exceed its MCL of 10 ug/l in MW-1 once in 1999 (12 ug/l), and in MW-4 once in 2000 (40 ug/l). Beryllium exceeded its MCL of 4 ug/l in MW-2 once in 1999 (5 ug/l). Cadmium exceeded its MCL of 5 ug/l in MW-4 six times in 1992 (20.6 ug/l), 1996 (10 ug/l), 1997 (8.6, 6.4, and 7.7 ug/l), and 1998 (6.8 ug/l), and once in MW-2 in 1998 (6.8 ug/l). The highest level of arsenic found was 20.6 ug/l in 1992. Lead, which does not have an MCL, exceeded its treatment technique (National Primary Drinking Water Standard) level of 15 ug/l in MW-2 once in 1997 (19 ug/l), and in MW-3 once in 2000 (62 ug/l). However, the 62 ug/l sampling result is thought to be a laboratory or sampling error [6]. All other quarterly and semi-annual sampling results were below detection limits for each of the above constituents. Sampling data from the deeper bedrock aquifer indicate that contaminated soils and waste have not impacted this aquifer.

The relative absence of COCs above their respective MCLs in all water table monitoring wells over most of the quarterly and semiannual sampling events that have taken place since 1991 indicates that this aquifer should not significantly impact Cedar Springs, Cedartown's source of drinking water. While groundwater from the site discharges to Cedar Creek through the water table aquifer, Cedar Creek appears not to have been impacted by the site (verified by sampling analysis [2]).

No potable wells are currently located on site. Although sampling results have been sporadic since 1991 and a completed exposure pathway does not exist, the potential for exposure to contaminated groundwater may result if a drinking water or domestic use water well is installed in the water table onsite. Because water table groundwater is flowing towards Cedar Creek, a mechanism for contaminant migration to surface water (Cedar Creek) and sediments exists. However, data indicate that the contamination level dilutes to below MCLs prior to reaching the creek [2].

Surface Water

The remedial investigation indicated that surface water has not been adversely impacted by contaminants from the site. Water samples were collected from Cedar Creek at three locations during Phase I of the remedial investigation and at five locations during Phase III. During Phase I sampling of surface water, lead was reported above the detection limit of 0.001 mg/L at 0.0012 and 0.0016 mg/L in only two samples. During Phase III water sampling, lead was reported above the detection limit in four of five surface water samples ranging from 0.0015 to 0.0021 mg/L. One semi-volatile compound, bis(2-ethylhexyl)phthalate, was detected in surface water samples, including the background sample. Concentrations ranged from 0.037 to 0.19 mg/L (background) [2]. All reported concentrations of all contaminants were below their respective National Primary Drinking Water Quality Standard [2].

[1] U.S. Environmental Protection Agency: National Primary Drinking Water Standards. Available at http://www.epa.gov/OGWDW/consumer/pdf/mcl.pdf

Water in the on-site surface impoundment was contaminated with lead. A grab sample taken on April 6, 1990 indicated concentrations were 3.03 mg/l. January 1984 sampling of sediment within the impoundment showed a concentration of 49 mg/kg [6]. An estimated 62,225 gallons of water from the impoundment was transported to an off-site treatment facility. Surface impoundment sediment was removed and transported to an off-site hazardous waste landfill [2].

Because of site topography, as well as being verified by sampling data, movement of contaminants to off-site surface water has been limited and significant contamination from Cedartown Industries has not occurred. Significant human exposure from surface water to COCs is unlikely.

Air

Air is a potential route for migration of contaminants through airborne contaminated dust and soil. During the interim waste removal project in 1990, two high volume monitors were used downwind of the waste piles. Data revealed that lead air levels were as high as 52.9 micrograms/cubic meter (ug/m^3) at the onset of remediation. Some activities during this time involved blasting of soil and slag. Data from the final week of excavation showed lead air levels at 2.21ug/m^3. Samples were not taken for other chemicals of concern. After the excavation and treatment was completed, lead air levels were 0.8ug/cubic meter. Workers were donned with appropriate personal protective equipment, and a dust suppression system with portable spray nozzles was used during waste removal and treatment activities. [10]. Since remediation activities, a majority of the site has been paved or covered with clean soil and/or crushed stone and vegetation, future exposure from this pathway has been eliminated

Toxicological Evaluation

Using soil sample results from Cedartown Industries, exposures were evaluated to determine the likelihood of adverse health effects. Estimated exposure doses were calculated for adults and children based on the average concentrations for lead [11] or midpoint concentrations of other contaminants above the health-based comparison value of each contaminant detected at the site. Use of the midpoint in the range a sample results was used as a conservative approach.

Because of the change of ownership and activities at the site over time, three different populations were assessed for exposure to COCs in soil:

1. The first population assessed was the workers of Sanders Lead Company, which operated on the site for two years. The estimated exposure dose was based on an adult worker with exposure duration of 2 years, assuming 5 days per week of exposure.

2. The second population takes into account children’s exposure. Although a fenced boundary exists around most of the site, there is still a chance that a child could trespass on the property. The estimated exposure dose for the second population was based on a child trespasser with exposure duration of 10 years, assuming 1 day per week of exposure.

3. The third population assessed was the workers for H&W Transfer Company, which leased the site for 6 years before the waste removal project was completed. The estimated exposure dose was based on an adult worker with an exposure duration of 6 years, assuming 2 days per week of exposure.

Antimony

Table 3: Calculated doses from exposure to soil contaminated with antimony

Contaminant	Total Estimated Dose mg/kg/day	Health Guideline mg/kg/day	Numeric Cancer Risk
Antimony Worker Sanders Lead Company	Adult: 0.00017	0.3	Not Applicable
Antimony Child Trespasser	Child: 0.00018	0.3	Not Applicable
Antimony Worker H&W Trucking Company	Adult: 0.00007	0.3	Not Applicable

mg/kg/day: milligrams per kilogram per day

The calculated exposure doses to antimony for all populations are far below the established health guideline of 0.3 mg/kg/day. The health guideline used is EPA's oral RfD, calculated for chronic exposure. Calculated doses for the populations assessed were at least 1500 times lower when compared to the health guideline [health guidelines], and at least 1400 times lower than the NOAEL established for rats at chronic exposure when cardio effects were studied. Because the difference between calculated exposure doses and exposure doses that are known to be associated with health effects is so great, GDPH concludes that adverse health effects from exposure to soil antimony are not expected to result from exposure to soil at Cedartown Industries [12].

Antimony is not classified as carcinogen to humans by either EPA or the NTP. The International Agency for Research on Cancer has classified antimony as possibly carcinogenic to humans with limited human evidence and less than sufficient evidence in animals [health guidelines]. Carcinogenic effects from ingestion of antimony are not expected.

