Public Health Assessment

Public Comment Release

DALZELL VIKING GLASS COMPANY SITE

NEW MARTINSVILLE, WETZEL COUNTY, WEST VIRGINIA

EPA FACILITY ID: WVSFN0305531

Prepared by
West Virginia Department of Health and Human Resources

AUGUST 31, 2009

COMMENT PERIOD ENDS: NOVEMBER 30, 2009

Prepared under a Cooperative Agreement with the
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment-Public Comment Release 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's Cooperative Agreement Partner 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. This document represents the agency's best efforts, based on currently available information, to fulfill the statutory criteria set out in CERCLA section 104 (i)(6) within a limited time frame. To the extent possible, it presents an assessment of potential risks to human health. Actions authorized by CERCLA section 104 (i)(11), or otherwise authorized by CERCLA, may be undertaken to prevent or mitigate human exposure or risks to human health. In addition, ATSDR's Cooperative Agreement Partner will utilize this document to determine if follow-up health actions are appropriate at this time.

This document has previously been provided to EPA and the affected state in an initial release, as required by CERCLA section 104 (i) (6) (H) for their information and review. Where necessary, it has been revised in response to comments or additional relevant information provided by them to ATSDR's Cooperative Agreement Partner. This revised document has now been released for a 30-day public comment period. Subsequent to the public comment period, ATSDR's Cooperative Agreement Partner will address all public comments and revise or append the document as appropriate. The public health assessment will then be reissued. This will conclude the public health assessment process for this site, unless additional information is obtained by ATSDR's Cooperative Agreement Partner which, in the agency's opinion, indicates a need to revise or append the conclusions previously issued.

Use of trade names is for identification only and does not constitute endorsement by the U.S. Department of Health and Human Services.

Please address comments regarding this report to:

Agency for Toxic Substances and Disease Registry
Attn: Records Center
1600 Clifton Road, N.E., MS F-09
Atlanta, Georgia 30333

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Foreword

The West Virginia Department of Health and Human Resources (WVDHHR) and the Agency for Toxic Substances and Disease Registry (ATSDR) prepared this public health assessment (PHA) to evaluate potential adverse human hazards related to exposure associated with the Dalzell Viking Glass Company Site. This document summarizes the available environmental data of soil and groundwater, and reports the results of WVDHHR's evaluation of past, present and future exposure to environmental contaminants associated with the Dalzell Viking Glass Company Site.

The steps taken in completing a public health assessment are as follows:

Evaluating exposure: WVDHHR starts by reviewing available information regarding environmental conditions at the site to determine the presence and location(s) of contamination, and assess the likelihood of human exposure. Typically WVDHHR does not collect environmental samples, but rather relies on information provided by the West Virginia Department of Environmental Protection (WVDEP), U.S. Environmental Protection Agency (USEPA), other governmental agencies, businesses, and organizations for accurate and reliable information.

Evaluating health effects: If evidence indicates current or potential human exposure to contamination is likely, WVDHHR will take steps to determine whether such exposures could result in unacceptable impacts to human health. The evaluation is based on existing scientific information, and is reported in the form of the public health assessment. The assessment focuses on the public health - impact of the community.

Developing recommendations: In the public health assessment, WVDHHR sets forth its conclusions regarding any potential health threat posed by the site and offers recommendations for reducing or eliminating human exposure to contaminants. The role of WVDHHR is primarily advisory. Acting in this capacity, it provides recommendations for implementation by other agencies, i.e., WVDEP and USEPA.

Soliciting community input: The evaluation process is interactive. WVDHHR starts by soliciting and evaluating information from various governmental agencies, and/or organizations responsible for cleaning up the site, as well as surrounding communities that may be impacted by onsite contaminants. Any conclusions about the site are shared with groups and organizations providing the information.

If you have questions or comments about this report, we encourage you to write:

Program Manager
ATSDR Cooperative Partners Program
Office of Environmental Health Services
Bureau for Public Health
West Virginia Department of Health and Human Resources
Capitol and Washington Streets
1 Davis Square, Suite 200
Charleston, West Virginia 25301-1798

or call: (304) 558-2981

Summary and Statement of Issues

At the request of WVDEP, the WVDHHR prepared this public health assessment to evaluate whether the former Dalzell Viking Glass Company Site poses a public health hazard to the surrounding community. Although, WVDHHR is not aware of health concerns from the community.

