Public Health Assessment for

JACKSON CERAMIX SITE

FALLS CREEK, JEFFERSON COUNTY, PENNSYLVANIA

EPA FACILITY ID: PAD001222025

MAY 21, 2008

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

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EPA FACILITY ID: PAD001222025

Prepared by:

Pennsylvania Department of Health
Division of Environmental Health Epidemiology
Under Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

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Summary

The Jackson Ceramix Site (the site) currently comprises an approximately 200-acre area and was formerly utilized as a china manufacturing plant in Falls Creek, Jefferson County, Pennsylvania. The former manufacturing facility area at the Jackson Ceramix Site is surrounded by residential areas to the west and to the north, a playground and ball field to the north, to the east by railroad tracks and a wetland area. Sandy Lick Creek also borders the site to the east and south. During operations at the former china manufacturing facility, a glazing compound was sprayed onto the china. This compound contained lead. The leaded glaze, mixed with water, was discharged into an unlined lagoon. The lagoon discharged into the adjacent wetlands to the southeast of the railroad tracks.

In preparing for this public health assessment, the Pennsylvania Department of Health (PADOH), working under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR), reviewed existing environmental sampling data from the Pennsylvania Department of Environmental Protection (PADEP), the United States Environmental Protection Agency (EPA), and visited the site.

Multiple PADEP (formerly PADER) and EPA investigations and clean-up actions have taken place at the site since discovery of the contamination in 1979; however, mainly lead and possibly volatile organic compound (VOC) contamination still exists at the site in surface and subsurface soil, and on-site groundwater. The site was proposed to the National Priorities List (NPL) in April of 2005 and was formally added to the NPL in September 2005. At the time this document was prepared, the EPA was in the planning phase to initiate a Remedial Investigation/Feasibility Study (RI/FS) at the Jackson Ceramix Site

After reviewing the environmental data, potential exposure scenarios, and contaminant toxicology information, PADOH and ATSDR conclude that the public health hazard category for current conditions at the Jackson Ceramix Site is ***no apparent public health hazard*** for the limited duration of exposure to lead-contaminated surface soils in the wetlands and no potential exposures to on-site VOC-contaminated groundwater. PADOH and ATSDR base their conclusion on the following:

1. The confirmation that older children and adults are not exposed to the surface soils on the Jackson Ceramix Site at a significant duration to result in adverse health effects; and children under the age of six would not be expected to be playing in these areas as the site-specific evidence suggests

2. The VOC-contaminated groundwater at the Jackson Ceramix Site has not migrated from the vicinity of the former Jackson Ceramix facility. Groundwater samples collected from the monitoring wells located hydrogeologically downgradient from the former facility in 2002 indicated that VOCs and dissolved lead were not present at detectable concentrations in this groundwater. As confirmation that vapor intrusion is not an issue, sub-slab or indoor air sampling for residences within 100 feet of the VOC plume could be considered.

To limit exposures or increase the knowledge of the public that an elevated lead contamination problem exists in portions of the site, PADOH and ATSDR are

recommending that signs be placed around the perimeter of these areas of the site. The recommended signs should warn individuals that significant exposures to the detected levels of lead in these areas could result in adverse health effects to those who might be exposed, especially if younger children visited the site. PADOH and ATSDR are also recommending that the surface soil (0 to 3 inches) of the community playground and ballfield adjacent to the north of the site be sampled to determine if there are any contaminants at levels of health concern. The ballfield and playground area are an indeterminate public health hazard, due to lack of sampling data.

The interpretation, conclusions, and recommendations regarding the Jackson Ceramix Site are site-specific and do not necessarily apply to any other site.

Purpose and Health Issues

In April 2005, the EPA proposed the addition of the Jackson Ceramix Site in Falls Creek, Jefferson and Clearfield Counties, Pennsylvania to the NPL. The listing was final and documented in the United States Federal Register in September 2005. The Jackson Ceramix Site was utilized for the manufacturing of china from the 1917 until 1985. The china manufacturing process involved application of lead-based glazing that was rinsed with water into an unlined wastewater treatment lagoon. In addition, a sludge of sand, clay, unheated glazing product, and paints (containing oxides of aluminum, tin, chromium, magnesium, lead, and copper) were also discharged into the lagoon through a drainage ditch [1]. The Jackson Ceramix Site is bordered by residential areas, mainly to the west. There is much evidence that people visit the site for recreation and hunting purposes. Access to the site is currently not restricted or posted with trespassing signs. The Division of Environmental Health Epidemiology, Bureau of Epidemiology, PADOH has a cooperative agreement with ATSDR to conduct public health assessments and consultations for hazardous waste sites in Pennsylvania. PADOH completed this public health assessment under this cooperative agreement.

A public health assessment is a tool used to determine if and what kind of activities are needed to protect the health of a community residing/working near a hazardous waste site, and to determine the need for follow-up health activities (e.g., health education, health study). To achieve this goal, this assessment contains three types of evaluations: (1) the identification of pathways of exposure to site contaminants and an evaluation of public health implications; (2) a summary of relevant and available health outcome data (e.g. cancer registry data); and (3) evaluations of specific community health concerns about the site. The first type of evaluation addresses the contaminants that are present at the site above comparison values, the determination of exposure pathways, and the potential for those chemicals to enter people's bodies.

Background

Site Location and Description

The Jackson Ceramix Site is located on the eastern edge of Falls Creek, Jefferson County, Pennsylvania (Figures 1, 2). A portion of the site also extends into Clearfield County. The area targeted for this study is located mainly to the east, south, and southeast of the former Jackson Ceramix facility in the topographically and hydrogeologically downgradient direction (Figures 2-4). It has been determined that the sludge from the manufacturing process periodically overflowed the lagoon. When this overflow occurred, it spilled into a culvert beneath the railroad tracks and discharged through a pipe into adjacent wetlands and possibly into an unnamed tributary of Sandy Lick Creek. Between 12 and 23 acres of wetlands are estimated to be contaminated with lead in the upper foot to two feet of soil [1]. The approximately 200-acre site, is not currently developed and does not appear to impact any habitable structure. A large portion of this area of the site is wooded, and is bordered to the east, southeast, and south by Sandy Lick Creek.

Site History

From 1917 to October 1985, the Jackson Ceramix facility operated as a china manufacturing plant [1]. The manufacturing process, while the facility was in operation, involved the painting, glazing, and production of china. As a result of the operations at the site, the wastewater was discharged to a drainage ditch that led to an unlined lagoon to the northeast of the facility. Paint wastes were released into the lagoon until 1984; glazing and clay wastes were discharged into the lagoon until 1985, when the plant ceased operations. From 1978 until October 1985, sludge from the lagoon was removed from the lagoon or recycled back into the manufacturing process. In 1985 the facility was abandoned and was heavily vandalized. A fire at the facility in 1989 destroyed approximately three quarters of the building.

In November 1979, the PADER reported that there was a discharge from the facility that lead into the wetland area east of the railroad tracks. PADER documented that they observed a white, silty, clay-like waste product in the wetlands located adjacent to the wastewater lagoon and in an unnamed tributary to Sandy Lick Creek.

To address the wastewater discharges into the lagoon, PADER entered into a consent order and agreement with Jackson Ceramix on April 4, 1979. As part of this agreement, Jackson Ceramix proposed the construction and operation of an industrial wastewater treatment plant. In June 1980, a National Pollutant Discharge Elimination System (NPDES) permit was issued to Jackson Ceramix that authorized the discharge of wastewater to the lagoon [2]. PADER and Jackson Ceramix entered into a second consent order and agreement on March 7, 1983 (amended on July 9, 1984) that required construction of an industrial wastewater treatment unit. Another NPDES permit was issued to Jackson Ceramix on September 27, 1984. Jackson Ceramix failed to comply with the terms of the second consent order and agreement. It was not reported that a treatment plant was constructed. During an inspection on May 23, 1984, PADER showed that conditions at the facility were similar to those found during the November 1979 visit [3].

On August 21, 1986, PADER visited the Jackson Ceramix facility again [2]. The manufacturing facility was abandoned and had been heavily vandalized. Drums and other containers potentially holding hazardous materials were observed by PADER. Two broken china waste piles were located north and northwest of the facility.

EPA Region 3's Field Investigation Team (FIT 3) conducted a site inspection of the Jackson Ceramix facility in April 1987 [4]. Samples were obtained from several areas of concern at the facility including: drums, the drainage ditch located adjacent to the facility, and the wastewater lagoon. Samples obtained from the drums revealed chloroform, tetrachloroethene, 2-methyl naphthalene, naphthalene, xylenes, and diethyl phthalate, as well as significant concentrations of lead (up to 15,800 mg/kg). Aqueous samples from the drainage ditch that received wastewater from the plant and discharged into the wastewater lagoon revealed the presence of trichloroethene (TCE), trans-1,2-dichloroethene (trans-1,2-DCE), and lead. Concentrations of lead, up to 242,000 milligrams per kilogram (mg/kg), were detected in samples collected of the sediment found in this drainage ditch. Auger samples of the lagoon showed the presence of toluene, trans-1,2-DCE, and lead concentrations of 10,500 mg/kg. Sediment samples collected in the wetlands that received the effluent from the lagoon revealed several contaminants, including lead at 25,000 mg/kg [4].

In July 1987, EPA Region 3's Technical Assistance Team (TAT) performed a site assessment at the facility. Samples were collected from the drainage ditch that led to the lagoon. Analytical results revealed lead contamination as high as 66,500 mg/kg [5,6].

In November 1987, ATSDR prepared a health consultation at the request of EPA. ATSDR studied contaminant levels at the site and concluded in the health consultation that the site posed a potential threat to public health. ATSDR based this conclusion on the levels of lead found in on-site soils and organic vapor levels near an on-site drum area. Also in the health consultation, ATSDR recommended securing the site, verifying the extent of surface soil contamination, monitoring nearby potable water wells, and assessing on-site indoor air quality for lead, VOCs, and explosivity [7].

In March 1988, TAT collected additional samples including stream sediment, soil, and background soil samples from the facility [5,7]. Analytical results indicated elevated levels of lead in the drainage ditch (up to 125,000 mg/kg), the lagoon (up to 15,600 mg/kg), and the wetlands located east of the former manufacturing facility (up to 17,000 mg/kg).

In January 1989, an EPA Region 3's Emergency Response Cleanup Services (ERCS) contractor excavated and removed 1,900 cubic yards of sludge from the lagoon area and contaminated material from the drainage ditch. The excavated lagoon area was backfilled with clean material, and an 80-foot section of pipe was placed over the area to ensure proper drainage [5].

TAT and ERCS conducted a drum inventory and compatibility analysis at the facility in January 1989 [4,5,8]. The inventory determined that drums located at the facility contained flammable liquid, PCE, acrylic lacquer thinner, denatured alcohol, xylol, combustible vapor, Engelhard-TD26318, flammable material, paint materials, TCE, and mineral spirits. An EPA On-Scene Coordinator's report indicated that 60 drums of flammable organic solvents were present on the property. In 1989, all drums identified on the property were stored in a secured, contained area. In February 1989, miscellaneous materials and bags of Ceraflux were secured and contained Ceraflux is a powder that contains high levels of lead. Ceraflux is used in pottery and wall-tile glaze. EPA's removal and stabilization activities were completed on February 10, 1989.

On October 29, 1989, a fire destroyed approximately 75 percent of the former manufacturing facility [9]. On October 31, 1989, in response to the fire, TAT returned to the facility and obtained samples of sludge, water, and glaze powders, along with wipe samples [10]. Lead levels up to 38,500 mg/kg were detected in the drainage ditch that led from the facility building to the lagoon.