Arsenic

Table 4: Calculated doses from exposure to soil contaminated with arsenic

Contaminant	Total Estimated Dose mg/kg/day	Health Guideline mg/kg/day	Numeric Cancer Risk
Arsenic Worker Sanders Lead Company	Adult: 0.00014	0.0003	2.0×10^{-6}
Arsenic Child Trespasser	Child: 0.00016	0.0003	1.1×10^{-5}
Arsenic Worker H&W Trucking Company	Adult: 0.00006	0.0003	2.4×10^{-6}

mg/kg/day: milligrams per kilogram per day

The calculated exposure doses to arsenic for all populations are below the established health guideline of 0.0003 mg/kg/day. The health guideline used is ATSDR's chronic oral MRL. Calculated doses for the populations assessed were at least 2 times lower than for workers at Sanders Lead Company and Children, and 5 times lower for workers at the H&W Transfer Company when compared to the health guideline [health guidelines], and at least 4-8 times lower than the NOAEL established for humans with chronic exposure when gastrointestinal irritation, diarrhea, and nausea were looked at [13]. Although the difference between calculated exposure doses and exposure doses that are known to be associated with health effects is small, the use of the midpoint concentration found in on-site soil for estimating exposure dose serves a conservative approach. Therefore, GDPH concludes that adverse health effects from past exposure to soil arsenic are not expected to result from exposure to soil at Cedartown Industries.

Data used to develop the health guideline and assess carcinogenic effects of arsenic exposure are based on the ingestion of drinking water, not the ingestion of soil or food containing arsenic. The EPA classifies inorganic arsenic as a human carcinogen based on sufficient evidence from human data. Increased mortality from multiple internal organ cancers (liver, kidney, lung, and bladder) and an increased incidence of skin cancer were observed in populations consuming drinking water high in inorganic arsenic [13]. Numeric risks of contracting cancer estimated for individuals exposed to arsenic concentrations in the soil at Cedartown, based on estimated doses, are 2.0×10^{-6} (2 in 1 million) for Sanders Lead Company workers based on 2 years of exposure, and 1.1×10^{-5} (1.1 in 100,000) for children exposed for 10 years, and 2.4×10^{-6} (2.4 in 1 million) for H&W Transfer Company workers based on 6 years of exposure. The numeric risks of developing cancer from exposure to arsenic from Cedartown are low for adults workers, and low-moderate for children who may have been exposed from trespassing over a 10 year period.

Cadmium

Table 5: Calculated doses from exposure to soil contaminated with cadmium

Contaminant	Total Estimated Dose mg/kg/day	Health Guideline mg/kg/day	Numeric Cancer Risk
Cadmium Worker Sanders Lead Company	Adult: 0.00018	0.0002	Not Applicable
Cadmium Child Trespasser	Child: 0.00020	0.0002	Not Applicable
Cadmium Worker H&W Trucking Company	Adult: 0.000036	0.0002	Not Applicable

mg/kg/day: milligrams per kilogram per day

The calculated exposure dose for both workers of the Sanders Lead Company and a child trespasser were very close to the health guideline, which is considered protective of human health. However, the doses were 11.6 and 10.5 times lower than the NOAEL, respectively, which was established for humans undergoing lifetime exposure to cadmium where renal, or kidney, damage was observed [14]. The calculated dose for workers of the H&W Transfer Company is 5.5 times lower than the health guideline and 58.3 times lower than the established NOAEL. Non-carcinogenic adverse health effects from soil ingestion are not expected to result from exposure to soil at Cedartown Industries.

The International Agency for Research on Cancer and the NTP classify cadmium as carcinogenic to humans with sufficient human evidence, while the EPA also classifies cadmium as a probable human carcinogen with sufficient animal studies but limited human data. However, EPA has not determined a slope factor for cadmium from which any kind of numeric cancer risk can be assessed (refer to Appendix B).

Lead

Table 6: Calculated doses from exposure to soil contaminated with lead.

Contaminant	Total Estimated Dose mg/kg/day	Estimated Blood Lead Level ug/dl*	Numeric Cancer Risk
Lead Worker Sanders Lead Company	Adult: 0.0094	Low:12.99 High: 19.11	Not Applicable
Lead Child Trespasser	Child: 0.0103	Low:12.99 High: 19.11	Not Applicable
Lead Worker H&W Trucking Company	Adult: 0.0037	Low:12.99 High: 19.11	Not Applicable

mg/kg/day: milligrams per kilogram per day
ug/dl: micrograms of lead per deciliter of blood.
* Based on ATSDR's Blood Lead Pharmacokinetic Model [15].

When lead exposure was assessed at Cedartown Industries, a worst case scenario using the average of all samples obtained was used as a conservative measure. It must be noted that the data is heavily weighted around a small area (smelting and waste pile areas) relative to the entire site so that the average soil lead sampling data is heavily skewed to this small area. An evaluation of the available lead soil data indicate that the calculated exposure dose is 0.0094 mg/kg/day for adult workers of Sanders Lead Company, 0.0103 mg/kg/day for child trespassers, and 0.0037 mg/kg/day for adult workers of H&W Transfer Company. A health guideline has not been established for lead, however, a less serious lowest observed adverse health effect level (LOAEL) of 0.014 mg/kg/day, where increased systolic blood pressure was observed in rats chronically exposed to lead [15]. Exposure for workers of Sanders Lead Company is approximately 1.5 times below this LOAEL, exposure to children is approximately 1.5 times below this LOAEL, and exposure for workers of H&W Transfer Company is approximately 4 times below this LOAEL. A more serious LOAEL of 0.05 mg/kg/day was observed in monkeys chronically exposed to lead resulting in impaired operational learning [15]. Exposure for workers of Sanders Lead Company is approximately 5 times below the more serious LOAEL, exposure to children is approximately 5 times below this LOAEL, and exposure for workers of H&W Transfer Company is approximately 13.5 times below this LOAEL. Assuming that exposure was limited to the smelting and waste areas utilizing the exposure scenario described, the margin of safety is slim and workers and trespassers may have been exposed to lead levels which may have resulted in increases in systolic blood pressure and operational learning impairment.

The Centers for Disease Control and Prevention (CDC) considers children to have an elevated blood lead level if the amount of lead in blood is 10 ug/dl of whole blood or greater [16]. Because of the varied nature of lead-containing compounds, ATSDR has not developed a health-based CV for lead; however, ATSDR has developed a mathematical model designed to estimate blood lead levels in the body based upon the actual concentrations in soil (Appendix C). The estimated blood lead levels from exposure to environmental and dietary lead for persons exposed to contaminated soil at Cedartown Industries prior to remediation are 12.99 ug/dl (low) and 19.11 ug/dl (high); above CDCs level of concern. The estimation utilized in this model assumes that a person spends 4.8 hours per day, 7 days per week in the contaminated soil area, which is highly unlikely. These being the case, realistic blood lead levels are likely to be much lower in the exposed population. Therefore, GDPH concludes that under the worst case scenario the site may have posed a risk for adverse health effects for lead exposure to children who may have trespassed onto the property on a regular basis, as well as for workers employed Sanders lead company between 1988 and 1990.