The USEPA and the WVDEP previously conducted an investigation, site assessment and a removal operation at the site after Dalzell Viking Glass Company entered bankruptcy in 1998. For this public health assessment, WVDHHR reviewed the available surface soil and groundwater data, and evaluated potential health concerns related to the site.

The primary route of human exposure identified at the Dalzell Viking Glass Company site was incidental ingestion of surface soil. Based on the review of available environmental information, site-specific estimates of exposure and toxicological analyses, WVDHHR concluded that:

- Between September 2002 and the present time (i.e. after the completion of all removal operations), estimates of exposures to chemicals from all sources (residential soil, non-residential soil) via accidental ingestion and drinking were and are not expected to harm people's health. The estimated theoretical cancer risks from exposures to the carcinogenic COCs such as PAHs and arsenic are below accepted risk level.
- Between 1998 and December 1999, (following cessation of the manufacturing activities but prior to any removal activities), estimated exposures of teenager and adolescent trespassers to chemicals via accidental ingestion were not expected to harm their health.
- Exposure to lead at the concentration in the surface soil on-site via accidental ingestion was and is not expected to harm young children's health, because the predicted blood lead levels of non-pica (normal behavior) children, and developing fetuses were below the level of concern (10 µg/dL) as recommended by the Center for Disease Control and Prevention (CDC) (CDC, 2005). The blood lead levels were predicted based upon lead concentrations in surface soil (2007)
- Past exposure to chemicals via air inhalation during active glass manufacturing operations cannot be concluded from currently available information.
- Exposure to radioactive chemicals from drinking water (was) is not expected to harm people's health, because the available records in West Virginia Safe Drinking Water Information System, indicate that the radiation levels in finished water of Wetzel and Leap *S*treet wells meet the USEPA's National Primary Drinking Water Regulation standards. In addition, USEPA concluded in June 2005 that overall reported radioactivity was relatively low and not what would commonly be construed as alarming [1].
- According to WVDHHR program data, the rate of elevated blood lead level (EBLL) in the 26155 zip code area is slightly higher than that in Wetzel County, although the small sample populations does not allow for any statistically significant conclusions. WVDHHR believe that the EBLL is not likely to be an indicator of proximity to the Dalzell Viking Glass Company Site. Many factors could contribute to the EBLL, such as the percentage of children in the target age group under the poverty level, the percentage

of older housing units in this area, and the zip code 26155 area geographically covers almost 1/3 of Wetzel County.

WVDHHR recommended that:

1. Ensure that access to the site is restricted.
2. Continued monitoring of the two municipal water supply wells located north of the site.
3. Health Education: Parents should observe their children to verify they do not exhibit pica behaviors. Parents should also encourage good hygiene, including regular hand washing after playing and before they eat and drink. Parents should use precaution, and warn their children that the site poses unsafe health conditions.
4. Additional residential soil sampling may be needed to ensure that the data reviewed in this PHA is representative.

And, the WVDHHR's public health action plan is the following:

WVDHHR will be developing a fact sheet outlining the keys points of this report, and educational fact sheets for some of the contaminants found at the site for the concerned community members; the local health official; New Martinsville Water Department; current owner of the site, and, Bridgeport Equipment and Tool, Inc. WVDHHR will be planning a public meeting at the town of New Martinsville to present this report and conclusions. In addition, the WVDHHR will provide health education to community members when concerns are expressed.

The WVDHHR prepared this public health assessment under a cooperative agreement with the ATSDR.

Background

Site Location and Description

The Dalzell Viking Glass Company Site is located at 802 Parkway Drive in New Martinsville, Wetzel County, West Virginia. The 3.65 acre [2] site is situated in a 100 year flood plain about 900 feet east of the Ohio River in an area of an urban west side community. An unnamed tributary to the Ohio River runs through a culvert beneath onsite buildings.

Two municipal water wells are located north of the property and up gradient to the site: the Leap Street Well is located approximately 100 to125 feet from the facility, and the Wetzel Street Well is approximately 100 feet further. This information was provided by the New Martinsville water department.

A residential community of approximately 100 homes is located within the immediate vicinity of the site. The site is bordered by city streets and residences to the south, east, and northeast, with the nearest residences within 100 feet. A parking area and city public works garage is located north of the site, and railroad tracks to the west.

The site consists of a main production building and a glass outlet retail shop, located east of the main building. Comprised of several segmented additions, the 76,300 square foot [1] building includes production and storage areas as well as a former office and showroom area.