In May and June 1991, one off-site monitoring well (MW) and four on-site MWs were installed [11,12]. In July 1991, TAT collected 25 soil, seven sediment, five aqueous, and four wipe samples from various areas on and near the facility. A sample of the drainage ditch bed and a sediment sample of the lagoon showed lead levels of 14,000 and 15,000 mg/kg, respectively. Five soil samples of the wetlands located east of the former manufacturing facility revealed lead at concentrations ranging from 2,900 to 14,000 mg/kg. In response to these elevated detections of lead in the soil, ATSDR prepared a second health consultation at EPA's request in November 1991. ATSDR reviewed data obtained from samples in the wetlands near the site. ATSDR concluded in this health consultation that this lead contamination represented a health threat by way of inhalation and ingestion. ATSDR recommended that access should be restricted at the areas contaminated with high levels of lead [13].

In January 1992, TAT conducted sampling of the wooded area north of the facility and the perimeter of the wetlands area located east of the facility. One sample located in a wetland about 2,000 feet south of the facility, showed a lead concentration of 1,760 mg/kg [14].

An expanded site inspection was conducted at the Jackson Ceramix facility in March and April 1992 [15]. The five MWs installed in 1991 were sampled and analyzed for EPA's organic target compound list (TCL) and inorganic target analyte list (TAL). In addition, filtered samples were obtained from each MW and analyzed for dissolved metals. Aqueous and sediment samples were obtained from the wetlands, Wolf Run, and Sandy Lick Creek. Six volatile organic compounds (PCE; cis-1,2-DCE; vinyl chloride; TCE; trans-1,2-DCE; and toluene) were detected in shallow on-site MWs. An elevated concentration of zinc, as compared to a background sample, was found in a filtered sample from one of the shallow on-site MWs. Elevated levels of lead were detected in wetland aqueous (up to 3,730 micrograms per liter and sediment samples (up to 24,800 mg/kg) [15].

In April 1996 PADEP sampled the sludge deposits in the swamp at 14 places. They found high levels of total lead in all 14 samples. In mg/kg, the range of total lead in the samples was from 6,030 to 28,200. The average value of total lead was 19,300 and the median value was 19,600. Using the Toxic Characteristic Leaching Procedure (TCLP), all 14 samples tested positive as lead-bearing hazardous waste under EPA's definition [16].

In August 1996, PADOH, under a Cooperative Agreement with ATSDR, prepared another health consultation at the request of the PADEP. In this health consultation, PADOH and ATSDR concluded that the Jackson Ceramix is a public health hazard [16]. PADOH and ATSDR based this conclusion on the presence of physical hazards and raw sewage at the site. Additionally, a completed exposure pathway was identified for site related lead in wetlands sediments near the site. PADOH did not expect any adverse health effects to result from a limited amount of exposure to these contaminated sediments. PADOH and ATSDR also concluded there are no completed or potential exposure pathways through drinking VOC-contaminated groundwater at the site.

At the request of PADEP, PADOH prepared another health consultation in September 1998 as a follow-up to the one prepared in August 1996. In this health consultation, PADOH and ATSDR concluded that the Jackson Ceramix Site remained a public health threat based on the continued presence of raw sewage on the site [17]. This health consultation also stated that the lead-contaminated clay in the wetlands is a potential public health hazard to people who may enter the swamp. PADOH and ATSDR also recommended sampling the top three inches of soil for lead in a playground and ball field adjacent to the site. The raw sewage on the site was removed, as the local authorities corrected this problem. The lead-contaminated clay in the wetlands remains on the site, and the top three inches of soil at the adjacent playground and ball field adjacent to the site have not been sampled to date.

A two-phased prompt interim response was conducted at the former manufacturing facility, under the direction of PADEP, during the periods of December 7, 1998 through February 5, 1999 and April 21, 1999 through July 15, 1999. The prompt interim response included:

- removal and off-site disposal of asbestos-containing material;
- excavation and on-site treatment and stabilization of contaminated sludge and soil from 16 sumps, the drainage ditch, and the lagoon;
- removal and off-site disposal or on-site treatment and stabilization of waste in pits and septic tanks, ceramic manufacturing process materials, construction debris, and stage materials;
- demolition of two buildings, two kilns, two railroad cars, a chimney stack, and various other structures;
- relocation of china waste and initial site grading; and
- construction and revegetation of a soil cap over about 12 acres of the property [18]. The capped area remains on the site today, and was observed to be heavily vegetated during the most recent site visit.

In August 2001, under the Pennsylvania Hazardous Sites Cleanup Act, a pre-design investigation was conducted in the wetland east of the lagoon [19]. The investigation was conducted to assist PADEP in implementing the remedial alternative selected from a feasibility study for the wetland area. The investigation included completion of 154 hand-augered soil borings in the wetland area. Based on the analytical results reported from these samples, it was determined that approximately 13 to 24 acres of the wetland that received drainage from the Jackson Ceramix facility contained lead greater than 1,000 mg/kg.

In 2002, an addendum was prepared to the August 2001 pre-design investigation to study shallow groundwater underlying the wetlands. Nine shallow wells were installed during the 2001 pre-design investigation. Samples from these wells were analyzed for VOCs and dissolved lead. No chemicals were detected above their quantitation limits.

The Jackson Ceramix Site was proposed to the NPL in the Federal Register on April 27, 2005. On September 14, 2005 the Jackson Ceramix Site was formally added to the NPL.

Site Demographics

The Jackson Ceramix Site is located in the eastern edge of Falls Creek in Jefferson County Pennsylvania. Portions of the site also extend into Clearfield County (Figures 2-3). The site is located in a mixed residential, industrial, and rural area and is currently about 200 acres in size. Undeveloped areas make up a majority of the targeted area. The former factory store is the only building that remains on the site.

Approximately 1,982 people live in Falls Creek (Zip Code 15840). As part of the total population, 6.5% (128/1,982) are children under the age of 6 years. Falls Creek consists of approximately 862 housing units with 26.5% (228/862) of these households with children under 18 years old [5]. By race, the majority of residents in Falls Creek are white, making up approximately 98.9% (1960/1982) of the total population [20].

Of all housing in Falls Creek, approximately 87.5% (754/862) of the units were constructed prior to 1980. The median year of housing construction in Falls Creek is 1952 [20].

Site Visits

In conjunction with the preparation of this PHA, representatives from the PADOH conducted a visit of the Jackson Ceramix Site on September 21, 2005. Staff members from PADEP, EPA Region 3, and EPA contractors (CDM), assisted PADOH with the tour of the site. PADOH observed the topography of the site, residential locations, a lagoon area, wetlands area, and areas surrounding the site that included a playground and ball field.

Discussion

Data Used

The data utilized in preparing this PHA included the August 2001 soil sample data from the wetland area on the site that was impacted by lead-contaminated sludge transported from the lagoon. PADOH also evaluated the results from the most recent round of groundwater samples that were collected during 2002 at the Jackson Ceramix Site.

In August 2001, PADEP's General Technical Assistance Contractor (GTAC) conducted an environmental investigation that focused in the wetlands east of the former Jackson Ceramix facility. A total of 154 soil boring locations were sampled for the presence of lead. All samples were screened for lead using a portable x-ray fluorescence analyzer and sent to a fixed PADEP accredited laboratory for analysis. The soil sampling data indicated that between 12 and 23 acres of wetlands that received drainage from the former Jackson Ceramix facility contained lead in concentrations greater than 1,000 mg/kg (Figure 4). The results of the soil sampling are presented in Table 4 of this document.

An addendum to the aforementioned environmental investigation was prepared by PADEP's GTAC to investigate the groundwater below the wetlands. The groundwater was sampled from nine monitoring wells and analyzed for VOCs and dissolved lead. No chemicals were detected above the quantitation limits in these water samples [19].

Contaminants of Concern

The existing data indicate that lead is the primary contaminant of concern at the Jackson Ceramix Site. Therefore, this PHA mainly focuses on the potential health effects associated with lead exposure. Additional data may also reveal detections of other chemicals at this site at levels of potential health concern. Generally, the areas influenced from the drainage of the lagoon that include the wetlands area and tributary to the Sandy Lick Creek were sampled and found to a have the highest lead concentration in the surface soil. PADOH may evaluate exposure to other contaminants of concern as additional information becomes available for the site.

Some VOCs were also detected in monitoring wells on the site. These wells have not been sampled since 2002. The groundwater contamination would not be expected to impact drinking water resources in the vicinity of the site. We are not aware of any private wells in the area. A private well investigation should be conducted to confirm this. Public water in the area is provided by Falls Creek Borough Water Treatment Plant (WTP), and the water source for this public water supply is not affected by any contamination at the site. The nearest municipal well is located approximately 0.25 miles hydrogeologically and topographically upgradient from the site. Falls Creek Borough WTP is monitored under requirements of PADEP's Safe Drinking Water Program. Falls Creek Borough WTP provides approximately 609 connections to 1,322 residents of this community adjacent to the site [21].

Lead

As indicated in past soil sampling events, lead is present in the soil primarily around the wetland areas impacted by the drainage from the lagoon that were utilized by the Jackson Ceramix facility for waste. During china manufacturing operations at the Jackson Ceramix facility, lead contaminated sludge and slurry was released from the facility into the unlined lagoon. Lead sludge from the lagoon sometimes drained into downgradient wetlands. The lead-contaminated sludge remains in the upper portions of the surface soil after deposition. Since lead does not dissipate, biodegrade, or decay, the risk of exposure could be long-term.

Lead from interior and exterior lead-based paint may also be present in houses and soil surrounding homes constructed prior to 1978, when lead was banned from paints in the United States.

Individuals could be exposed to lead in soil through incidental ingestion of soil during activities such as gardening and outdoor play [22]. Tracking of lead-contaminated soils into the home could also occur if footwear is in contact with soil contamination. People could also be exposed to lead from inhaling dust and drinking water contaminated with lead.

The biological fate of lead is well known [22]. When ingested, 10 to 80% (depending on various factors) is absorbed directly and distributed throughout the body through the bloodstream, while the remaining lead (about 5 %) is excreted. Lead is primarily distributed through the kidneys, bone marrow, liver, brain, bones, and teeth. Bone and tissue have been found to contain 95% of the total amount of lead stored in the body. Therefore, collecting and analyzing blood samples for lead measures recent and ongoing exposures, but not the lead that is being stored. However, if blood is mobilized from bones (during pregnancy, menopause, etc.) then you can also measure it in blood samples from preexisting exposures.

<u>General Health effects in Children from Lead</u>

Although we would not necessarily expect to see the health outcomes listed below at this site, children under the age of six are considered to be at a greater risk for health effects from exposure to lead compared to older children and adults [22]. The reasons for children's increased vulnerability to lead poisoning are due to the following factors:

1. children's developing central nervous system;

2. hand-to-mouth behavior exhibited by children increases the ingestion rate for either contaminated soil or the ingestion of lead containing dust or paint chips;
3. children's efficiency of lead absorption from the gastrointestinal tract is greater than adults; and
4. iron and calcium deficiencies that are prevalent in children may enhance the absorption and increase the toxic effects of lead [22].

Most children with lead poisoning have no obvious symptoms; therefore, the condition often remains undiagnosed and untreated [23].

Fetuses are at even a greater risk from lead exposure than children [22,23]. Since lead crosses the placenta, a women exposed to lead during her pregnancy can pass on lead to her developing fetus. Lead in bones of women who were exposed before pregnancy may be mobilized because of the physiological stresses of pregnancy resulting in exposure to fetus as well.

Studies that involve exposure of lead to children and the developing fetus have demonstrated an association between lead and several health effects [22,23]. These health effects include both physical and mental impairments, hearing difficulties, impaired neurological development, and reduced birth weights and gestational age [22,24]. They can also include behavioral effects such as impulsivity, aggression, and short attention span when exposure levels are high and distractibility, poor organization, a lack of persistence, and daydreaming when exposure levels are low [25]. The neurotoxicity of lead is a particular concern. Some health effects, such as impaired academic performance and motor skills, may become irreversible and persist as a result of lead exposure, even when blood lead concentration return to below 10 µg/dL [22,26].