The International Agency for Research on Cancer classifies lead as possibly carcinogenic to humans (limited human evidence; less than sufficient evidence in animals), and the EPA classifies lead as a probable human carcinogen (inadequate human, sufficient animal studies). In 2004, the National Toxicology Program (NTP) classified lead as reasonably anticipated to be a human carcinogen because lead exposure has been associated with increased risk of lung, stomach and bladder in diverse human populations [17]. However, EPA has not determined a slope factor for lead from which any kind of numeric cancer risk can be assessed (refer to Appendix B).

Children's Health Considerations

To protect the health of the nation's children, ATSDR has implemented an initiative to guard children from exposure to hazardous substances. In communities faced with contamination of the water, soil, air, or food, ATSDR and GDPH recognize that the unique vulnerabilities of infants and children demand special emphasis. Due to their immature and developing organs, infants and children are usually more susceptible to toxic substances than are adults. Children are more likely to be exposed because they play outdoors and they often bring food into contaminated areas. They are also more likely to encounter dust, soil, and contaminated vapors close to the ground. Children are generally smaller than adults, which results in higher doses of chemical exposure because of their lower body weights relative to adults. In addition, the developing body systems of children can sustain permanent damage if toxic exposures occur during critical growth stages. At the Cedartown Industries site, children may have been exposed to contaminants in soil, surface water, and air in the past if they trespassed regularly on the property. However, with the possible exception to lead under a relatively unlikely exposure scenario, the levels of exposure to the contaminants found are not at levels of health concern. Currently, children are not being exposed to contaminants at levels of health concern, and increased exposures in the future are unlikely due to remediation processes which included excavation and treatment of contaminants, planting of vegetation, and pouring of a concrete cap on-site.

Conclusions

GDPH developed the following conclusions and assigned public health hazard categories to the site based on past, present, and future time frames at Cedartown Industries. A description of public health hazard categories is provided in Appendix D.

1. GDPH has determined that under the worst case scenario the site may have posed a **past public health hazard** for lead exposure to children who may have trespassed onto the property on a regular basis, as well as for workers employed by Sanders lead company between 1988 and 1990.

2. Based on past exposure to antimony, arsenic, beryllium, and cadmium, **no public health hazard** existed.

3. **No public health hazard** currently exists at the site because remediation was completed in 1997.

Recommendations

There are no recommendations at this time.

Public Health Action Plan

Actions Completed

- EPA held a public meeting with public officials and concerned citizens in 1993 addressing the public's health concerns regarding EPA's plan for the remediation Cedartown Industries.

- Remediation of Cedartown Industries was completed in May 1997.

- Quarterly, then semiannual monitoring of groundwater has been conducted at this site to ensure that site remediation was successful.

Actions Planned

- EPA continues to monitor groundwater semiannually at this site.

- If additional data become available, GDPH will review the information and take appropriate actions. GDPH will respond to all requests for information regarding health issues associated with Cedartown Industries.

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Certification

This Cedartown Industries Public Health Assessment was prepared by the Georgia Department of Human Resources, Division of Public Health, under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It was written in accordance with ATSDR policies and guidelines available at the time of publication. . Editorial review was completed by the Cooperative Agreement partner.

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The Division of Health Assessment and Consultation (DHAC), ATSDR, has reviewed this health consultation and concurs with its findings.