One underground storage tank (UST) is located south of the former outlet store and has been closed in place (see Figure 3). The above ground tanks (ASTs) and containment dikes have been removed from the site [2]. The site location is depicted in Figure 1 (Courtesy of TRIAD Engineering, Inc.)

Site Operations and History

The facility originated as the New Martinsville Glass Company in 1900. It was sold in 1944 to Viking Glass. In 1987, the Dalzell Viking Glass Company was formed. Sixty workers were employed by the company. The facility had three furnaces fueled by natural gas and produced five tons of glass per day. The Dalzell Viking Glass produced domestic glassware, artware, ashtrays, barware, restaurant ware, bowls, drinking glasses, gift ware, jugs, paperweights, stemware, tableware, tumblers, vases, crystal, colored glass, handmade glass, and lighting glassware.

In 1998, the company filed for bankruptcy, and the furnaces were shut down. On May 17, 1999, the company entered receivership, the assets of the company were sold and the site was left abandoned. In 2005, Litman Excavating, owned by Robert Litman, purchased the property.

According to communications with the representative of the current property owner, the former retail shop building (located on the northeast corner of the site, facing First Street) was leased to an auto glass company for use as storage space. The northern half of the former new warehouse has been leased to Bridgeport Equipment and Tool Company for storage, and another half is currently occupied by the owner as storage space. Since the new warehouse building is not heated, usage during the winter is minimal.

Figure 1. Dalzell Viking Glass Company Location

Historical Site Investigation and Removal Activities

Summary of Environmental Investigation History for the Dalzell Viking Glass Site [1]

Time	Events
May 12, 1998	West Virginia Division of Environmental Protection (WVDEP), Office of Waste Management (OWM) performed a Pre-closure Inspection (PI). The focus of this inspection was to ensure that the facility did not leave contamination or other environmental problems behind that the State or Federal Government would have to address under Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) or some other type of environmental response program.
1998	Dalzell Viking Glass Company filed for bankruptcy, and the furnaces were shut down.
May 17, 1999	The Company entered receivership. The assets of the company were sold off, and the facility was left vacant.
November 18, 1999	A follow up inspection was performed by the WVDEP. Most of the chemicals and chemical waste observed during the May 12, 1998,

	inspection were still on-site. Due to the site conditions, and the fact that children have been playing in and around the facility, WVDEP requested assistance of EPA.
November 29, 1999	USEPA On-Scene-Coordinator (OSC) and the Weston Site Assessment and Technical Assistance (SATA) team with assistance of WVDEP conducted an emergency removal assessment. Based on the finding, an emergency effort was initiated by USEPA OSC to minimize exposure to the health risk posed by the hazards located at this unsecured site.
December 10, 1999	Emergency Rapid Response Services (ERRS) contractor, Guardian Environmental Services, began site operations, which consisted of: • site security • boarding up of all open doorways and windows • consolidate and segregate hazardous material
January 20, 2000	ERRS completed the consolidation and segregation of all known hazardous material.
February 23, 2000	ERRS completed the hazard categorization (HAZCAT) of unknown chemicals for disposal classifications and compatibility. WVDEP collected a 5-gallon pail of mercury for recycling purposes. SATA performed an extent of contamination sampling event by collecting nine surface soil samples for Target Analyte List (TAL) metal analysis. Results from the analysis showed arsenic, cadmium, and lead contamination.
March 23, 2000	Request for Funds for a Removal Action was approved to continue the mitigation activities begun under the OSC's delegation of authority.
April 28, 2000	A total of 60 cubic yards of asbestos waste was removed from the building and properly disposed of by an ERRS subcontractor, Choice Insulation, Inc. In addition, USEPA and WVDEP coordinated the recycling of materials found on site, such as quartzite sodium carbonate (soda ash), zinc oxide, limestone, and concrete powder. ERRS consolidated and disposed of solid waste from within the building to facilitate the disposal and reduce the fire risk.
May 4, 2000	A total of 1,672 gallons of fuel oil were removed from the tanks onsite and properly disposed of offsite.
May 23, 2000	Sixty mercury filled switches were removed from gauges and transported to WVDEP for appropriate disposal.
May 24, 2000	Approximately 100 tons of contaminated soil were excavated and transported to an area of the facility to await disposal.

Seventy tons of silica were removed from the basement and properly packed to await disposal.

A total of 26 waste stream samples were taken for lab analysis.

Radiation sources with readings > 30 micro Roentgens per hour (µR/hr) were collected, properly packed and stored in an area away from the daily activity.