Evaluation of Health Effects from Exposure to Lead

ATSDR has developed health-based comparison values (CVs) that are chemical-specific concentrations, which help to determine which environmental contaminants are of possible health concern and need further evaluation [27]. If a chemical concentration is found in the environment at levels below the CV, it is not likely to cause adverse health effects, though chemicals that exceed CVs do not necessarily produce adverse health effects. If a contaminant exceeds its corresponding CV or does not have a CV, PADOH examines health-based guideline levels and evaluates toxicological research data for the contaminant.

For the evaluation of most chemicals, PADOH and ATSDR calculate an exposure dose and compare it to a CV established for that particular chemical. The exposure dose is a calculation that estimates the amount of a contaminant that gets into a person's body for a given exposure scenario. The CVs typically utilized by PADOH and ATSDR usually are ATSDR's minimal risk levels (MRLs) or EPA's reference dose (RfD). ATSDR has developed MRLs for many contaminants commonly found at hazardous waste sites. MRL's are estimates of daily exposure to a contaminant below which noncarcinogenic adverse health effects are unlikely to occur. In other words, adverse health effects would not be expected to occur at estimated exposure doses below the MRL. MRLs are developed for different routes of exposure, such as ingestion and inhalation. They are also developed for different lengths of exposure, such as acute (less than 14 days), intermediate (15-365 days), and chronic (365 days or more). RfDs are estimates of daily, lifetime exposure of human populations to a possible hazard that is not likely to cause noncarcinogenic health effects.

ATSDR has not derived MRLs for lead exposure, nor has EPA developed an RfD for inorganic lead and lead compounds. The main obstacle to developing an RfD is the lack of an identifiable threshold. Lead exhibits a dose-response relationship, although it is not linear and is complicated by body-burden issues. Studies do not indicate clear dose-response relationships using environmental concentrations of lead [22, 28].

Based on mainly animal studies, EPA and the International Agency for Research in Cancer (IARC) have identified lead as a probable human carcinogen [22, 28]. Several studies reported an increased incidence of kidney cancer among lab animals that ingested or had direct skin contact with several lead compounds. There is increasing evidence from human studies of lead exposure supporting findings of animal studies regarding the cancer-causing potential of lead [29, 30]. An IARC working group recently reviewed six studies of workers exposed to elevated concentrations of lead and found limited evidence linking lead with stomach, kidney, lung, and brain cancer [29].

In addition, in a recent report by the National Institute of Environmental Health Sciences, National Report on Carcinogens Review Committee list lead and lead compounds as reasonably anticipated to cause cancer in humans. According to this report, exposure to lead has been associated with a small increased risk for lung and stomach cancer in humans, and kidney, brain, or lung cancer in animals [30]. However, no cancer slope factor has been developed in order to be able to calculate a theoretical lifetime excess cancer risk.

As previously indicated, no health guidelines or threshold values have been established for health effects resulting from exposure to lead in various environmental media. However, evidence from health studies indicates a link of health effects to elevated blood lead levels [22,23]. Levels of 10 to 20 µg/dL, and maybe even less, in children's blood have been associated with decreases in IQ and slightly impaired hearing and growth [22, 23, 31]. Blood lead levels of 20 µg/dL and greater are associated with changes in nerve conduction velocity. Vitamin D metabolism, which is essential in bone development, can suffer at elevated blood lead levels of 30 µg/dL [23]. In children, lead begins to affect hemoglobin synthesis at 40 µg/dL. Colic, anemia, kidney disease, and diseases of the brain occur at blood lead levels between 60 µg/dL and 100 µg/dL. CDC considers blood lead levels greater than 10 µg/dL in children less than six years old and 25 µg/dL in older children and adults to be elevated and of public health concern [23].

Therefore, in this public health assessment document, PADOH and ATSDR will use blood lead levels or a prediction of blood lead levels to evaluate the possible health effects of lead exposure. The following sections will discuss the relationship between lead levels in surface soil and blood lead levels and the impact of remediation of soil contaminated with lead and blood lead levels.

Impact of Soil Lead Concentrations on Children's Blood Lead

There is a great deal of disparity that has been reported in studies regarding the relationship of soil lead concentrations and blood lead levels. According to an ATSDR study of several different communities, lead soil concentrations greater than 500 mg/kg were associated with average blood lead concentrations greater than 10 µg/dL in children [29]. One study reported a correlation between soil lead concentration of 250 mg/kg and an estimated blood lead level of 2 µg/dL [32]. CDC reported that, in general, blood lead levels increase 3 to 7 µg/dL for every 1,000 mg/kg increase in the soil lead concentration, based on the available scientific literature [22]. The differences reported amongst studies are a reflection of the different exposure conditions (i.e., ground cover, seasonal variations), the different absorption rates of lead and lead-containing compounds, and different exposed populations. In addition, pre-existing health conditions, such as iron deficiencies, can enhance lead absorption and toxicity [22].

A number of studies report that the increases in blood lead levels, as a function of concentration of lead in soil is not linear. That is, from exposure to elevated lead concentrations in soil, the rate of increase in blood lead levels is not as significant [33]. According to one study, an increase in lead concentrations in soil from 100 mg/kg to 1,000 mg/kg was linked to a change of the predicted blood level of 7.3 µg/dL to 13.0 µg/dL, a change of 5.7 µg/dL. However, exposure to soil with average lead at concentrations of 2,100 mg/kg was linked to an estimated blood lead level of 15.2 µg/dL, an increase of only 2.2 µg/dL.

To deal with this non-linear relationship, EPA developed the *Integrated Exposure Uptake Biokinetic Model for Lead in Children* (IEUBK) [34]. The IEUBK Model is used to predict the risk of EBLLs in children less than seven years old that are exposed to lead from various sources. The model also predicts the risk that typical child, exposed to specified media lead concentrations, will have a blood lead level greater than or equal to the level of concern (10µg/dL). The IEUBK Model is EPA's primary tool for identifying clean-up levels for lead-contaminated soil. The following criteria are factored into the IEUBK Model [18]:

1. *Intake of lead in soil, house dust, air, water, and food*. Sampling data on lead in these various media are used to identify site-specific intake rates. Media specific default intake rates are used in this model if the sampling data was not available. These default rates were carefully determined from available research data.

2. *Uptake of lead from the contaminated media into the blood stream*. Only a fraction of the lead that an individual is exposed to is taken in and makes it to the bloodstream. Typically, default uptakes rates are used in the IEUBK model. However, some studies estimate the bioavailability of lead in soils through EPA's *in vitro* method.

3. *Biokinetics of lead within the body*. The biokinetics of lead, or where lead goes within the body and how fast it is eliminated, is also considered in the IEUBK Model through default values that were used to calculate a mean blood lead concentration.

4. *Distribution of blood lead concentrations within the population of concern*. The mean identified in the biokinetic component is then used to calculate the most probable distribution of blood lead levels within a population using default assumptions on the distribution. These assumptions include variability in

physiology, behavior, sampling, and analysis. These results are used to determine the probability that a child will have a blood lead concentration above a specific level (default value of 10µg/dL).

The validity of the IEUBK Model was calibrated against two separate blood and soil lead community studies [35]. Subsequent comparisons involved well-conducted blood and environmental lead studies of children with adequate exposure characterizations. Those comparisons demonstrate reasonably close agreement between mean observed and predicted blood lead concentrations, and between observed and predicted blood leads in excess of 10 µg/dL. Both of these studies focused on communities with at least 15% of the children having blood lead concentrations in exceedance of 10 µg/dL.

Lead Standards, Regulations, and Recommendations

The following section briefly describes some of the current regulations and standards regarding exposure to lead.

EPA regulates lead under the Clean Air Act and has designated lead as a hazardous air pollutant [22]. Prior to the Clean Air Act of 1977, the amount of lead discharged from industrial sources was not restricted. Contaminants were released into the air from the stacks at industrial facilities and settled out of air on to nearby soil, and accumulated over time.

In the early 1970s, EPA began to phase-out the use of leaded gasoline because of its effects on the environment from automobile emissions [22]. By 1988, less than 1% of gasoline contained lead as compared to the gasoline used in 1970. In 1990, Congress stated that it would be unlawful for automotive gasoline to contain lead or lead additives after December 31, 1995.

In 1988, the Lead-Based Paint Poisoning Prevention Act was passed through legislation and became law. It prohibits the use of lead-based paint in residential structures built or renovated by any federal agency [36]. The Act also gives the Department of Housing and Urban Development (HUD) authority to develop regulations on the removal of lead-based paint from housing constructed prior to 1978. In addition to HUD, EPA, the U.S. Department of Health and Human Services, and the Department of Labor's Occupational Safety and Health Administration (OSHA) are the primary federal agencies for promulgating regulations aimed at minimizing lead exposure.

In compliance with the Toxic Substance Control Act (TSCA) §403, EPA published a final rule for dangerous levels of lead in 2001. That rule establishes a soil-lead hazard of 400 mg/kg for bare soil in play areas and 1,200 mg/kg for bare soil in non-play areas for the rest of the yard [37]. As recognized in the TSCA §403 rule, lead contamination at levels equal to or exceeding the 400 mg/kg and 1,200 mg/kg standards may pose serious health risks. The potential risks are site-specific and may warrant timely response actions. However, the soil-lead hazard levels under the TSCA §403 Rule should not be used to modify approaches to addressing brownfields, NPL site, state Superfund sites, federal CERCLA removal actions, and CERCLA non-NPL facilities.

Exposure Pathway Analysis

ATSDR and PADOH define human exposure pathways by examining environmental and human components that might lead to contact with contaminants of concern. A pathway analysis considers five main elements:

1. a source of contamination,
2. transport through an environmental medium,
3. a point of exposure,
4. a route of human exposure, and
5. a receptor population.

Completed exposure pathways are those in which all five elements are present and exposure to a contaminant has occurred in the past, is currently occurring, or will occur in the future. ATSDR regards those people who contact contaminants as being exposed. That exposure can occur through breathing airborne contaminants, drinking water known to be contaminated, or playing or digging in contaminated soil. The identification of an exposure pathway does not imply that health effects will occur. Exposure may or may not be substantive. Thus, even if exposure has occurred, human health effects may not necessarily result.

PADOH and ATSDR reviewed site history, information on site activities, and the available sampling data for the Jackson Ceramix Site. From this review, PADOH and ATSDR identified several exposure pathways that warranted consideration. The completed exposure pathways are discussed in the following section. A discussion of additional pathways that are potential or have been eliminated for further evaluation also follows.

Completed Exposure Pathways

A completed exposure pathway requires all the five elements to be present: (1) source of the contamination; (2) transport through an environmental medium; (3) a point of exposure; (4) a route of human exposure; and (5) an exposed population. The completed exposure pathway for the Jackson Ceramix Site is listed on Table 1.

Table 1. Completed Exposure Pathway for the Jackson Ceramix Site

Pathway	Media and Transport	Exposure Point	Exposure Route	Exposed Population	Period of Exposure	Exposure Status
On-site Surface Soil	Lead present in surface soil	Surface soil at site in wetlands area	incidental ingestion, inhalation	trespassers, hunters, recreators on the site	Past	Completed
					Present	Completed
					Future	Completed

Surface Soil (On-site)

Based on past sampling results and observations of the grayish-white sludge that remains in the wetlands area, lead contamination exists in the surface soils of this area of the site. This contamination also appears to extend into the sediments of the unnamed tributary to the Sandy Lick Creek that transects the site (Figure 4). Exposure to lead contaminated sludge, soils, and sediment may have been occurring since the 1917, when the Jackson Ceramix facility initiated its china manufacturing operation and lead contaminants were discharged through slurry into an unlined lagoon a result [1]. Lead-contaminated waste in the lagoon area migrated into a wetlands area through a culvert downgradient of the facility.

Individuals could ingest surface soils as an incidental consequence of general outdoor activities. The soil exposure pathway is an especially important pathway for children, who often exhibit hand-to-mouth behavior and have consequently higher ingestion rates of soil. There was not any evidence, and it would not be expected, that children frequent these remote areas of the site that contain surface soil contamination. However, the site is not fenced and access is not restricted.