Team Lead, CAT, SPAB, DHAC, ATSDR

FIGURES

Figure 1: Site Map and Demographic Characteristics

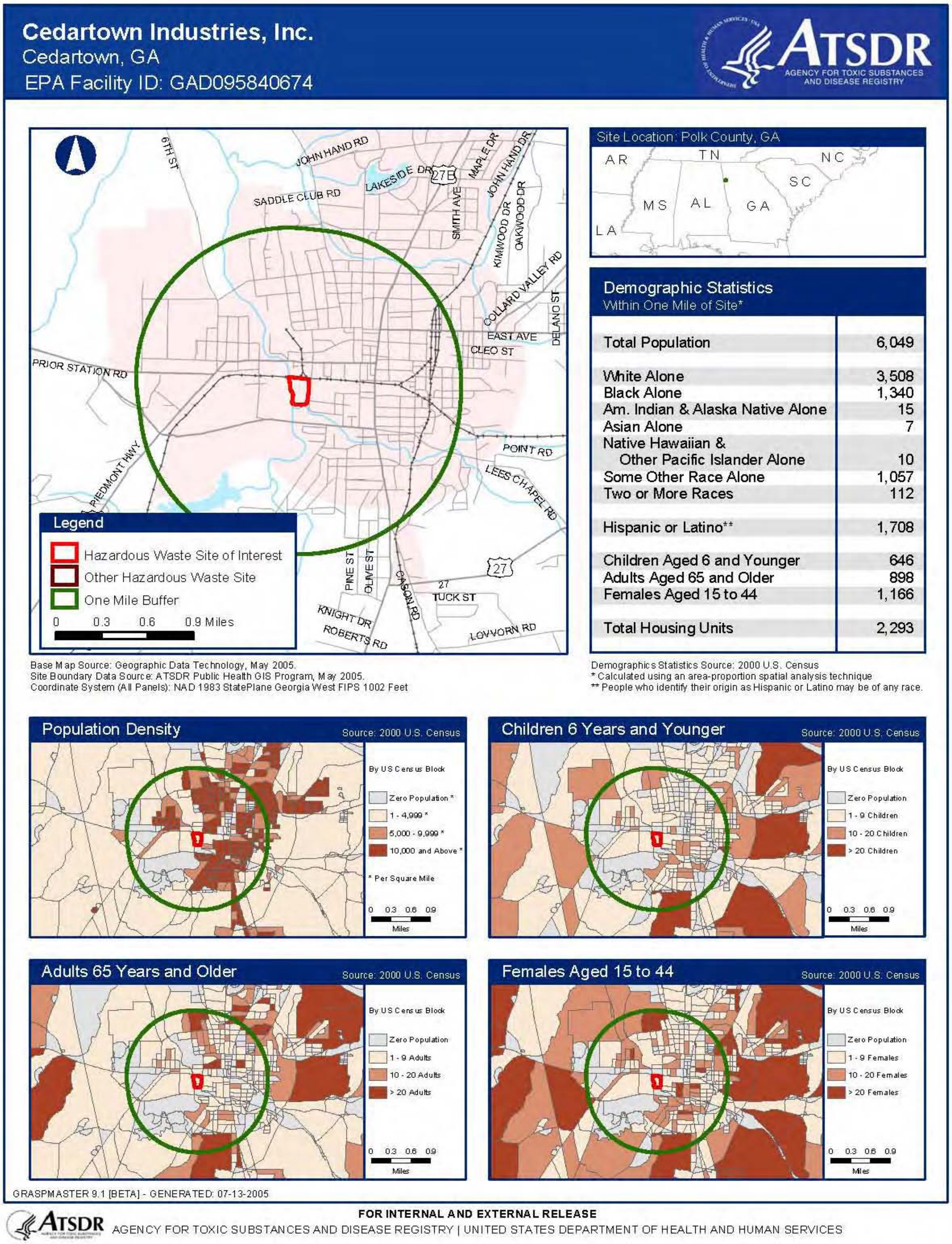


Figure 2: Site Map

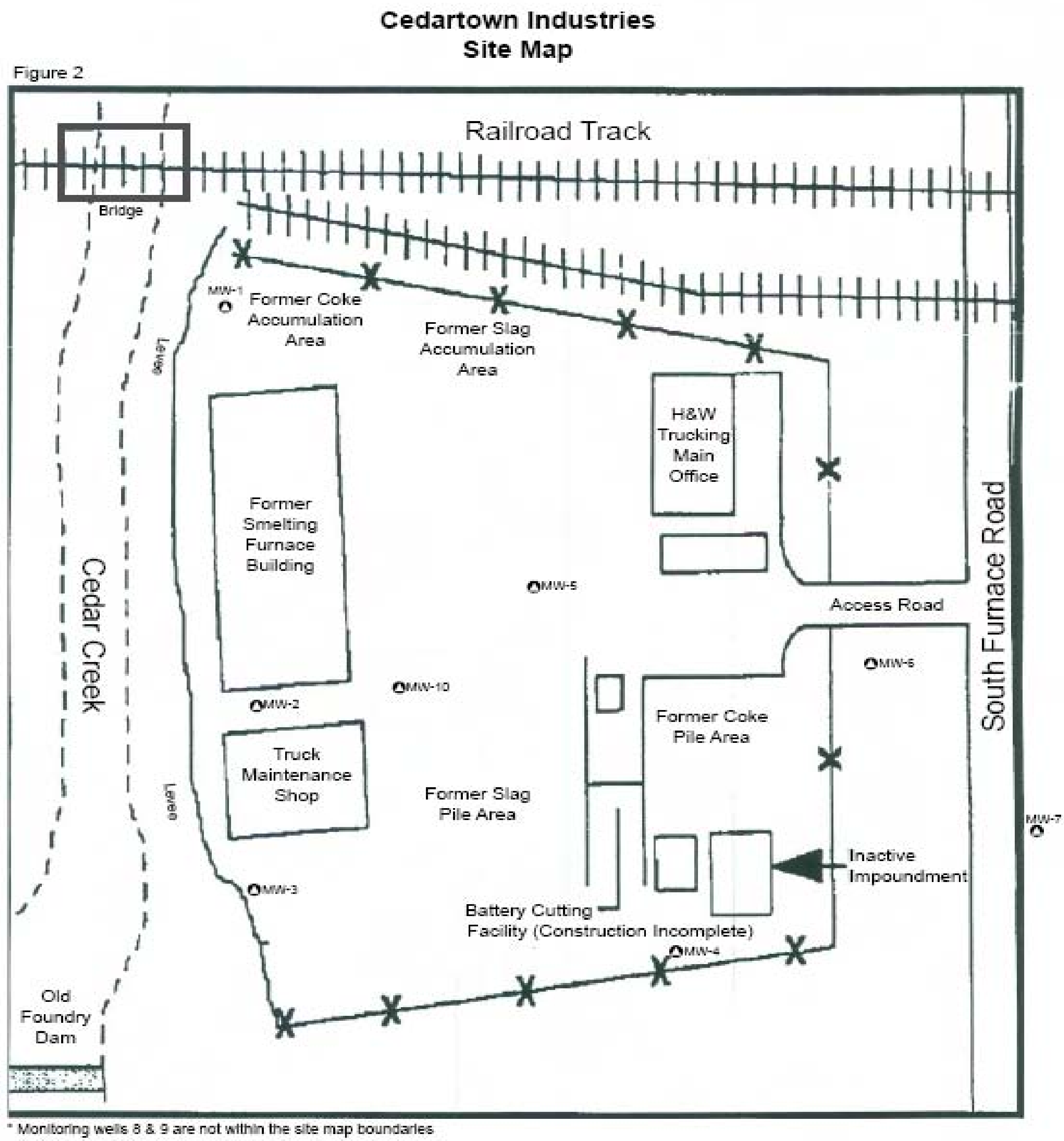
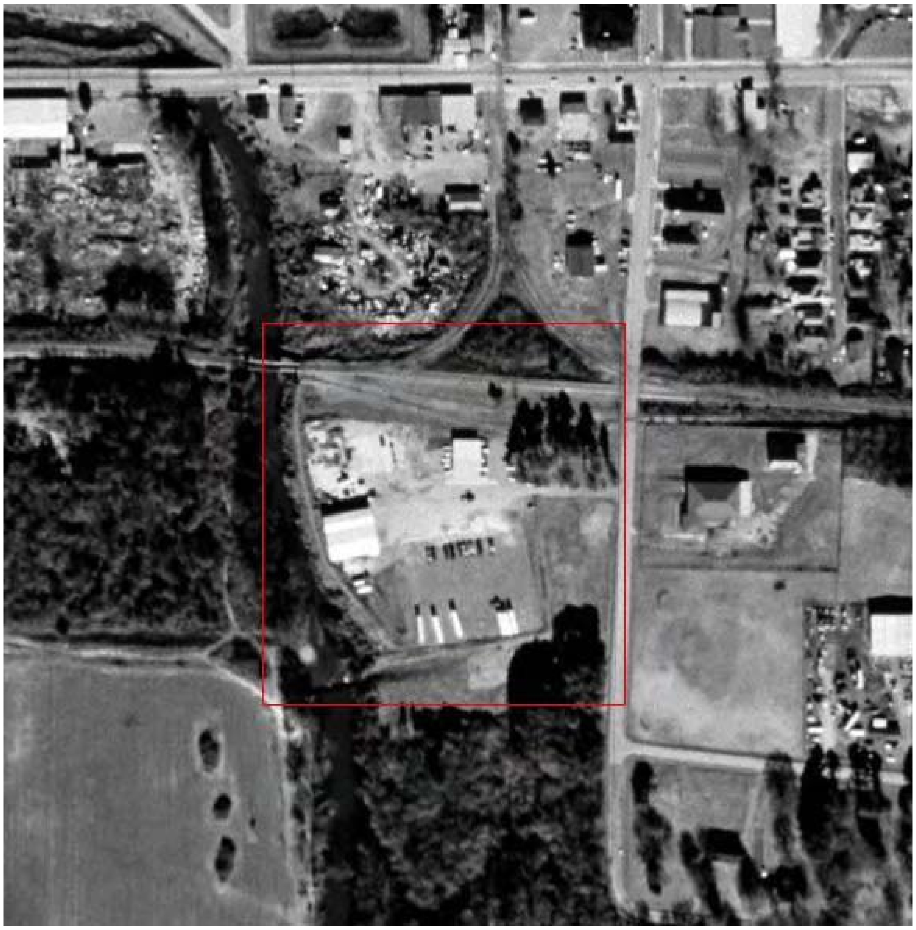