June 21, 2000 — 121.8 tons of contaminated soil excavated behind the building was transported offsite as hazardous solid waste to Mill Service Inc., Yukon, Pennsylvania.

June 23, 2000 — Silica in the basement was removed.

July 25, 2000 — 120 cubic yards of non-hazardous solid waste/debris from within the building were removed.

The following wastes were transported off site:

- 7 drums of cadmium and PCB contaminated solids
- 60 mercury filled switches
- 222 tons of contaminated soil
- 4 – 30 yard roll offs of combustible debris
- 70 tons of silica
- 13.5 tons of soda ash
- 1,800 pounds of zinc oxide pellets
- 15,450 pounds of fireclay, limestone, and bags of concrete
- 22,750 pounds of quartzite material
- 22 tons of cadmium and lead contaminated solids
- 27 various drums of paints, oils and sodium hydroxide solution
- 30 drums of hydrofluoric acid, sulfuric acids, and waste aerosols
- 10 various drums of alcohols/xylene, and petroleum distillates
- 1 cylinder of compressed nitrogen
- 9 various drums of waste paints, flammable, toxic liquids containing alcohol/lead/cadmium and toxic organic liquid containing TCE
- 14 various drums of labpacks and small containers
- Three drums containing 1,117 pounds of radioactive thorium-232 salt.

July 28, 2000 — The disposal of all known hazardous materials at the site was completed. Security was discontinued as of July 28, 2000, since all known hazardous material had been removed from the site.

October 31, 2000 — Three monitoring wells (MWs) were installed by a USEPA contractor, Ecology & Environment, Inc.:

MW #A located at the south end of the plant

MW B located at the west end of the plant between building and railroad tracks.
MW D located at the north end of the plant

During well installation, ten subsurface soil samples and six groundwater samples were collected and analyzed for total metals, cyanide, and volatile organic compounds.

Groundwater analytical results indicated:

Arsenic: 16.2 -54.7 micrograms per liter (µg/L), or parts per billion (ppb)
Lead: the maximum concentration of 135 µg/L
The maximum levels were detected in MW #3 located between the building and the railroad tracks on the west side of the site.

Sub-surface soil analytical results indicated:

Arsenic: 6.1-21.4 milligram per kilogram (mg/kg), or parts per millions (ppm). The arsenic concentration decreased with soil depth.

December 4-5, 2000 — Because the Viking Glass Company held a U.S. Atomic Energy Commission license from 1958 to 1974 for the possession and use of uranium in the manufacturing of colored glass, the Nuclear Regulatory Commission (NRC) conducted an inspection to determine whether radioactive materials remained onsite. The NRC inspection reported:

- Two metal drums of glass cullet in the color room revealed radiation exposure levels ranged from 8 to 60 µR/hour on contact with the cullet in the drum, higher than background
- Cullet found in three wooden bins containing yellow or red glass cullet revealed radiation levels ranged 4 to 30 µR /hour, higher than background
- Grinding equipment located in the facility measured radiation levels ranged 30 to 210 µR/hour
- Background radiation levels of 10 to 12 µR/hour were measured in unaffected areas near the facility

In addition, the NRC discussed the possibility of EPA testing the groundwater for radioactive chemicals in the next groundwater sampling event.

February 2001 — Six additional samples were collected by NRC from the glass cullet and the grinding fines in the facility for isotopic analysis to determine if the radioactive materials contained any NRC licensed materials. Sample results confirmed the presence of Uranium-235 and Thorium-232. The OSC submitted the initial NRC report to the ATSDR for evaluation.

August 2001 — In its evaluation to the NRC report, ATSDR recommended that

- USEPA remove the radioactive material and dispose of it off-site
- A full site radiation survey be conducted