Potential Exposure Pathways

A potential exposure pathway is defined as one where exposure could be possible except that one or more of the five elements is missing. In some cases this means that the exposure is not possible now, but may be possible in the future. In other cases, exposure may be possible, but cannot be confirmed because environmental sampling data are not available. The potential exposure pathways for the Jackson Ceramix Site are listed on Table 2.

Table 2. Potential Exposure Pathways for Community Near the Jackson Ceramix Site

Pathway	Media and Transport	Exposure Point	Exposure Route	Exposed Population	Period of Exposure	Exposure Status
Lead-based paint (not site related)	Lead potentially present in house dust, soil and paint chips from utilization of lead-based paint	House dust, soil, and paint chips in homes with deteriorating lead-based paint	ingestion, inhalation	residents near site (particularly children under six years)	Past	Potential
					Present	Potential
					Future	Potential
Off-site surface soil	Surface soil potentially impacted by site contaminants through transport	Surface soil at an adjacent off-site playground and ballfield	ingestion, inhalation	Recreators, park visitors (particularly children under six years)	Past	Potential
					Present	Potential
					Future	Potential

Lead-Based Paint

Even though exposure to lead-based paint is not related to the Jackson Ceramix Site, it could be a source of exposure to lead for children six years and younger in the Falls Creek area. The connection between elevated blood lead levels is very difficult to establish through a straightforward comparison all of children who reside in homes constructed prior to 1978. A number of factors could play a role in the level of lead in a person's blood. The evaluation of all these factors would require an exhaustive investigation of each property. Such an investigation is beyond the scope or purpose of this PHA. However, the lead-based paint exposure pathway is described here so that the community will be familiar about this source of lead in and around the home.

People are potentially exposed to lead-based paint through ingestion of dust or soil contaminated with small particles of lead-based paint or through direct ingestion of paint chips. Potential exposure to lead-based paint occurs in and around homes that had interiors and/or exteriors painted with lead-based paint that is not intact (peeling, chipping, chalking or otherwise deteriorating). Homes constructed prior to 1950 are most likely to have surfaces painted with lead-based paint, but lead was still used in some homes built from 1950 to1978. Use of lead-based paint in homes was banned in the United States in 1978, so it is unlikely the homes built after 1978 contain lead-based paint.

As indicated earlier, approximately 87.5% of the housing in Falls Creek was built prior to 1980, with a median construction date of 1952. Therefore, there is a possibility that a child living in the Falls Creek area near the Jackson Ceramix Site could be exposed to lead from homes with lead-based paint.

Surface Soil (Off-site)

A community park and ball field borders the Jackson Ceramix Site to the north. It is possible that during former facility operations (1917-1985) at the site, that some hazardous materials (mainly lead) could have been physically transported onto the neighboring park. A health consultation prepared by PADOH and ATSDR in 1998 recommended that the upper three inches of soil was sampled at the adjacent park. However, no environmental sampling data was available to confirm or deny the presence of contaminants in the surface soil for these off-site locations. As a result of this uncertainty, the off-site surface soil remains a potential exposure pathway.

Eliminated Exposure Pathways

Eliminated exposure pathways are defined as when exposure to the contaminants is unlikely and that one or more of the five elements of an exposure pathway are missing. This means that exposure is not possible now, and it is not likely to be possible in the future. The eliminated pathways for the Jackson Ceramix Site are summarized in Table 3.

Table 3. Eliminated Exposure Pathways for the Jackson Ceramix Site

Pathway	Media and Transport	Exposure Point	Exposure Route	Exposed Population	Period of Exposure	Exposure Status
Drinking Water	Transfer of VOCs and lead from soil to groundwater or surface water	Private, Municipal drinking water	ingestion	Private and City water supply users	Past	Eliminated
					Present	Eliminated
					Future	Potential
Hazardous chemicals at former Jackson Ceramix Plant	Handling of hazardous materials at the former plant	Occupational exposures to hazardous materials	ingestion, inhalation	Former employees of Jackson Ceramix, Inc.	Past	Potential
					Present	Eliminated
					Future	Eliminated

Drinking Water

A public water supplier provides drinking water for residents in the borough of Falls Creek. The Falls Creek WTP, a public water source, supplies drinking water to approximately 1,322 customers for the greater Falls Creek Area at approximately 605 connections. We do not believe that any private wells exist near the Jackson Ceramix Site study area.

The Falls Creek WTP routinely monitors drinking water as it leaves the treatment plant and at some taps to ensure contaminants, including lead and VOCs, are below health-based levels established under the Safe Drinking Water Act [21]. Under certain conditions, however, the piping in older homes could contain lead solder that can introduce lead into the home's water supply. Exposure to harmful concentrations of lead in drinking water is not expected in this area, but is possible in some older homes.

Previous environmental investigations also revealed detectable concentrations of chlorinated VOCs in on-site monitoring wells in the vicinity of the former manufacturing facility. Shallow monitoring wells were also installed in the wetlands and sampled for VOCs and dissolved lead in an investigation that occurred in 2002. No chemicals were detected in the samples collected from these monitoring wells. Currently, contaminated groundwater from the site is not utilized for any purpose, and is not believed to be migrating off the site where groundwater may be utilized for drinking water. The nearest municipal well is located approximately 0.25 miles hydrogeologically and topographically upgradient from the site.

Occupational Exposures

There was no information available to review to the levels of lead or other compounds that workers at the former facility were potentially exposed because of the manufacturing processes. A potential exposure pathway existed for workers to mainly lead from the use of Ceraflux (containing very high percentage of lead), as well as other chemicals such as: oxides of aluminum, tin, chromium, magnesium, lead, and copper; and PCE; acrylic lacquer thinner; denatured alcohol; xylol; combustible vapor; Engelhard-TD26318; flammable material; paint materials; TCE; mineral spirits; cis-1,2-DCE; vinyl chloride; trans-1,2-DCE; and toluene.

This exposure pathway was eliminated to workers in 1985 when the Jackson Ceramix plant ceased operations. Industries today take safety measures to prevent lead exposure. Once you are no longer exposed to lead, your body slowly gets rid of most of it. Some lead is stored in bones and could be released later in life or during pregnancy. If workers at the plant never had symptoms of lead poisoning or health effects for exposures to materials used at the plant, there may not be a reason for concern. If there are concerns about these past exposures, it is recommended that individuals discuss them with their family physician. ATSDR and PADOH can make a referral to an occupational and environmental health medical specialist, if needed.

Contaminant Evaluation

Lead

As a result of the drainage of the lagoon near the former Jackson Ceramix facility, a thick layer of sludge was observed to cover between 12 and 23 acres of the wetland area of the Jackson Ceramix Site. Some sludge was also observed in the unnamed tributary at the southwestern end of these wetlands that eventually flows into Sandy Lick Creek. In August 2001, 154 soil boring samples were collected from the wetland that received surface water runoff from the drainage ditch that lead to the lagoon, formerly located adjacent to the Jackson Ceramix facility. The 2001 Final Pre-Design Report prepared for PADEP indicated that one soil sample was collected from each one-foot depth interval from every soil boring location, typically down to two-feet (0 to 1 foot and 1 to 2 feet). These soil boring samples were analyzed by a PADEP approved laboratory for total lead in accordance with EPA Method 6010B [19].

Table 4 shows the range of soil lead levels and mean soil lead levels in the site release and background areas for the zero to one-foot interval. The 13 background locations were sampled in the same manner as the release area. The background areas were not visibly impacted by the release area. The background samples did not contain the grayish-white clay-like soils found in the release areas.

Table 4 – Soil Lead Data for the Jackson Ceramix Site*

Location	Number of Samples Analyzed – Lab Data	Number of Detects	Range of Detected Contaminated Soil Lead Levels in Parts per Million (mg/kg)	Mean, not including Non-Detects Contaminated Soil Lead Level (mg/kg)
Site Release Area	154	39	1,240 – 36,800	9,453
Background Area	13	7	21.9 – 270	128

*Soil samples (0-12") data in this assessment were collected during August 2001 by PADEP's environmental contractor during the 2001 Pre-Design Investigation

For the evaluation of human exposure for incidental contact with contaminated surface soils, ATSDR and PADOH prefer to evaluate surface soil in the zero to three inches layer. In general, human contact, realistically, will not occur with soils deeper than three inches, unless there is some deliberate means to do so. However, for the following site-specific exceptions, PADOH decided to evaluate the zero to 12 inches "surface" soil data to make their conclusions and recommendations:

- The grayish-white clay-like material (sludge) that contains elevated levels of lead was observed to be at the surface of the wetlands area of the site, and for the most part, the sludge was observed to depths down to 12 inches. With the mean contaminated soil lead concentration of 9,453 mg/kg in the zero to 12 inches samples, PADOH believes this concentration would be representative of the upper three inches of soil in these areas.

- Given the remoteness and the indication that the wetlands areas of the site are not visited by humans on a regular basis, the evaluation of zero to three inches surface soil data would likely not change the conclusions made in this public health assessment document. Furthermore, PADOH expect that similar resultant data would be reported from the zero to three inches surface soil samples for these similar areas.

Potential Health Effects From Elevated Blood Lead Levels

Children whose blood-lead levels range from 10 to 20 µg/dL are at a risk of having decreases in IQ of up to 11 points, and slightly impaired hearing and growth [23]. Those children with blood lead levels of 20 to 40 µg/dL could experience problems in metabolizing vitamin D, which is crucial in bone development. Children with blood lead levels greater than 40 µg/dL could experience anemia and other blood related problems. Colic, kidney disease, and diseases of the brain have been observed in children with blood lead levels greater than 60 µg/dL.

Sources of Lead Exposure for Children with Elevated Blood Lead Levels (EBLL)

PADOH's review of available information indicates there are two major sources of lead for children living in the Jackson Ceramix Site area – lead contaminated soil and lead-based paint. Given the remoteness, inaccessibility, and distance from the residential areas, lead in on-site surface soil is not likely a significant source of exposure to lead, unless children are regularly playing in the wetlands area of the site, which does not appear to be the case.

As discussed earlier, a majority of the homes in Falls Creek Borough were constructed prior to 1978, and homes, on average, were constructed in approximately 1952 [20]. Nearly all pre-1950 homes had exteriors and interiors painted with paint that could contain up to 50% lead [31]. Thus, children 6 years and younger living in homes constructed prior to 1950 likely are exposed to lead from paint if the lead-based paint has not been sealed or removed. It is also possible for individuals to be exposed to lead-based paint in or outside of homes constructed prior to 1978. The Consumer Products and Safety Commission did not release the ban on the sale and use of residential lead paint until September of 1977 [38].

Elimination or Reduction of Children's Exposure to Lead

The elimination or reduction of children's blood lead levels in or near the Jackson Ceramix Site involves identifying specific locations where exposure to lead-based paint is occurring. This is currently accomplished through the following activities:

1) Primary prevention activities that identify, evaluate, and promote control of lead hazards through ongoing temporary mitigation (i.e., sealing or repainting) or permanent elimination (i.e., removal).

2) Effective interventions for children with known lead exposure to reduce or prevent further exposure to mitigate adverse health effects.

As part of this effort and CDC's request for every state to develop a plan to eliminate lead poisoning by 2010, PADOH has developed the following case management plan for every child reported to have a blood lead level of 10 µg/dL or greater [39]:

1. Provide general health education by contacting family and mailing of a fact sheet.
2. Coordinate care and follow-up testing following CDC guidelines between patient, physician or other primary medical provider, and PADOH.
3. Discuss the importance of testing the blood lead levels of all children and pregnant and lactating women living in the same household with the EBLL child.
4. Conduct family education, including a home visit with assessment of possible sources of exposure and history of exposure for confirmed blood lead levels of 15 µg/dL or higher. Refer individuals and families as needed for follow-up care or intervention.
5. Perform an environmental assessment for sources and pathways of lead exposure (e.g. paint, dust, soil, water) with lead hazard reduction follow-up and enforcement (confirmed blood lead levels of 15 µg/dL or greater).
6. Coordinate free venous or capillary blood lead level retesting of all children and pregnant and lactating women living in the same household with the EBLL child.