Figure 3: Aerial view of Cedartown Industries and surrounding area



APPENDICES

APPENDIX A: Cancer Incidence, 1999-2001

(Source: GDPH, Cancer Control Section)

Age-Adjusted Cancer Incidence Rates for Zip Code 30125, Georgia, 1999-2002

	Total		Male		Female	
Site	**Cases**	**Rate***	**Cases**	**Rate**	**Cases**	**Rate**
All Sites	421	442.2	222	554.2	199	374.8
Oral Cavity	13	~	6	~	7	~
Esophagus	5	~	<5	~	<5	~
Stomach	9	~	***	~	<5	~
Colon and Rectum	38	40.2	15	~	23	40.9
Liver	5	~	<5	~	<5	~
Pancreas	12	~	<5	~	***	~
Larynx	<5	~	<5	~	<5	~
Lung and Bronchus	87	90.8	53	131.7	34	63.9
Bone and Joints	<5	~	<5	~	<5	~
Melanoma	11	~	6	~	5	~
Breast	--	--	--	--	53	98.9
Uterine Cervix	--	--	--	--	<5	~
Uterine Corpus	--	--	--	--	15	~
Ovary	--	--	--	--	5	~
Prostate	--	--	68	160.6	--	--
Testis	--	--	<5	~	--	--
Kidney and Renal Pelvis	11	~	6	~	5	~
Bladder (Incl in situ)	21	21.8	14	~	7	~
Brain and Other Nervous System	7	~	<5	~	<5	~
Thyroid	6	~	<5	~	<5	~
Hodgkin Lymphoma	<5	~	<5	~	<5	~
Non-Hodgkin Lymphoma	16	~	6	~	10	~
Multiple Myeloma	<5	~	<5	~	<5	~
Leukemias	5	~	<5	~	<5	~

Average annual rate per 100,000, age-adjusted to the 2000 US standard population.
***GDPH does not calculate rates where the number of cases (or deaths) is less than twenty. For small numbers, the rates can vary dramatically with the slightest shift in actual numbers.**

Data Summary

All Cancer Sites

- 421 new cancer cases were diagnosed in Zip Code 30125 from 1999 to 2002, an average of 140 new cases per year.
- It is expected that about 74 men and 66 women will be diagnosed with cancer every year in Zip Code 30125.
- The overall age-adjusted cancer incidence rate in Zip Code is 442.5 per 100,000 population. This is lower than the rate for Georgia (461.4 per 100,000), but this difference is not statistically significant.

Males

- Men are 48% more likely than females to be diagnosed with cancer in Zip Code 30125.
- The overall age-adjusted cancer incidence rate for men in Zip Code 30125 is 554.2 per 100,000 population. This is lower than the rate for Georgia men (569.8 per 100,000), but this difference is not statistically significant.
- Prostate, lung, and colorectal are the top cancer sites among men in both Zip Code 30125 and the State of Georgia.
- The age-adjusted prostate cancer incidence rate for men in Zip Code 30125 (160.6 per 100,000) is slightly lower to that for Georgia men (168.9 per 100,000).
- The age-adjusted lung cancer incidence rate is higher for men in Zip Code 30125 (131.7 per 100,000) than for Georgia men (109.9 per 100,000), but this difference is not statistically significant.

Females

- The overall age-adjusted cancer incidence rate for women in Zip Code 30125 is 374.8 per 100,000 population. This is lower than the rate for Georgia women (390.7 per 100,000), but this difference is not statistically significant.
- Breast, lung and colorectal are the top cancer sites among women in both Zip Code 30125 and the State of Georgia.
- The age-adjusted breast cancer incidence rate is lower for women in Zip Code 30125 (98.9 per 100,000) than for Georgia women (124.3 per 100,000), but this difference is not statistically significant.
- The age-adjusted lung cancer incidence rate is higher for women in Zip Code 30125 (63.9 per 100,000) than for Georgia women (52.5 per 100,000), but this difference is not statistically significant.
- The age-adjusted colorectal cancer incidence rate is lower for women in Zip Code (40.9 per 100,000) than for Georgia women (43.9 per 100,000), but this difference is not statistically significant.

APPENDIX B: Explanation of Toxicological Evaluation

Step 1--The Screening Process

In order to evaluate the available data, GDPH used comparison values (CVs) to determine which chemicals to examine more closely. CVs are contaminant concentrations found in a specific environmental media (for example: air, soil, or water) and are used to select contaminants for further evaluation. CVs incorporate assumptions of daily exposure to the chemical and a standard amount of air, soil, or water that someone may inhale or ingest each day. CVs are generated to be conservative and non-site specific. The CV is used as a screening level during the health consultation process where substances found in amounts greater than their CVs might be selected for further evaluation. CVs are not intended to be environmental clean-up levels or to indicate that health effects occur at concentrations that exceed these values.

CVs can be based on either carcinogenic (cancer-causing) or non-carcinogenic effects. Cancer-based CVs are calculated from the U.S. Environmental Protection Agency's (EPA) oral cancer slope factors for ingestion exposure, or inhalation risk units for inhalation exposure. Non-cancer CVs are calculated from ATSDR's minimal risk levels, EPA's reference doses, or EPA's reference concentrations for ingestion and inhalation exposure. When a cancer and non-cancer CV exist for the same chemical, the lower of these values is used as a conservative measure. The chemical and media-specific CVs used in the preparation of this health consultation are listed below:

An **Environmental Media Evaluation Guide (EMEG)** is an estimated comparison concentration for exposure that is unlikely to cause adverse health effects, as determined by ATSDR from its toxicological profiles for a specific chemical.

A **Reference Dose Media Evaluation Guide (RMEG)** is an estimated comparison concentration that is based on EPA's estimate of daily exposure to a contaminant that is unlikely to cause adverse health effects.

A **Cancer Risk Evaluation Guide (CREG)** is an estimated comparison concentration that is based on an excess cancer rate of one in a million persons exposed over a lifetime (70 years), and is calculated using EPA's cancer slope factor.

Step 2--Evaluation of Public Health Implications

The next step in the evaluation process is to take those contaminants that are above their respective CVs and further identify which chemicals and exposure situations are likely to be a health hazard. Separate child and adult exposure doses (or the amount of a contaminant that gets into a person's body) are calculated for site-specific scenarios, using assumptions regarding an individual's likelihood of accessing the site and contacting contamination. A brief explanation of the calculation of estimated exposure doses used in this health consultation are presented below. Calculated doses are reported in units of milligrams per kilogram per day (mg/kg/day).