June 12-14, 2001	Samples of groundwater from three onsite monitoring wells and a sample from the Leap Street well of the New Martinsville water department were collected by USEPA Superfund Technical Assessment and Response Team (START). The samples were analyzed for total metals and radiochemical analysis. Lab results of the groundwater indicated: Arsenic: Non-filtered water samples: 10 to 46.3 µg/L (ppb) Filtered water samples: 10 to 71.7 µg/L (ppb) Lead: Non-filtered: water samples: 43.5 to 143 µg/L(ppb) Filtered water samples: 9.9 to 17.3 µg/L (ppb) The MW B located between the building and the railroad tracks on the west side of the site had the highest concentrations of arsenic and lead.
June 25, 2002	A Request for a 12 Month Exemption for a Removal Action was approved.
September 9, 2002	Emergency and Rapid Response Services (ERRS) completed the following tasks: • Packing and disposal of low-level radioactive materials such as glass cullet and grinding fines. • Disposal of investigative-derived wastes (IDW) and PPE. • Securing of the building by blocking all open access points. “No trespassing” signs were installed around the site.
September 16, 2002	Radioactive glass cullet as well as cut up radiation contaminated grinding machine were containerized by ERRS. Per OSC request, Signal Corporation, a radiological support contractor conducted a radiological survey of the interior and exterior of the building. The survey concluded that: • Grinding stations and the powders they contain are the only items of concern in the plant. • Thorium-232, Uranium-238 and Potassium-40 isotopes were present at the site. The presence of these isotopes may be attributable to uranium used in the coloring of glass, abrasives, raw material for making glass, or in the building and refractory materials.
September 19, 2002	12,386 pounds of low-level radioactive waste was disposed from the site to Oak Ridge, Tennessee for disposal.
September 20, 2002	ERRS completed the boarding up of the building and installation of the access gates. All removal operations were completed. Sampling of the monitoring and municipal wells was scheduled.

May 17-20, 2004	Groundwater samples from three monitoring wells and the municipal wells on Leap Street and Wetzel Street were collected. All samples were analyzed for total metals and for radiochemical analysis of gross Alpha/Beta analysis, Gamma analysis, and isotopic (Uranium, Thorium, Radium-226, and Radium-228). In filtered samples, all metals analyzed were below their corresponding EPA Maximum Contaminant Levels (MCL). In non-filtered samples, the maximum detected lead concentration was 83.8 parts per billion (ppb), which may be attributed to the sediments contained in the samples.
June 27, 2005	Dalzell Viking site groundwater radiation data indicated somewhat elevated levels of radioactivity present in three monitoring wells, and the results from two municipal wells were lower than the onsite monitoring wells. USEPA concluded that overall reported radioactivity was relatively low and not what would commonly be construed as alarming [1]. USEPA OSC determined that no further removal activities were anticipated under this removal response action.
September, 2007	TRIAD Engineering, Inc., a contractor for WVDEP, performed field sampling activities at the Dalzell Viking Glass Company site. Twenty-one non-residential and seven residential surface soil samples (including duplicate samples), and eight groundwater samples (four each from potable and monitoring wells) were collected.

Site Visit

On May 14, 2008, representatives from the WVDHHR, WVDEP and Wetzel County Health Department visited the Dalzell Viking Glass Company Site. The site was viewed from the perimeter fences on the east and north sides, and the boundary on the west and south sides. The presence of graffiti on the former production building adjacent to the railroad suggested recent trespassing activities. Depressed vegetation was seen in most of the areas between the former production building and the railroad, and a gravel parking lot is located on both the south and north ends of the site. Of the three residences located along Leap Street north of the site, two appeared to be occupied, and one has a backyard adjacent to the former Dalzell Viking Glass Company retail shop.

Demographics

The 2000 census indicated the population of New Martinsville, West Virginia was 5,984 [3], and the estimated population in July 2006 was 5,649 people [4]. In the city, the population was spread out with about 337 people under 5 years, 357 between the ages of 5 and 9, 414 between the ages of 10 and 14, 409 between the ages of 15 and 19. 4,612 people are 18 years of age and over, and 1,078 are 65 years of age and over. In terms of race, 98.1 % are white non-Hispanic, and 0.5 % is two or more races.

One high school and two elementary schools are in the city of the New Martinsville: the New Martinsville Elementary School operates K-8th grades with a current enrollment of 975, and is about three miles north of the site; the Magnolia High School houses 9^{th} – 12^{th} grades with total of 516 students [4], and is about ½ mile southwest of the Dalzell site; and the Wetzel County Center for Children and Family operates only pre-kindergarten with current enrollment of 139, and is about 3.5 miles north of the site.

According to the New Martinsville city water department, the New Martinsville Water Department currently serves a population of about 6,000, and also provides water to the Wetzel County Public Service District #1(WCPSD#1) which supplies a population of 620. The Leap and Wetzel Street Wells provide water to approximately 2/3 of the city (the southern and center section of the city), as well as to the WCPSD#1, which includes a population of approximately 4,500 people.

Groundwater

Groundwater at the site flows from east north-east to west southwest toward the Ohio River (according to the communications with an official from New Martinsville Water Department). The water table is about 35 to 38 feet below ground surface (bgs) [5]. Groundwater in the area is utilized for industrial and residential water supplies. Two municipal supply wells, the Leap Street Well and the Wetzel Street Well, are located within 225 feet to the north side of the site.