Children's Health Concerns

PADOH and ATSDR have established an ongoing initiative to protect children from exposure to hazardous substances. PADOH and ATSDR recognize that the unique vulnerabilities of infants and children demand special emphasis in communities faced with contamination of their water, soil, air, or food. Because of their immature and developing organs, infants and children are usually more susceptible to toxic substances than are adults. Children are also smaller, which results in higher exposure doses when compared with adults. Moreover, children depend entirely on adults for identification of hazards and management decisions, housing decisions, and access to medical care. PADOH's and ATSDR's evaluation contained within this public health assessment document considered children as a susceptible subpopulation.

As indicated earlier, the occurrence of homes likely built with lead-based paint are prevalent in residential locations in the vicinity of the Jackson Ceramix Site. If a child is diagnosed with an EBLL, they are at a risk of a variety of lead-related adverse health effects that include slight decreases in intelligence, impaired hearing and growth, behavioral changes, and other effects. The main potential source of exposure to lead near the Jackson Ceramix Site would appear to be lead-based paint from homes constructed prior to 1978; especially those homes constructed prior to 1950. Efforts to reduce or eliminate exposures to both sources should be addressed. The remaining sources of lead at the Jackson Ceramix Site, in the surface soil are not readily accessible to children under the age of six, but should be brought to the attention of the public to protect this most sensitive sub-group of people.

Health Outcome Data Evaluation

A health outcome data evaluation or review of health statistics is the analysis of existing health information (i.e., from cancer registries, death certificates, birth defect registries, blood lead screening databases, etc.) to determine if there is excess disease in a specific population, geographic area, or time period. The evaluation of health outcome data may determine whether the occurrences of certain adverse health effects are higher than expected in the area potentially affected by the site contaminants. Health outcome data evaluation might also give a general picture of the health of a community. However, elevated rates of a particular disease may not necessarily be caused by exposure to hazardous substances. Other factors, such as personal habits, socioeconomic status, genetic pre-disposition, and occupation, may also influence the onset of a particular disease. In contrast, even if elevated rates of disease are not found, a contaminant may still have caused illness or disease.

The Superfund law requires that evaluation of health outcome data be considered in a PHA [40]. ATSDR developed guidance that recommends an evaluation of health outcome data be done only if all the criteria listed below are met. Here are the criteria and the determination of whether they were met at this site:

1. *Presence of a completed human exposure pathway*
    - There is one completed current or past exposure pathways at the Jackson Ceramix Site (on-site surface soil) for hunters, trespassers, or recreators. PADOH suspects that most of the group that may be exposed to on-site surface soils are older children and adults.
2. *Elevated contaminant levels that result in measurable effects*
    - As described earlier, soil lead levels are high enough to either result in adverse health effects or increase a child's risk of having a blood lead levels above CDC's health level of concern of 10 µg/dL. The principle route of exposure is ingestion of the on-site surface soils contaminated with lead in the wetlands. However, there is no indication that children frequent this area because it would not be expected that children under that age of six play on this site. Additionally, occasional trespassing and/or hunting on the site would not lead to a significant exposure to result in measurable health effects in older children or adults.
3. *Sufficient persons in the completed pathway for health effects to be measured*
    - Based on observations at a recent site visit and reported site history since 1985, PADOH does not believe that a considerable number of people visit the Jackson Ceramix Site. There are signs, such as empty shotgun shells, hunting blinds, and discarded bottles, which indicate that hunters and an occasional trespasser or recreators may visit the site in the existing areas of concern.
4. *A health outcome database exists from which disease rates for population of concern can be identified*
    - PADOH's Bureau of Family Health PALL Tracking System includes blood lead data from 1998 – September 2004, and PA-NEDDS is a blood lead database that contains blood lead data for 2004 - 2005 only. Prior to 1998, blood lead data was not collected in a centralized database.

For the reasons that were mentioned above, PADOH determined that the Jackson Ceramix Site did not meet all the criteria for conducting an evaluation of health outcome data. PADOH decided not to conduct a review of health outcome data for this public health assessment.

Community Health Concerns

PADOH is in the planning stages of engaging in activities with the neighborhood of Falls Creek to communicate about exposures related to the Jackson Ceramix Site and to solicit health concerns. Some of these plans include:

1. coordinating a public availability session to invite community members to meet with PADOH and ATSDR staff and communicate their health concerns directly with these staff members.
2. participating in site visits and/or other community meetings to gather information and provide technical assistance and health education.

To date, there have been no specific health concerns expressed from the residents that live near the Jackson Ceramix Site to the PADOH.

Conclusions

PADOH and ATSDR conclude that the Public Health Hazard Category for current conditions at the Jackson Ceramix Site is *no apparent public health hazard* for the limited duration of exposure to lead-contaminated soils in the wetlands and no potential exposures to on-site VOC-contaminated groundwater. Appendix B presents a description of each of the Public Health Hazard Categories considered during the assessment process. PADOH and ATSDR base their conclusion on the following:

1. The confirmation that older children and adults are not exposed to the surface soils on the Jackson Ceramix Site at a significant duration to result in adverse health effects; and children under the age of six would not be expected to be playing in these areas as the site-specific evidence suggest. However, if more significant, regular or daily exposures to the surface soil occur in the future, the current levels of lead in the surface soil would likely increase blood lead levels in humans resulting in adverse health effects. Any alteration in site use that would increase human activity, especially younger children, and contact with the elevated levels of lead in the surface soils, may change this conclusion.
2. The VOC-contaminated groundwater at the Jackson Ceramix Site has not migrated from the vicinity of the former Jackson Ceramix facility. Groundwater samples collected from the monitoring wells located hydrogeologically downgradient from the former facility in 2002 indicated that VOCs and dissolved lead were not present at detectable concentrations in this groundwater. As confirmation that vapor intrusion is not an issue, sub-slab or indoor air sampling for the three residences within 100 feet of the VOC plume could be considered [4].
3. The ballfield and playground area are an indeterminate public health hazard, due to lack of sampling data.

Recommendations

PADOH and ATSDR recommend the following:

1. PADOH, ATSDR, and EPA should work in partnership on increasing the knowledge in the Falls Creek community regarding the identified lead hazards at the Jackson Ceramix Site. PADOH and ATSDR recommend placing warning signs around the existing areas at the site that remain impacted by lead in surface soil would educate persons regarding a possible health risk if they enter that area and have significant exposure to the elevated lead contamination in the surface soil. The placement of signs around the remaining impacted areas at the Jackson Ceramix Site would ensure that visitors other than Falls Creek community members would be aware that a health risk could exist for exposure to the surface soil contamination.
2. PADOH and ATSDR recommend collecting surface soil samples (0 to 3 inches) at the park adjacent to the north of the site. Given the proximity of the park to the site, there is a possibility that some contaminants may have migrated to the surface soils of this park. To date there has been no surface soil sampling conducted at the park and this possible exposure pathway should be evaluated, as it was also recommended in the health consultation prepared for the site by PADOH and ATSDR in 1998.
3. PADOH and ATSDR recommend that the on-site groundwater is not utilized for a potable water supply and is monitored by the EPA to ensure that it does not migrate off the site and impact drinking water resources (public or private).
4. PADOH and ATSDR recommend that if former workers at the Jackson Ceramix facility are concerned due to past exposures to hazardous chemicals that could have been handled at the former facility, they should discuss them with their family doctor. No information in regards to the levels of the chemicals that the workers may have been exposed to were available for evaluation. Therefore, it is not known to whether prior occupational exposures were of a health concern for site workers. ATSDR and PADOH can make a referral to an occupational and environmental health medical specialist, if needed.
5. Residents should not trespass on the site.

Public Health Actions

The purpose of the public health action plan is to ensure that this public health assessment not only identifies current and potential exposure pathways and related hazards, but also to provide a plan of action to mitigate and prevent adverse human health effects resulting from exposures to hazardous substances in the environment. The following sections summarize the completed, on-going, and planned public health actions at the Jackson Ceramix Site.

Completed

When EPA studies were initiated at the site in 1987, they requested ATSDR's assistance in determining whether the site posed a potential threat to public health. Since then, ATSDR and PADOH have been involved in making public health conclusions and recommendations at the Jackson Ceramix Site. EPA and PADEP's environmental investigations were utilized in making the recommended public health actions through ATSDR health consultations for the Jackson Ceramix Site. To date, the following public health documents were published by ATSDR for the Jackson Ceramix Site:

1. In November 1987, ATSDR prepared a health consultation at the request of EPA. ATSDR studied contaminant levels at the site and concluded that in the health consultation the site posed a potential threat to public health. ATSDR based this conclusion on the levels of lead found in on-site soils and organic vapor levels near an on-site drum area. Also in the health consultation, ATSDR recommended securing the site, verifying the extent of surface soil contamination, monitoring nearby potable water wells, and assessing on-site indoor air quality for lead, VOCs, and explosivity [7].

2. ATSDR prepared a second health consultation at EPA's request in November 1991. ATSDR reviewed data obtained from soil samples in the wetlands near the site. Investigators found elevated levels of lead at 14,000 mg/kg in the wetlands. ATSDR concluded in this health consultation that this lead contamination represented a health threat by way of inhalation and ingestion. ATSDR recommended that access should be restricted at the areas contaminated with high levels of lead [13].

3. In August 1996, PADOH prepared another health consultation at the request of the PADEP. In this health consultation, PADOH and ATSDR concluded that the Jackson Ceramix is a public health hazard. PADOH and ATSDR based this conclusion on the presence of physical hazards and raw sewage at the site. Additionally, a completed exposure pathway was identified for site related lead in wetlands sediments near the site. PADOH did not expect any adverse health effects to result from a limited amount of exposure to these contaminated sediments. PADOH and ATSDR also concluded there are no completed or potential exposure pathways through drinking VOC-contaminated groundwater at the site [16]. PADOH prepared and disseminated a fact sheet to the health care providers and the community in March 1997 warning residents, especially children, not to trespass onto the site.

4. At the request of PADEP, PADOH prepared another health consultation in September 1998 as a follow-up to the one prepared in August 1996. In this health consultation, PADOH and ATSDR concluded that the Jackson Ceramix Site remained a public health threat based on the continued presence of raw sewage on the site. This health consultation also stated that the lead-contaminated clay in the wetlands is a potential public health hazard to people who may enter the swamp for whatever reason. PADOH and ATSDR also recommended sampling the top three inches of soil for lead in a playground adjacent to the site [17].

Actions Taken

1. PADOH and ATSDR conducted a Public Availability Session (PAS) during the public comment period of the PHA. The purpose of the PAS is to address the community concerns and inform residents not to trespass on the site. The PAS was conducted on Thursday, November 15, 2007 to gather questions from the community about the draft PHA. The public availability session was held at the Falls Creek Borough Office at 117 Taylor Avenue, Falls Creek, PA from 2:00 p.m. until 4:00 p.m.
2. Jackson Ceramix Fact Sheets were distributed to the borough hall to be handed out at the next public borough meeting. Contact information for residents with additional questions or concerns about the site was included in the fact sheet.

Ongoing and Planned

The following public health actions are on going or planned at the Jackson Ceramix Site:

1. PADOH will remain available to respond to community concerns regarding the site.
2. EPA plans to continue to investigate lead contamination in the surface soil of the wetlands and tributary to the Sandy Lick Creek. In addition, EPA plans to monitor the groundwater on the site for organic and inorganic contamination.

PADOH and ATSDR will update this public health action plan for the Jackson Ceramix Site as additional data or site conditions warrant.

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Certification

This Public Health Assessment for the Jackson Ceramix Site was prepared by the Pennsylvania Department of Health under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry. It is in accordance with approved methodology and procedures existing at the time the health consultation was initiated. 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.