Ingestion of contaminants present in soil

Exposure doses for ingestion of contaminants present in soil were calculated using the average detected concentrations of contaminants in milligrams per kilogram (mg/kg [mg/kg = ppm]). The following equation is used to estimate the exposure doses resulting from ingestion of contaminated soil:

$$ED_s = \frac{C \times IR \times EF \times CF}{BW}$$

where;

ED_s = exposure dose soil (mg/kg/day)

C = contaminant concentration (mg/kg)
IR = intake rate of contaminated medium (based on default values of 100 mg/day for adults, and 200 mg/day for children.
EF = exposure factor (based on frequency of exposure, exposure duration, and time of exposure). The exposure factor used for Sanders Lead workers is 0.71, based on an adult worker with exposure duration of 2 years, assuming 5 days per week of exposure. The exposure factor used for children trespassers is 0.14, based on a child trespasser with exposure duration of 10 years, assuming 1 day per week of exposure. The exposure factor used for H&W Trucking workers is 0.28, based on an adult worker with exposure duration of 6 years, assuming 2 days per week of exposure.
CF = kilograms of soil per milligram of soil (10^{-6} kg/mg)
BW = body weight (based on average rates: for adults, 70 kg; children, and 25 kg)

Non-cancer Health Risks

The doses calculated for exposure to individual chemicals are then compared to an established health guideline, such as an ATSDR minimal risk level (MRL) or an EPA reference dose (RfD), in order to assess whether adverse health impacts from exposure are expected. Health guidelines are chemical-specific values that are based on available scientific literature and are considered protective of human health. Non-carcinogenic effects, unlike carcinogenic effects, are believed to have a threshold, that is, a dose below which adverse health effects will not occur. As a result, the current practice to derive health guidelines is to identify, usually from animal toxicology experiments, a no observed adverse effect level (NOAEL), which indicates that no effects are observed at a particular exposure level. This is the experimental exposure level in animals (and sometimes humans) at which no adverse toxic effect is observed. The known toxicological values are doses derived from human and animal studies that are summarized in ATSDR's *Toxicological Profiles (www.atsdr.cdc.gov/toxpro2.html).* The NOAEL is modified with an uncertainty (or safety) factor, which reflects the degree of uncertainty that exists when experimental animal data are extrapolated to the human population. The magnitude of the uncertainty factor considers various factors such as sensitive subpopulations (e.g., children, pregnant women, the elderly), extrapolation from animals to humans, and the completeness of the available data. Thus, exposure doses at or below the established health guideline are not expected to cause adverse health effects because these values are much lower (and more human health protective) than doses, which do not cause adverse health effects in laboratory animal studies.

For non-cancer health effects, the following health guidelines were used in this health consultation:

Minimal Risk Levels (MRLs) are developed by ATSDR for contaminants commonly found at hazardous waste sites. The MRL is developed for ingestion and inhalation exposure, and for lengths of exposures: acute (less than 14 days); intermediate (between 15-364 days), and chronic (365 days or greater). ATSDR has not developed MRLs for dermal exposure (absorption through skin).

If the estimated exposure dose to an individual is less than the health guideline value, the exposure is unlikely to result in non-cancer health effects. If the calculated exposure dose is greater than the health guideline, the exposure dose is compared to known toxicological values for the particular chemical and is discussed in more detail in the text of the health consultation. A direct comparison of site-specific exposures and doses to study-derived exposures and doses found to cause adverse health effects is the basis for deciding whether health effects are likely to occur.

It is important to consider that the methodology used to develop health guidelines does not provide any information on the presence, absence, or level of cancer risk. Therefore, a separate cancer risk evaluation is necessary for potentially cancer-causing contaminants detected at this site.

Cancer Risks

Exposure to a cancer-causing chemical, even at low concentrations, is assumed to be associated with some increased risk for evaluation purposes. The estimated risk for developing cancer from exposure to contaminants associated with the site was calculated by multiplying the site-specific doses by EPA's chemical-specific cancer slope factors (CSFs) available at *www.epa.gov/iris*. This calculation estimates a theoretical excess cancer risk expressed as a proportion of the population that may be affected by a carcinogen during a lifetime of exposure. For example, an estimated risk of 1×10^{-6} predicts the probability of one additional cancer over background in a population of 1 million. An increased lifetime cancer risk is not a specified estimate of expected cancers. Rather, it is an estimate of the increase in the probability that a person may develop cancer sometime in his or her lifetime following exposure to a particular contaminant under specific exposure scenarios. For children, the theoretical excess cancer risk is not calculated for a lifetime of exposure, but from a fraction of lifetime; based on known or suspected length of exposure, or years of childhood.

Because of conservative models used to derive CSFs, using this approach provides a theoretical estimate of risk; the true or actual risk is unknown and could be as low as zero. Numerical risk estimates are generated using mathematical models applied to epidemiologic or experimental data for carcinogenic effects. The mathematical models extrapolate from higher experimental doses to lower experimental doses. Often, the experimental data represent exposures to chemicals at concentrations orders of magnitude higher than concentrations found in the environment. In addition, these models often assume that there are no thresholds to carcinogenic effects--a single molecule of a carcinogen is assumed to be able to cause cancer. The doses associated with these estimated hypothetical risks might be orders of magnitude lower that doses reported in toxicology literature to cause carcinogenic effects. As such, a low cancer risk estimate of 1×10^{-6} and below may indicate that the toxicology literature supports a finding that no excess cancer risk is likely. A cancer risk estimate greater than 1×10^{-6}, however, indicates that a careful review of toxicology literature before making conclusions about cancer risks is in order.

APPENDIX C: ATSDR Lead Model

(Source: Agency for Toxic Substances and Disease Registry, Toxicological Profile for Lead, 1999)

Numerous longitudinal and cross-sectional studies have attempted to correlate environmental lead levels with blood lead levels. The studies have provided a number of regression analyses and corresponding slope factors for various media including air, soil, dust, water, and food. In an attempt to use this valuable body of data, ATSDR has developed an integrated exposure regression analysis. This approach utilizes slope values from selected studies to integrate all exposures from various pathways, thus providing a cumulative exposure estimate expressed as total blood lead. The worktable in the text can be used to calculate a cumulative exposure estimate on a site-specific basis. To use the table, environmental levels for outdoor air, indoor air, food, water, soil, and dust are needed. In the absence of such data, default values can be used. In most situations, default values will be background levels unless data are available to indicate otherwise. Based on the US Food and Drug Administration's Total Diet Study data, lead intake from food for infants and toddlers is about 5 micrograms per day. In some cases, a missing value can be estimated from a known value**.** For example, EPA has suggested that indoor air can be considered 0.03 times the level of outdoor air.

Empirically determined or default environmental levels are multiplied by the percentage of time one is exposed to a particular source and then multiplied by an appropriate regression slope factor. Slope factor studies were based upon an assumption that exposure is continuous. The slope factors can be derived from regression analysis studies that determine blood lead levels for a similar route of exposure. Typically, these studies identify standard errors describing the regression line of a particular source of lead exposure. These standard errors can be used to provide an upper and lower confidence limit contribution of each estimate of blood lead. The individual source contributions can then be summed to provide an overall range estimate of blood lead. While it is known that such summing of standard errors can lead to errors of population dynamics, detailed demographic analysis (e.g., Monte Carlo simulations) would likely lead to a model without much utility. As a screening tool, estimates provided by the table have a much greater utility than single value central tendency estimates, yet still provide a simple-to-use model that allows the health assessor an easy means to estimate source contributions to blood lead.