Surface Water

Surface water runoff from the site flows toward the Ohio River. The Ohio River is located about 900 feet to the west of the site. An unnamed tributary to the Ohio River runs underneath the property via a culvert with manholes located within the building on site. The site is located in the 100-year floodplain of the Ohio River [5].

New Martinsville's Public Water Supply System

Five municipal wells provide the source water for the New Martinsville Water Department to supply potable water to residences located along the Ohio River within the city limits of New Martinsville: Leap Street Well, Wetzel Street Well, Bridgeman Lane Well, Rosary Road Well and Benjamin Drive Well. The Leap Street Well is located approximately 100 - 125 feet north of the facility, and the Wetzel Street Well is 100 feet further north. The Bridgeman Lane Well and Rosary Road Well are approximately one mile and 1.75 miles north of the facility, respectively. The Rosary Road Well is only for emergency usage.

The Leap Street and the Wetzel Street wells are combined through underground piping to a thirty minute chlorine contact tank, and therefore are considered as one water treatment plant. The other three wells have distinct chlorine contact tanks and are considered as independent treatment plant. The Leap and Wetzel Street Wells provide water to the southern and central section of the city as well as to the WCPSD#1. The Bridgeman Lane well supplies water to all sections of town, but primarily supplies to the central and southern part of town. The Rosary Road Well is only used for emergencies primarily serving the northern section of the city. The Benjamin Drive Well supplies water to the northern areas of the city.

Water pumped from the ground is initially treated with orthophosphate to sequester iron and manganese for corrosion control, and then treated with 10% sodium hypochlorite for disinfection. Finally, water is pumped into the chlorine contact tanks for a thirty minute contact period before being supplied to customers.

Community Health Concern

WVDHHR /ATSDR program staff contacted the Wetzel County Health Department, New Martinsville Water Department, Litman Excavating, and Bridgeport Equipment and Tool regarding any community health concerns they were aware of. None of these entities reported any site-specific health concerns.

Discussion

WVDHHR Evaluation Process

ATSDR developed environmental and health guideline comparison values (CVs) to evaluate if the levels of contaminants in the environment might affect public health. CVs are chemical-specific values derived for each environmental medium (air, soil, and groundwater). They are derived from available scientific literature concerning exposure assumptions and health effects. CVs are not used to predict adverse health effects; rather they are used to screen for environmental contaminants for further evaluation to determine public health significance. In recognition of the increased sensitivity of children, ATSDR provides CVs for children for most of the chemicals and medium, in addition to those developed for application to adult receptors. In this PHA, whenever available, CVs for children are applied to screen the environmental contaminants detected in the media. It should be noted, however, the presence of contaminants at levels exceeding their respective CVs does not necessarily imply that exposure to these levels would cause adverse health effects. Instead, it represents a point at which further evaluation is necessary. The CVs used in the evaluation of Dalzell Viking Glass Company Site samples are listed below:

Minimal Risk Levels (MRLs) are estimates of daily human exposure to a substance at which adverse non-cancer health effects are unlikely during a specified duration (in milligrams per kilogram per day, mg/kg/day for oral exposure, and parts per billion, ppb or microgram per cubic meter, $\mu g/m^3$ for inhalation exposure).

Environmental Media Evaluation Guides (EMEGs) are estimated contaminant concentrations in impacted environmental medium that are unlikely to result in adverse non-cancer health effects in receptors exposed to the contaminated medium. They are calculated from the ATSDR minimal risk levels (MRLs).

Reference Dose Media Evaluation Guides (RMEGs) are similar to EMEGs in that they represent the contaminant concentrations at which daily human exposure is unlikely to result in adverse non-cancer health effects. Unlike the EMEGs, they are calculated from the U.S. Environmental Protection Agency's (EPA) reference dose (RfD).

Intermediate EMEGs are estimated contaminant concentrations at which non-cancer health effects are unlikely for human exposure lasting 14 to 365 days.

Cancer Risk Evaluation Guides (CREGs) are estimated contaminant concentrations that would be expected to result in a cancer occurrence above the background lifetime rate in the exposed population of no greater than one cancer per million persons. ATSDR's CREGs are calculated from USEPA's cancer slope factor (CSF) for oral exposures or air unit risk values for inhalation exposures.