Alan W. Yarbrough

Alan Yarbrough

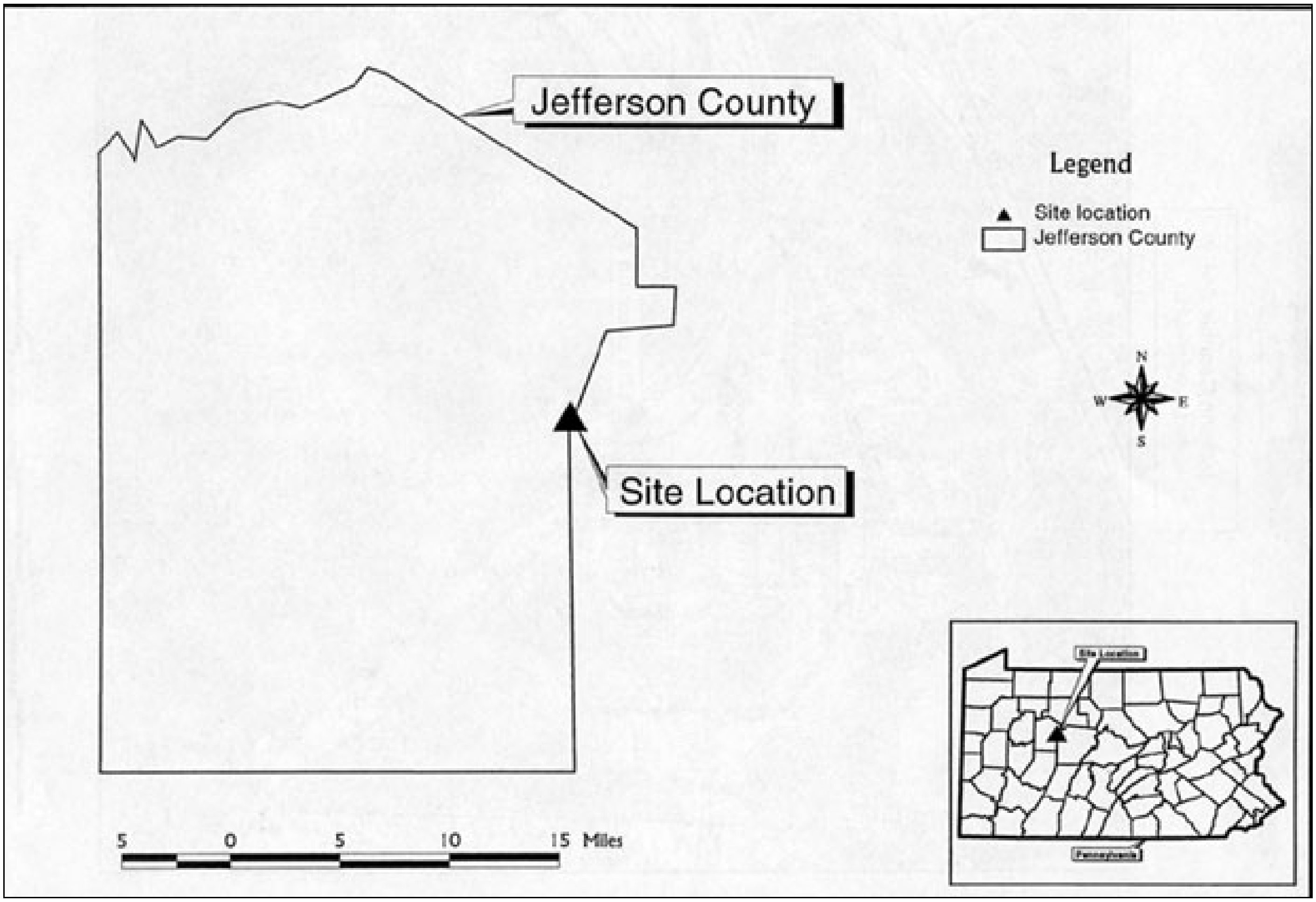
Team Leader, CAT, CAPEB, DHAC, ATSDR

APPENDIX A

FIGURES

Figure 1

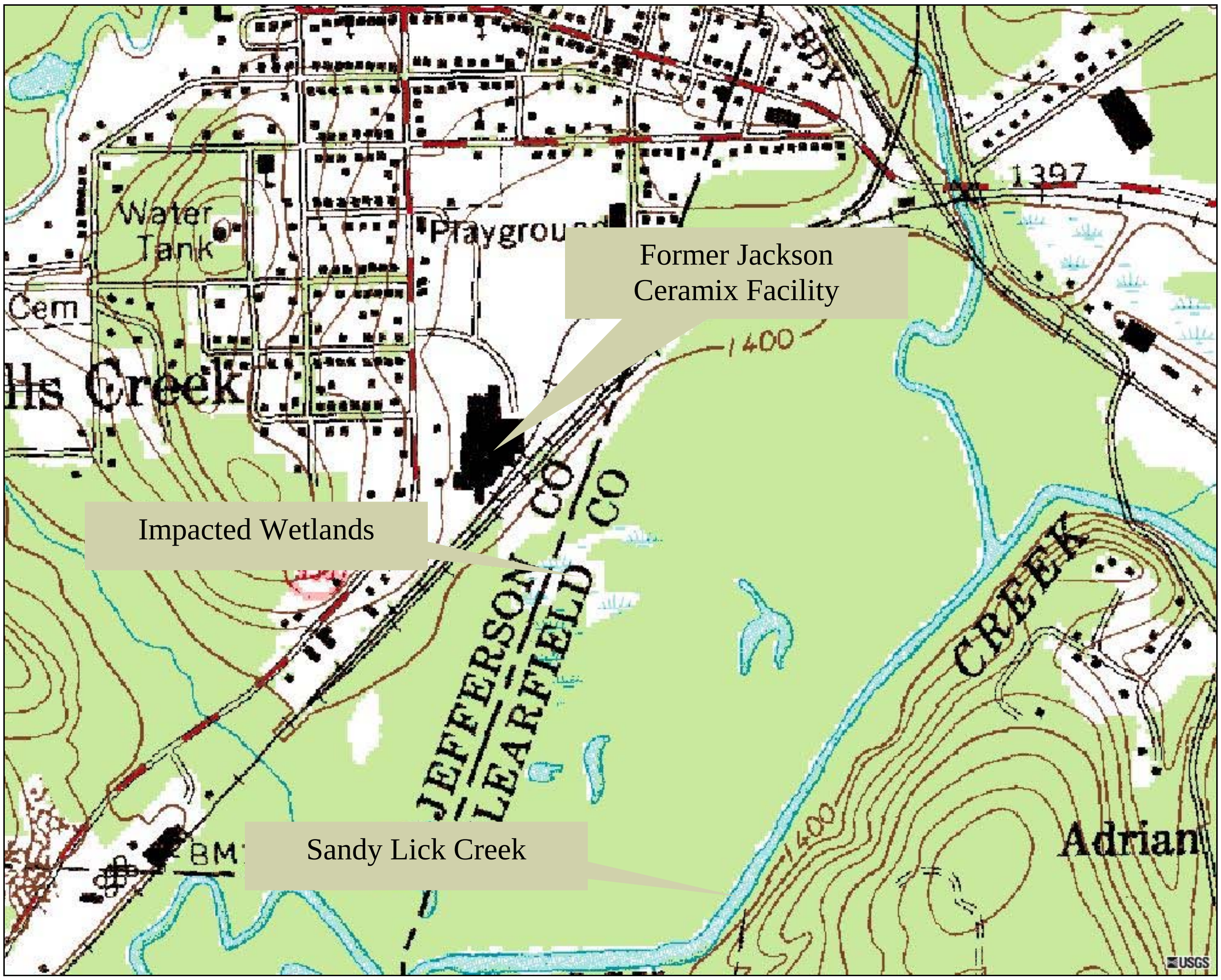
Jackson Ceramix Site Location Map



Source: ATSDR Health Consultation for Jackson Ceramix Site, August 1996

Figure 2

Jackson Ceramix Site Topographic Location Map (July 1996)



Source: USGS

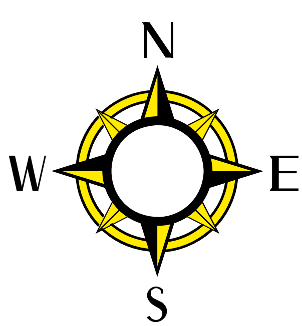
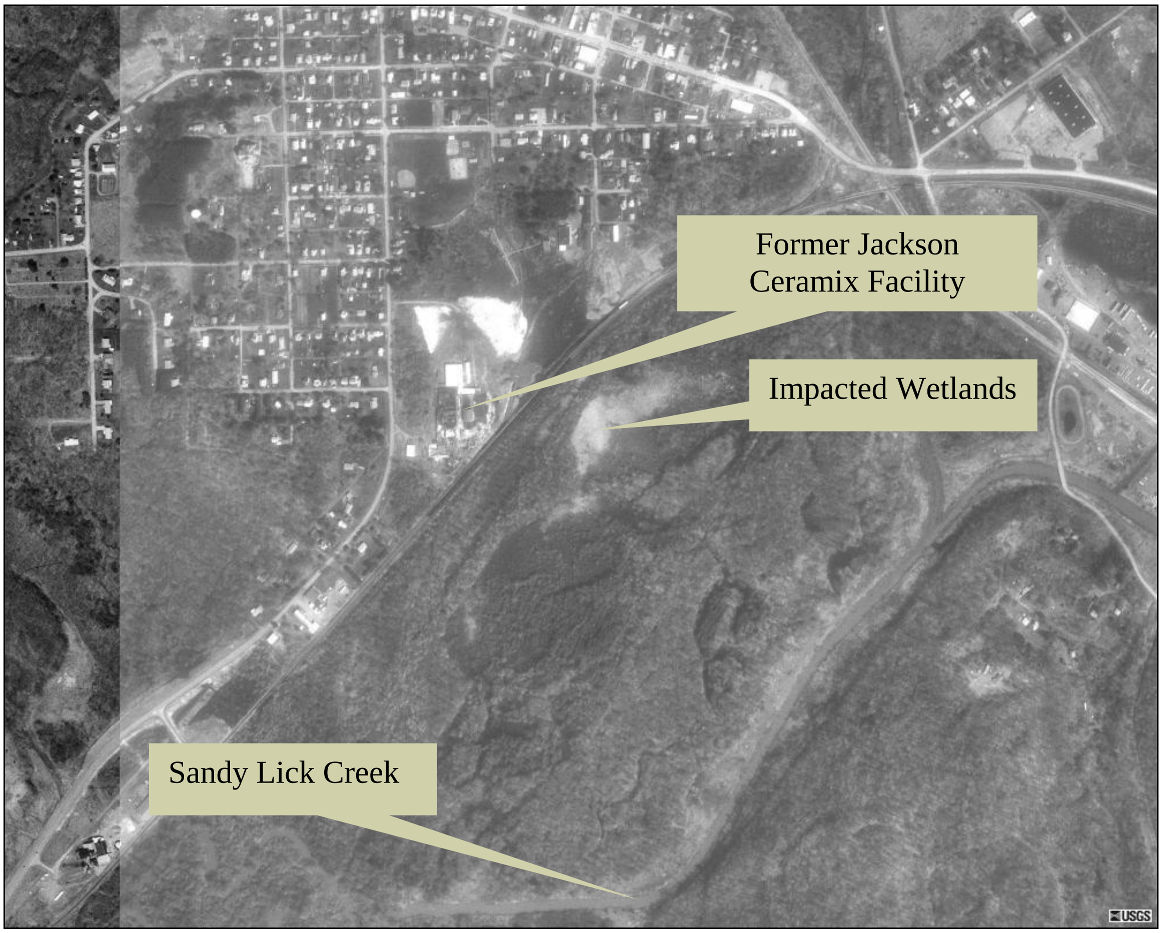


Figure 3

Jackson Ceramix Site from Aerial Photograph (April 1993)