Table C-1 provides estimated blood lead levels from exposure to environmental and dietary sources of lead for persons exposed to past contaminated soil at Cedartown Industries.

Table C-1: Estimated blood lead levels from exposure to environmental and dietary lead for persons exposed to past, on-site soil contamination at Cedartown Industries.

Media	Concentration*	Relative Time Spent (fraction of a day)	Slope Factor**	Estimated Blood Lead Level micrograms per deciliter (µg/dL)	
Outdoor Air	0.15 $\mu g/m^3$	0.2	1.32 (low)[1]	0.0396	
			2.52 (high)[1]		0.0756
Indoor Air	0.15 $\mu g/m^3$	0.8	1.32 (low)[2]	0.1584	
			2.52 (high)[2]		0.3024
Food	5 µg/day	1	0.24 [3]	1.2	
Water	4 µg/day	1	0.16 [4]	0.64	
Soil	9,225 mg/kg #	0.2	0.00583 (low)[5]	10.76	
			0.00777 (high)[5]		14.33
Dust	40 mg/kg	0.8	0.00628 (low)[6]	0.201	
			0.008 (high)[6]		0.256
			Total	**Low 12.99**	**High 19.11**

When suggested default values are a range of values, the average of the range is used as the default value.
Average surface soil concentration of lead found in all samples collected and analyzed.

* Suggested default values references:

Outdoor Air	0.1–0.2 $\mu g/m^3$	Eldred and Cahill 1994 [7]
Indoor Air	0.1–0.2 $\mu g/m^3$	EPA 1986 [8]
Food	5 µg/day	Bolger et al 1991 [6]
Water	4 µg/day	EPA 1991 [2]
Dust	10–70 mg/kg	Shacklette and Boerngen 1972 [10]

** Slope values references

[1,2]Outdoor, Indoor air	1.32 (low)–2.52 (high)	µg/dL per µg Pb/m^3	Angle et al 1984 [11]
[3]Food	0.24	µg/dL per µg Pb/day	Ryu et al 1983[12]
[4]Water	0.16	µg/dL per µg Pb/day	Laxen et al 1977 [13]
[5]Soil	0.00583 (low)–0.008 (high)	µg/dL per µg Pb/kg	Angle et al 1984 [11]
[6]Dust	0.00628 (low)–0.008 (high)	µg/dL per µg Pb/kg	Angle et al 1984 [11]

APPENDIX C References:

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5. Angle CR, Marcus A, Cheng I-H, et al, *Omaha childhood blood lead and environmental lead: a linear total exposure model,* Environmental Res 35:160-170, 1984.
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7. Ryu JE, Ziegler EE, Nelson SE, et al., *Dietary intake of lead and blood lead concentrations in early infancy,* Am J Dis Child 137:986-991, 1983.
8. Shacklette HT, Boerngen JG, *Elemental composition of surficial materials in the conterminous United States,* U.S. Department of the Interior, Geological Survey Professional Paper no. 1270, 1972.

APPENDIX D: ATSDR Public Health Hazard Categories

No Public Health Hazard

A category used in ATSDR's public health assessment documents for sites where people have never and will never come into contact with harmful amounts of site-related substances

No Apparent Public Health Hazard

A category used in ATSDR's public health assessments for sites where human exposure to contaminated media might be occurring, might have occurred in the past, or might occur in the future, but where the exposure is not expected to cause any harmful health effects

Indeterminate Public Health Hazard

The category used in ATSDR's public health assessment documents when a professional judgment about the level of health hazard cannot be made because information critical to such a decision is lacking.

Public Health Hazard

A category used in ATSDR's public health assessments for sites that pose a public health hazard because of long-term exposures (greater than 1 year) to sufficiently high levels of hazardous substances or radionuclides that could result in harmful health effects

Urgent Public Health Hazard

A category used in ATSDR's public health assessments for sites where short-term exposures (less than 1 year) to hazardous substances or conditions could result in harmful health effects that require rapid intervention.

APPENDIX E: ATSDR/GDPH Glossary of Environmental Health Terms

Absorption
The process of taking in. For a person or animal, absorption is the process of a substance getting into the body through the eyes, skin, stomach, intestines, or lungs.

Acute
Occurring over a short time [compare with **chronic**].

Acute exposure
Contact with a substance that occurs once or for only a short time (up to 14 days) [compare with **intermediate duration exposure** and **chronic exposure]**.

Additive effect
A biologic response to exposure to multiple substances that equals the sum of responses of all the individual substances added together [compare with **antagonistic effect** and **synergistic effect]**.

Adverse health effect
A change in body function or cell structure that might lead to disease or health problems.

Aerobic
Requiring oxygen [compare with **anaerobic**].

Ambient
Surrounding (for example, *ambient* air).

Background level
An average or expected amount of a substance or radioactive material in a specific environment, or typical amounts of substances that occur naturally in an environment.

Biodegradation
Decomposition or breakdown of a substance through the action of microorganisms (such as bacteria or fungi) or other natural physical processes (such as sunlight).

Biologic uptake
The transfer of substances from the environment to plants, animals, and humans.

Biota
Plants and animals in an environment. Some of these plants and animals might be sources of food, clothing, or medicines for people.

Cancer
Any one of a group of diseases that occurs when cells in the body become abnormal and grow or multiply out of control.

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

Carcinogen
A substance that causes cancer.

Central nervous system
The part of the nervous system that consists of the brain and the spinal cord.

Chronic
Occurring over a long time (more than 1 year) [compare with **acute**].

Chronic exposure
Contact with a substance that occurs over a long time (more than 1 year) [compare with **acute exposure** and **intermediate duration exposure**].

Comparison value (CV)
Calculated concentration of a substance in air, water, food, or soil that is unlikely to cause harmful (adverse) health effects in exposed people. The CV is used as a screening level during the public health assessment process. Substances found in amounts greater than their CVs might be selected for further evaluation in the public health assessment process.

Completed exposure pathway [see **exposure pathway**].

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)
CERCLA, also known as **Superfund**, is the federal law that concerns the removal or cleanup of hazardous substances in the environment and at hazardous waste sites. ATSDR, which was created by CERCLA, is responsible for assessing health issues and supporting public health activities related to hazardous waste sites or other environmental releases of hazardous substances.

Concentration
The amount of a substance present in a certain amount of soil, water, air, food, blood, hair, urine, breath, or any other media.

Contaminant
A substance that is either present in an environment where it does not belong or is present at levels that might cause harmful (adverse) health effects.

Dermal
Referring to the skin. For example, dermal absorption means passing through the skin.

Dose (for chemicals that are not radioactive)
The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An “exposure dose” is how much of a substance is encountered in the environment. An “absorbed dose” is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.