USEPA Region III Risk-based Concentrations (RBCs*)* are estimated contaminant concentrations unlikely to result in either non-cancer health effects, or a cancer occurrence above the background lifetime rate in the exposed population of greater than one cancer per million persons. The RBCs used in this public health assessment were last updated in October 11, 2007.

Maximum Contamination Levels (MCLs) are the maximum contaminants concentrations allowed in drinking water. They are established by the USEPA.

Lead Soil Screening Level (Pb SSL of 400 mg/kg) is the screening concentration in soil established by USEPA for a child's play area.

Quality Assurance and Control

The data presented and discussed in the subsequent sections are provided by USEPA or WVDEP. WVDHHR's conclusions for this public health assessment are determined by the quality of the data, including the validity of the sample analysis and the results, and the reliability of the referenced information. WVDHHR assumes that adequate quality assurance and control measures were followed with regard to chain-of-custody, laboratory procedures, and data reporting.

Data Review and Select Contaminants of Concern

On May 1998, a soil boring sample (0 – 2') and a surface soil sample, seven subsurface soil samples, and three groundwater samples from monitoring wells were collected on-site by the Environmental Safety Consultants, Inc., (ENSPEC). All samples were analyzed for benzene, toluene, ethylbenzene and xylene (BTEX), and total petroleum hydrocarbons (TPH) - Gasoline Range Organics (GRO), and Diesel Range Organics (DRO) [5]. The concentrations of all analytes in surface, subsurface and groundwater samples were well below their corresponding CVs.

On December 28, 1999, perimeter surface soil sampling was conducted. Additional surface soil sampling on the west side of the building was conducted on February 23, 2000. A total of 35 surface soil samples were collected during these two sampling events, and analyzed for total metals. The sampling locations are depicted in Figure 2. [5]

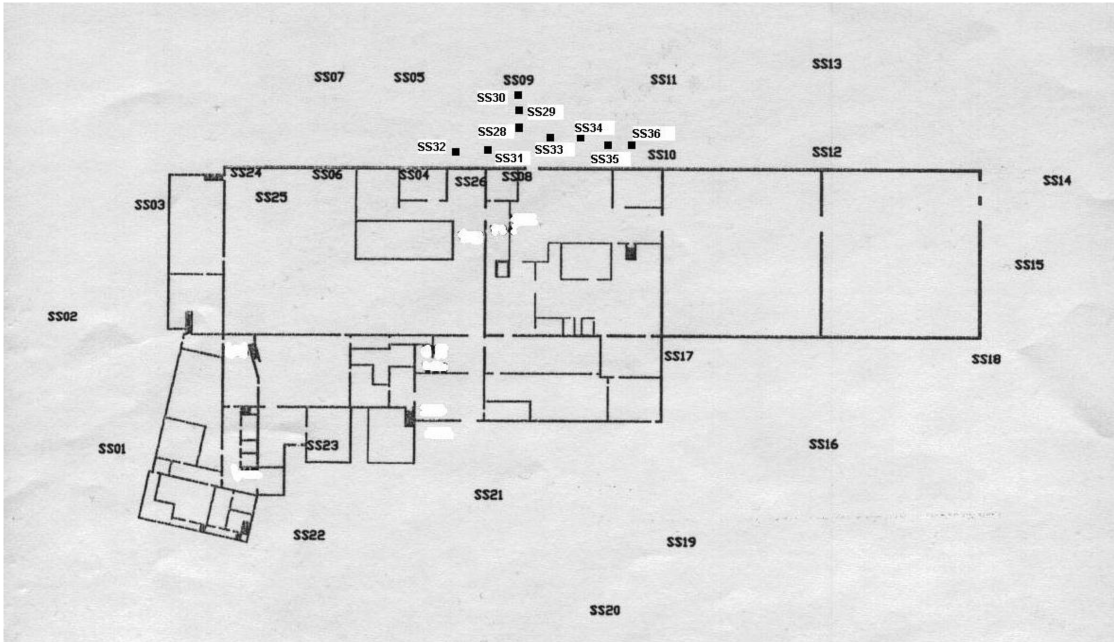

Figure 2 Surface Soil Samples Location Map, 12/18/1999 and 2/23/2000 (WESTON, 2000)

On October 31, 2000, three monitoring wells were installed on-site by Ecology & Environment, Inc. (E&E), a contractor for USEPA. A total of six groundwater samples were collected from the monitoring wells. All samples were analyzed for organic compounds and total metals. On June 12-14, 2001, additional groundwater samples from three onsite groundwater monitoring wells and from the Leap Street Well of the New Martinsville water department were collected. The samples were analyzed for total metals and radiochemical analysis.