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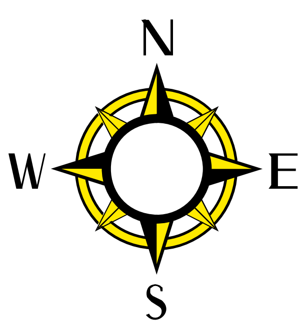
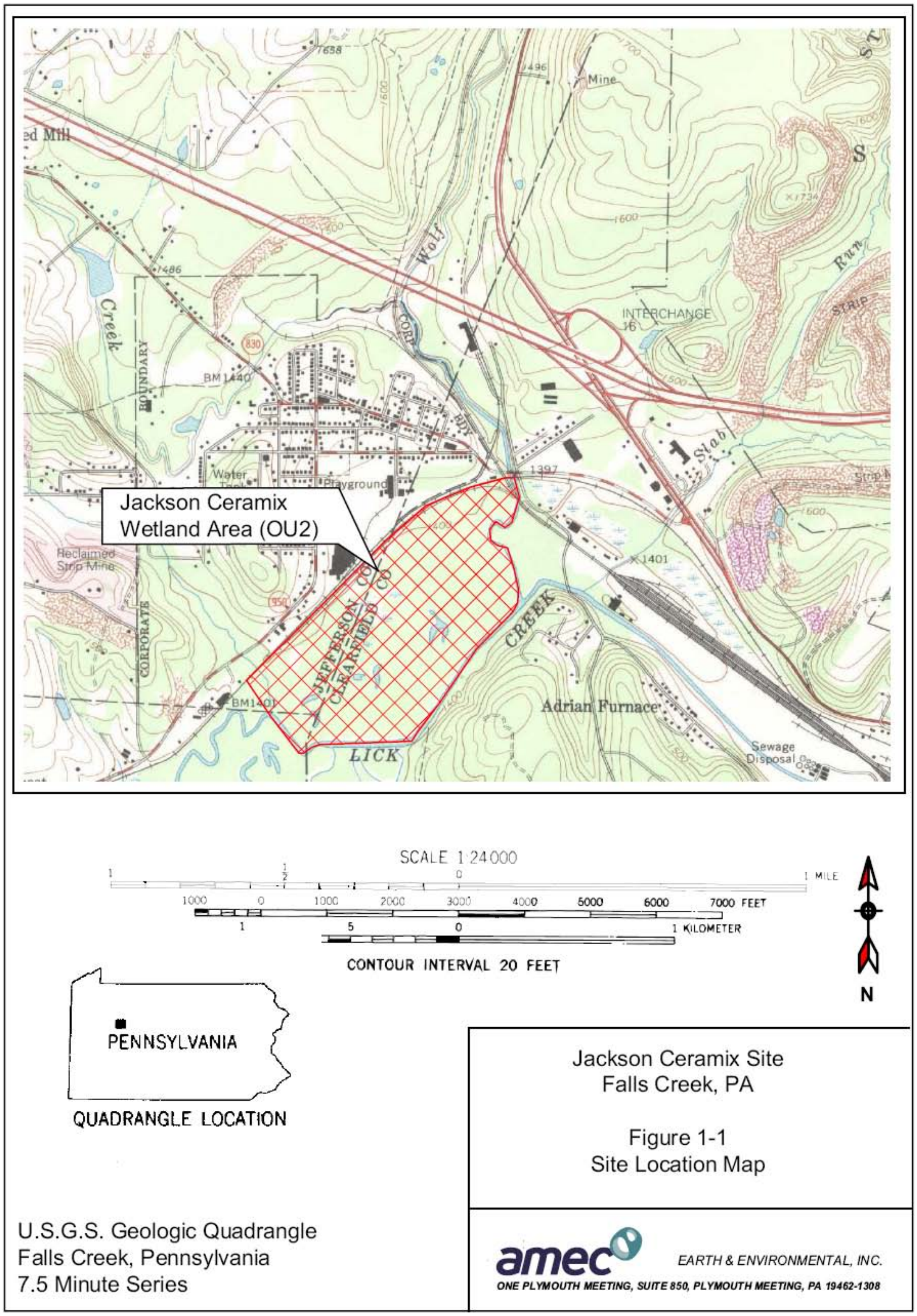


Figure 4

Jackson Ceramix Site – Wetland Area



APPENDIX B

ATSDR EVALUATION AND

PUBLIC HEALTH HAZARD CATEGORIES

ATSDR EVALUATION

To determine the likelihood of possible health effects of site-specific chemicals, ATSDR has developed health-based comparison values (CVs). Comparison values (CV)s are health guidelines or environmental guidelines set well below levels that are known or anticipated to result in adverse health effects. ATSDR developed these values to help health assessors make consistent decisions about what substance concentrations or dose levels associated with site exposures might require a closer look.

Comparison values are not thresholds of toxicity. Comparison values should not be used to predict adverse health effects. These values serve only as guidelines to provide an initial screen of human exposure to substances. Although concentrations at or below the relevant comparison value may reasonably be considered safe, it does not automatically follow that any environmental concentration that exceeds a comparison value would be expected to produce adverse health effects.

Health guidelines are derived based on data drawn from the epidemiologic and toxicologic literature with many uncertainty or safety factors applied to ensure that they are amply protective of human health. ATSDR's minimal risk level (MRL) and EPA's reference doses, reference concentrations, and cancer slope factors are the health guidelines most commonly used in the public health assessment screening process.

Minimal Risk Levels (MRLs)

A MRL is an estimate of daily human exposure to a substance (in milligrams per kilogram per day [mg/kg/day] for oral exposures and parts per billion [ppb] or micrograms per cubic meter [µg/m^3] for inhalation exposures) that is likely to be without noncarcinogenic health effects during a specified duration of exposure based on ATSDR evaluations.

Environmental guidelines are derived from the health guidelines and represent concentrations of a substance (e.g., in water, soil, and air) to which humans may be exposed via a particular exposure route during a specified period of time without experiencing adverse health effects. ATSDR's environmental guidelines include environmental media evaluation guides (EMEGs) and cancer risk evaluation guides (CREGs).

In general, comparison values are derived for substances for which adequate toxicity data exist for the exposure route of interest. Where possible, comparison values are generally available for three specified exposure periods: acute (14 days or less), intermediate (15 to 365 days), and chronic (more than 365 days). Comparison values are also generally available for two exposure routes: ingestion and inhalation.

ATSDR has developed environmental guidelines for substances in drinking water, soil, and air. ATSDR's environmental guidelines include environmental media evaluation guides (EMEGs), cancer risk evaluation guides (CREGs), and reference dose media evaluation guides (RMEGs). These guidelines are derived in a uniform way using health guidelines and standard default exposure assumptions. These default exposure assumptions generally represent high estimates of exposure (greater than the mean, approaching the 90th percentile), based on observed ranges of human activity patterns (e.g., water ingestion rates, residence times). Guidelines are available to evaluate both child and adult exposures.

Environmental Media Evaluation Guides (EMEGs)
EMEGs are estimated contaminant concentrations that are not expected to result in adverse noncarcinogenic health effects based on ATSDR evaluation. EMEGs are based on ATSDR MRLs and conservative assumptions about exposure, such as intake rate, exposure frequency and duration, and body weight.

Cancer Risk Guides (CREGs)
CREGs are estimated contaminant concentrations that would be expected to cause no more than one excess cancer in a million (10^{-6}) persons exposed during their lifetime (70 years). ATSDR's CREGs are calculated from EPA's cancer slope factors (CSFs) for oral exposures or unit risk values for inhalation exposures. These values are based on EPA evaluations and assumptions about hypothetical cancer risks at low levels of exposure.

Reference Dose Media Evaluation Guides (RMEGs)
ATSDR derives RMEGs from EPA's oral reference doses, which are developed based on EPA evaluations. RMEGs represent the concentration in water or soil at which daily human exposure is unlikely to result in adverse noncarcinogenic effects [12].

Cancer risk for inhalation is determined using the EPA risk based concentration table (RBC) and ATSDR cancer risk evaluation guide (CREG) numbers. If no CREG is available, the EPA cancer slope factor is used. Cancer risk is usually calculated for 30 years using adult parameters as defaults in the calculations unless an individual assessment is needed for a specific time frame or using different factors. Sometimes sample collection problems, the testing equipment, dilution factor, outside contaminants and such need to be addressed and evaluated for validity. Non-carcinogenic chemical exposure results are evaluated using child factors such as 10 m^3/day inhalation rate and 16 kg body weight. The highest concentration found for each chemical from the lab results was used to calculate the highest possible exposure from a conservative perspective. Cancer risk calculations were determined using the highest contaminant concentration in ug/m^3 and multiplied by the inhalation unit risk factor in (ug/m^3)-1 whenever available. If the CREG was then available, then the risk was calculated using that value to estimate the cancer risk exposure.

Cancer risks are calculated for chemicals determined to be carcinogens or possible carcinogens when possible for 30 years of exposure.

The EPA has quantified the lifetime cancer risk by categories. A cancer risk of $1x10^{-6}$ was determined to be one additional cancer per 1 million people or $1x10^{-6}$ = 1 in million to mean "insignificant or no increase risk". The higher the number, the greater the increased risk for cancer. For example, $1x10^{-5}$ = 1 in 100,000 with "no apparent increased risk" but $1x10^{-4}$ = 1 in 10,000 has a "low increased risk".

ATSDR Public Health Hazard Categories

Category	Definition	Criteria
A. Urgent public health hazard	This category is used for sites that pose an urgent public health hazard as the result of short-term exposures to hazardous substances.	Evidence exists that exposures have occurred, are occurring, or are likely to occur in the future AND Estimated exposures are to a substance(s) at concentrations in the environment that, upon short-term exposures, can cause adverse health effects to any segment of the receptor population AND/OR Community-specific health outcome data indicate that the site has had an adverse impact on human health that requires rapid intervention AND/OR Physical hazards at the site pose an imminent risk of physical injury
B. Public health hazard	This category is used for sites that pose a public health hazard as the result of long-term exposures to hazardous substances.	• Evidence exists that exposures have occurred, are occurring, or are likely to occur in the future AND • Estimated exposures are to a substance(s) at concentrations in the environment that, upon long-term exposures, can cause adverse health effects to any segment of the receptor population AND/OR • Community-specific health outcome data indicate that the site has had an adverse impact on human health that requires intervention
C. Indeterminate public health hazard	This category is used for sites with incomplete information.	• Limited available data do not indicate that humans are being or have been exposed to levels of contamination that would be expected to cause adverse health effects; data or information are not available for all environmental media to which humans may be exposed AND • There are insufficient or no community-specific health outcome data to indicate that the site has had an adverse impact on human health
D. No apparent public health hazard	This category is used for sites where human exposure to contaminated media is occurring or has occurred in the past, but where that exposure is below a level of health hazard.	• Exposures do not exceed an ATSDR chronic MRL or other comparable value AND • Data are available for all environmental media to which humans are being exposed AND • There are no community-specific health outcome data to indicate that the site has had an adverse impact on human health
E. No public health hazard	This category is used for sites that do not pose a public health hazard.	• There is no evidence of current or past human exposure to contaminated media AND • Future exposures to contaminated media are not likely to occur AND • There are no community-specific health outcome data to indicate that the site has had an adverse impact on human health

APPENDIX C

ATSDR GLOSSARY OF ENVIRONMENTAL HEALTH TERMS

ATSDR Glossary of Environmental Health Terms

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal public health agency with headquarters in Atlanta, Georgia, and 10 regional offices in the United States. ATSDR serves the public by using the best science to take responsive public health actions and to provide trusted health information to prevent harmful exposures and diseases related to toxic substances. ATSDR is not a regulatory agency, unlike the U.S. Environmental Protection Agency (EPA), which is the federal agency that develops and enforces environmental laws to protect the environment and human health. This glossary defines words used by ATSDR in communications with the public. It is not a complete dictionary of environmental health terms. If you have questions or comments, call ATSDR's toll-free telephone number, 1-888-42-ATSDR (1-888-422-8737).

Absorption - For a person or animal, absorption is the process through which a substance enters 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 to the individual substances [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).