Dose (for radioactive chemicals)
The radiation dose is the amount of energy from radiation that is actually absorbed by the body. This is not the same as measurements of the amount of radiation in the environment.

Dose-response relationship
The relationship between the amount of exposure [**dose**] to a substance and the resulting changes in body function or health (response).

Environmental media
Soil, water, air, **biota** (plants and animals), or any other parts of the environment that can contain contaminants.

Environmental media and transport mechanism
Environmental media include water, air, soil, and **biota** (plants and animals). Transport mechanisms move contaminants from the source to points where human exposure can occur. The **environmental media and transport mechanism** is the second part of an **exposure pathway**.

EPA
United States Environmental Protection Agency.

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

Exposure assessment
The process of finding out how people come into contact with a hazardous substance, how often and for how long they are in contact with the substance, and how much of the substance they are in contact with.

Exposure pathway
The route a substance takes from its source (where it began) to its end point (where it ends), and how people can come into contact with (or get exposed to) it. An exposure pathway has five parts: a **source of contamination** (such as an abandoned business); an **environmental media and transport mechanism** (such as movement through groundwater); a **point of exposure** (such as a private well); a **route of exposure** (eating, drinking, breathing, or touching), and a **receptor**

population (people potentially or actually exposed). When all five parts are present, the exposure pathway is termed a **completed exposure pathway**.

Groundwater
Water beneath the earth's surface in the spaces between soil particles and between rock surfaces [compare with **surface water**].

Hazard
A source of potential harm from past, current, or future exposures.

Hazardous waste
Potentially harmful substances that have been released or discarded into the environment.

Health consultation
A review of available information or collection of new data to respond to a specific health question or request for information about a potential environmental hazard. Health consultations are focused on a specific exposure issue. Health consultations are therefore more limited than a public health assessment, which reviews the exposure potential of each pathway and chemical [compare with **public health assessment**].

Ingestion
The act of swallowing something through eating, drinking, or mouthing objects. A hazardous substance can enter the body this way [see **route of exposure**].

Inhalation
The act of breathing. A hazardous substance can enter the body this way [see **route of exposure**].

Intermediate duration exposure
Contact with a substance that occurs for more than 14 days and less than a year [compare with **acute exposure** and **chronic exposure**].

Lowest-observed-adverse-effect level (LOAEL)
The lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals.

mg/kg
Milligram per kilogram.

mg/cm^2
Milligram per square centimeter (of a surface).

mg/m^3
Milligram per cubic meter; a measure of the concentration of a chemical in a known volume (a cubic meter) of air, soil, or water.

Minimal risk level (MRL)
An ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects. MRLs are calculated for a route of exposure (inhalation or oral) over a specified time period (acute, intermediate, or chronic). MRLs should not be used as predictors of harmful (adverse) health effects [see **reference dose**].

No apparent public health hazard
A category used in ATSDR's public health assessments for sites where human exposure to contaminated media might be occurring, might have occurred in the past, or might occur in the future, but where the exposure is not expected to cause any harmful health effects.

No-observed-adverse-effect level (NOAEL)
The highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals.

No public health hazard
A category used in ATSDR's public health assessment documents for sites where people have never and will never come into contact with harmful amounts of site-related substances.

Pica
A craving to eat nonfood items, such as dirt, paint chips, and clay. Some children exhibit pica-related behavior.

Plume
A volume of a substance that moves from its source to places farther away from the source. Plumes can be described by the volume of air or water they occupy and the direction they move. For example, a plume can be a column of smoke from a chimney or a substance moving with groundwater.

Point of exposure
The place where someone can come into contact with a substance present in the environment [see **exposure pathway**].

Population
A group or number of people living within a specified area or sharing similar characteristics (such as occupation or age).

ppb
Parts per billion.

Ppm
Parts per million.

Public health action
A list of steps to protect public health.

Public health assessment (PHA)
An ATSDR document that examines hazardous substances, health outcomes, and community concerns at a hazardous waste site to determine whether people could be harmed from coming into contact with those substances. The PHA also lists actions that need to be taken to protect public health [compare with **health consultation**].

Public health hazard
A category used in ATSDR's public health assessments for sites that pose a public health hazard because of long-term exposures (greater than 1 year) to sufficiently high levels of hazardous substances or radionuclides that could result in harmful health effects.

Public health hazard categories
Public health hazard categories are statements about whether people could be harmed by conditions present at the site in the past, present, or future. One or more hazard categories might be appropriate for each site. The five public health hazard categories are **no public health hazard, no apparent public health hazard**, **indeterminate public health hazard**, **public health hazard**, and **urgent public health hazard**.

Receptor population
People who could come into contact with hazardous substances [see **exposure pathway**].

Reference dose (RfD)
An EPA estimate, with uncertainty or safety factors built in, of the daily lifetime dose of a substance that is unlikely to cause harm in humans.

RfD
See **reference dose**.

Risk
The probability that something will cause injury or harm.

Route of exposure
The way people come into contact with a hazardous substance. Three routes of exposure are breathing [**inhalation**], eating or drinking [**ingestion**], or contact with the skin [**dermal contact**].

Sample
A portion or piece of a whole. A selected subset of a population or subset of whatever is being studied. For example, in a study of people the sample is a number of people chosen from a larger population [see **population**]. An environmental sample (for example, a small amount of soil or water) might be collected to measure contamination in the environment at a specific location.

Sample size
The number of units chosen from a population or environment.

Source of contamination
The place where a hazardous substance comes from, such as a landfill, waste pond, incinerator, storage tank, or drum. A source of contamination is the first part of an **exposure pathway**.

Surface water
Water on the surface of the earth, such as in lakes, rivers, streams, ponds, and springs [compare with **groundwater**].

Toxic agent
Chemical or physical (for example, radiation, heat, cold, microwaves) agents which, under certain circumstances of exposure, can cause harmful effects to living organisms.

Toxicological profile
An ATSDR document that examines, summarizes, and interprets information about a hazardous substance to determine harmful levels of exposure and associated health effects. A toxicological profile also identifies significant gaps in knowledge on the substance and describes areas where further research is needed.

Toxicology
The study of the harmful effects of substances on humans or animals.

Uncertainty factor
Mathematical adjustments for reasons of safety when knowledge is incomplete. For example, factors used in the calculation of doses that are not harmful (adverse) to people. These factors are applied to the lowest-observed-adverse-effect-level (LOAEL) or the no-observed-adverse-effect-level (NOAEL) to derive a minimal risk level (MRL). Uncertainty factors are used to account for variations in people's sensitivity, for differences between animals and humans, and for differences between a LOAEL and a NOAEL. Scientists use uncertainty factors when they have some, but not all, the information from animal or human studies to decide whether an exposure will cause harm to people [also sometimes called a **safety factor**].

Urgent public health hazard
A category used in ATSDR's public health assessments for sites where short-term exposures (less than 1 year) to hazardous substances or conditions could result in harmful health effects that require rapid intervention.

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