Anaerobic - Requiring the absence of oxygen [compare with **aerobic**].

Analyte - A substance measured in the laboratory. A chemical a laboratory tests for in a sample (such as water, air, or blood). For example, if the analyte is mercury, the laboratory test will determine the amount of mercury in the sample.

Analytic epidemiologic study - A study that evaluates a proposed association between exposure to hazardous substances and disease.

Antagonistic effect - A biologic response to exposure to multiple substances that is **less** than would be expected if the known effects of the individual substances were added together [compare with **additive effect** and **synergistic effect**].

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 indicators of exposure study - A study to confirm human exposure to a hazardous substance. It does that through **biomedical testing** or by measuring a substance (an **analyte**), its **metabolite**, or another marker of exposure in human body fluids or tissues [also see **exposure investigation**].

Biologic monitoring - Measuring hazardous substances in biologic materials (such as blood, hair, urine, or breath) to determine whether exposure has occurred. A blood test for lead is an example of biologic monitoring.

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

Biomedical testing - Testing people to find out whether a change in a body function might have occurred because of exposure to a hazardous substance.

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

Body burden - The total amount of a substance in the body. Some substances build up in the body because they are stored in fat or bone or because they leave the body very slowly.

CAP [see **Community Assistance Panel]**

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 for developing cancer if exposed to a substance every day for 30 years. Some cancer risk calculations are used based on 70 years for a lifetime exposure. The true risk might be lower. Cancer risk can be calculated for a variety of exposure durations, and, in the superfund program, 30 years is more typical.

Carcinogen - A substance that causes cancer.

Case study - A medical or epidemiologic evaluation of one person or a small group of people to gather information about specific health conditions and past exposures.

Case-control study - A study that compares exposures of people who have a disease or condition (cases) with people who do not have the disease or condition (controls). Exposures that are more common among the cases may be considered as possible risk factors for the disease.

CAS registry number - A unique number assigned to a substance or mixture by the American Chemical Society Abstracts Service.

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

CERCLA [see **Comprehensive Environmental Response, Compensation, and Liability Act of 1980**]

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**].

Cluster investigation - A review of an unusual number, real or perceived, of health events (for example, reports of cancer) grouped together in time and location. Cluster investigations are designed to confirm case reports; determine whether they represent an unusual disease occurrence; and, if possible, explore possible causes and contributing environmental factors.

Community Assistance Panel (CAP) - A group of people, from a community and from health and environmental agencies, who work with ATSDR to resolve issues and problems related to hazardous substances in the community. CAP members work with ATSDR to gather and review community health concerns, provide information on how people might have been or might now be exposed to hazardous substances, and inform ATSDR on ways to involve the community in its activities.

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.

Delayed health effect - A disease or injury that happens as a result of exposures that might have occurred in the past.

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

Dermal contact - Contact with (touching) the skin [see **route of exposure**].

Descriptive epidemiology - The study of the amount and distribution of a disease in a specified population by person, place, and time.

Detection limit - The lowest concentration of a chemical that can reliably be distinguished from a zero concentration.

Disease prevention - Measures used to prevent a disease or reduce its severity.

Disease registry - A system of ongoing registration of all cases of a particular disease or health condition in a defined population.

DOD - United States Department of Defense.

DOE - United States Department of Energy.

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.

Epidemiologic surveillance - The ongoing, systematic collection, analysis, and interpretation of health data. This activity also involves timely dissemination of the data and use for public health programs.

Epidemiology - The study of the distribution and determinants of disease or health status in a population; the study of the occurrence and causes of health effects in humans.

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-dose reconstruction - A method of estimating the amount of people's past exposure to hazardous substances. Computer and approximation methods are used when past information is limited, not available, or missing.

Exposure investigation - The collection and analysis of site-specific information and biologic tests (when appropriate) to determine whether people have been exposed to hazardous substances.

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**.

Exposure registry - A system of ongoing follow-up of people who have had documented environmental exposures.

Feasibility study - A study by EPA to determine the best way to clean up environmental contamination. A number of factors are considered, including health risk, costs, and what methods will work well.

Geographic information system (GIS) - A mapping system that uses computers to collect, store, manipulate, analyze, and display data. For example, GIS can show the concentration of a contaminant within a community in relation to points of reference such as streets and homes.

Grand rounds - Training sessions for physicians and other health care providers about health topics.

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

Half-life ($t_{1/2}$) - The time it takes for half the original amount of a substance to disappear. In the environment, the half-life is the time it takes for half the original amount of a substance to disappear when it is changed to another chemical by bacteria, fungi, sunlight, or other chemical processes. In the human body, the half-life is the time it takes for half the original amount of the substance to disappear, either by being changed to another substance or by leaving the body. In the case of radioactive material, the half life is the amount of time necessary for one half the initial number of radioactive atoms to change or transform into another atom (that is normally not radioactive). After two half lives, 25% of the original number of radioactive atoms remain.

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

Hazardous Substance Release and Health Effects Database (HazDat) - The scientific and administrative database system developed by ATSDR to manage data collection, retrieval, and analysis of site-specific information on hazardous substances, community health concerns, and public health activities.

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**].

Health education - Programs designed with a community to help it know about health risks and how to reduce these risks.

Health investigation - The collection and evaluation of information about the health of community residents. This information is used to describe or count the occurrence of a disease, symptom, or clinical measure and to estimate the possible association between the occurrence and exposure to hazardous substances.

Health promotion - The process of enabling people to increase control over, and to improve, their health.

Health statistics review or health outcome data evaluation - The analysis of existing health information (i.e., from death certificates, birth defects registries, blood lead surveillance databases, and cancer registries) to determine if there is excess disease in a specific population, geographic area, and time period. A health statistics review/health outcome data evaluation is a descriptive epidemiologic study.

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.

Incidence - The number of new cases of disease in a defined population over a specific time period [contrast with **prevalence**].

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**].

In vitro - In an artificial environment outside a living organism or body. For example, some toxicity testing is done on cell cultures or slices of tissue grown in the laboratory, rather than on a living animal [compare with **in vivo**].

In vivo - Within a living organism or body. For example, some toxicity testing is done on whole animals, such as rats or mice [compare with **in vitro**].

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.

Medical monitoring - A set of medical tests and physical exams specifically designed to evaluate whether an individual's exposure could negatively affect that person's health.

Metabolism - The conversion or breakdown of a substance from one form to another by a living organism.

Metabolite - Any product of **metabolism**.

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.

Migration - Moving from one location to another.

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**].

Morbidity - State of being ill or diseased. Morbidity is the occurrence of a disease or condition that alters health and quality of life.

Mortality - Death. Usually the cause (a specific disease, condition, or injury) is stated.

Mutagen - A substance that causes **mutations** (genetic damage).

Mutation - A change (damage) to the DNA, genes, or chromosomes of living organisms.

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

No 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.

NPL [see **National Priorities List for Uncontrolled Hazardous Waste Sites]**

Physiologically based pharmacokinetic model (PBPK model) - A computer model that describes what happens to a chemical in the body. This model describes how the chemical gets into the body, where it goes in the body, how it is changed by the body, and how it leaves the body.

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).

Potentially responsible party (PRP) - A company, government, or person legally responsible for cleaning up the pollution at a hazardous waste site under Superfund. There may be more than one PRP for a particular site.

ppb - Parts per billion.

ppm - Parts per million.

Prevalence - The number of existing disease cases in a defined population during a specific period [contrast with **incidence**].

Prevalence survey - The measure of the current level of disease(s) or symptoms and exposures through a questionnaire that collects self-reported information from a defined population.

Prevention - Actions that reduce exposure or other risks, keep people from getting sick, or keep disease from getting worse.

Public comment period - An opportunity for the public to comment on agency findings or proposed activities contained in draft reports or documents. The public comment period is a limited time period during which comments will be accepted.

Public availability session - An informal, drop-by meeting at which community members can meet one-on-one with ATSDR staff members to discuss health and site-related concerns.

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

Public health advisory - A statement made by ATSDR to EPA or a state regulatory agency that a release of hazardous substances poses an immediate threat to human health. The advisory includes recommended measures to reduce exposure and reduce the threat to human 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**.

Public health statement - The first chapter of an ATSDR **toxicological profile**. The public health statement is a summary written in words that are easy to understand. The public health statement explains how people might be exposed to a specific substance and describes the known health effects of that substance.

Public meeting - A public forum with community members for communication about a site.

Radioisotope - An unstable or radioactive isotope (form) of an element that can change into another element by giving off radiation.

Radionuclide - Any radioactive isotope (form) of any element.

RCRA [see **Resource Conservation and Recovery Act (1976, 1984)**]

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.

Registry - A systematic collection of information on persons exposed to a specific substance or having specific diseases [see **exposure registry** and **disease registry**].

Remedial investigation - The CERCLA process of determining the type and extent of hazardous material contamination at a site.

Resource Conservation and Recovery Act (1976, 1984) (RCRA) - This Act regulates management and disposal of hazardous wastes currently generated, treated, stored, disposed of, or distributed.

RFA - RCRA Facility Assessment. An assessment required by RCRA to identify potential and actual releases of hazardous chemicals.

RfD [see **reference dose**]

Risk - The probability that something will cause injury or harm.

Risk reduction - Actions that can decrease the likelihood that individuals, groups, or communities will experience disease or other health conditions.

Risk communication - The exchange of information to increase understanding of health risks.

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**].

Safety factor [see **uncertainty factor]**

SARA [see **Superfund Amendments and Reauthorization Act**]

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.

Solvent - A liquid capable of dissolving or dispersing another substance (for example, acetone or mineral spirits).

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**.

Special populations - People who might be more sensitive or susceptible to exposure to hazardous substances because of factors such as age, occupation, sex, or behaviors (for example, cigarette smoking). Children, pregnant women, and older people are often considered special populations.

Stakeholder - A person, group, or community who has an interest in activities at a hazardous waste site.

Statistics - A branch of mathematics that deals with collecting, reviewing, summarizing, and interpreting data or information. Statistics are used to determine whether differences between study groups are meaningful.

Substance - A chemical.

Substance-specific applied research - A program of research designed to fill important data needs for specific hazardous substances identified in ATSDR's **toxicological profiles**. Filling these data needs would allow more accurate assessment of human risks from specific substances contaminating the environment. This research might include human studies or laboratory experiments to determine health effects resulting from exposure to a given hazardous substance.

Superfund Amendments and Reauthorization Act (SARA) - In 1986, SARA amended CERCLA and expanded the health-related responsibilities of ATSDR. CERCLA and SARA direct ATSDR to look into the health effects from substance exposures at hazardous waste sites and to perform activities including health education, health studies, surveillance, health consultations, and toxicological profiles.

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

Surveillance [see **epidemiologic surveillance**]

Survey - A systematic collection of information or data. A survey can be conducted to collect information from a group of people or from the environment. Surveys of a group of people can be conducted by telephone, by mail, or in person. Some surveys are done by interviewing a group of people [see **prevalence survey**].

Synergistic effect - A biologic response to multiple substances where one substance worsens the effect of another substance. The combined effect of the substances acting together is greater than the sum of the effects of the substances acting by themselves [see **additive effect** and **antagonistic effect**].

Teratogen - A substance that causes defects in development between conception and birth. A teratogen is a substance that causes a structural or functional birth defect.

Toxic agent - Chemical agent (for example, arsenic, benzene) or biological agent (for example, venom, bacteriological toxin) that, 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.

Tumor - An abnormal mass of tissue that results from excessive cell division that is uncontrolled and progressive. Tumors perform no useful body function. Tumors can be either benign (not cancer) or malignant (cancer).

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.

Other Glossaries and Dictionaries

Environmental Protection Agency:
http://www.epa.gov/OCEPAterms/

National Center for Environmental Health (CDC):
http://www.cdc.gov/nceh/dls/report/glossary.htm

National Library of Medicine (NIH):
http://www.nlm.nih.gov/medlineplus/mplusdictionary.html