The most recent sampling event was conducted on September 7, 2007, by TRIAD Engineering, Inc. Twenty-one non-residential surface soil samples, and seven residential surface soil samples (SS7, SS8, SS10, SS11, SS21, SS23, and SS32, a field duplicate of SS21) were collected from Dalzell Viking Glass Company Site and nearby areas. In addition, groundwater samples from three on-site groundwater wells and two nearby municipal water supply wells were collected. Figure 3 depicts the September 7, 2007, surface soil sampling (SS#) locations (courtesy of TRIAD Engineering, Inc.).

WVDHHR reviewed all available environmental data, and screened each of the detected contaminants from various media against the health-based, media and chemical specific CVs. The initial screening results follow.

Figure 3. Surface Soil Samples Location, 9/7/2007 Sampling Event

1. Contaminants of Concern - Surface Soil

WVDHHR screened the maximum detected concentrations of each analyzed metal from all samples against ATSDR health-based or USEPA CVs. The environmental guidelines used to screen for the contaminants in the surface soil samples are ATSDR's or USEPA's CVs for residential soil, and for children, the most sensitive sub-population. Contaminants with the maximum concentration greater than their respective CVs are selected as the contaminants of concern (COCs) for further evaluation.

For the 35 surface soil samples collected on and off site before the completion of USEPA removal operations (September 20, 2002), the maximum detected concentration of antimony, arsenic, cadmium, chromium, copper, iron, lead, selenium, thallium exceeded their respective environmental guideline CVs. Those chemicals are selected as COCs for further evaluation. See Table 1 in Appendix A. The sampling locations are depicted in Figure 2.

For the residential surface soil samples collected on September 7, 2007, screening of the maximum detected concentrations of each analyzed metal and polycyclic aromatic hydrocarbon (PAHs) compound in all samples indicated that arsenic, cadmium, lead, Benzo(a)anthracene, Benzo(b)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd) pyrene, and Benzo(g,h,i)perylene exceeded their respective health based CVs for residential soil. These contaminants are selected as COCs in residential soil for further evaluation. See Table 2 and Table 3 in Appendix A. The surface soil sample locations are depicted in Figure 3.

For the non-residential surface soil samples collected on September 7, 2007, screening of the maximum detected concentration of all analyte in each sample indicated that antimony, arsenic, cadmium, chromium, copper, iron, lead, benzo(a)pyrene, benzo(a)anthracene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene and benzo(g,h,i)perylene exceeded their CVs for residential soil. Those chemicals are considered as the COCs for further evaluation. See Table 4 and Table 5 in Appendix A.

2. Contaminants of Concern - Groundwater

<u>On-Site Monitoring Wells (MWs) Data</u>

According to available information, three on-site monitoring wells were installed in October, 2000. Since then, the on-site groundwater has been sampled periodically. In October 2000, a total of four onsite groundwater samples were collected from three monitoring wells: one from MW-1, located at the south end of the site, one from MW-3, located west of the site between the railroad track and facility building, and two samples from the MW-2, located at the north end of the property. All samples were analyzed for total metals, cyanide and Volatile Organic Compounds (VOCs). No VOCs were detected.

On June 2001, eight more onsite monitoring well samples were collected and analyzed for total metals. The maximum detected concentration of each analyzed metal in a total of 12 samples (from both sampling events) were compared to the ATSDR's health-based drinking water CVs for adults, USEPA region III RBC for tap water, as well as the USEPA's MCL for drinking water. It should be noted that evaluation of onsite groundwater as a potable water source is extremely health protective. Except for arsenic, lead and thallium, concentrations of all other analytes were below their respective CVs. See Table 6 in Appendix A.

In May 2004, groundwater samples from three monitoring wells and the municipal wells on Leap Street and Wetzel Street were collected by USEPA Superfund Technical Assessment Response Technical Team (START). Filtered and unfiltered samples were analyzed for total metals and for radiochemical analysis of gross Alpha/Beta, Gamma, and specific isotopes (Uranium, Thorium, Radium-226, and Radium-228). In the filtered samples from onsite wells, no metals were detected above their respective USEPA's MCLs. In the unfiltered samples, only lead (maximum concentration = 83.8 µg/L) exceeded its action level of 15 µg/L. Review of radiochemical analyses data by the radiological officer of Ecology & Environmental, Inc., concluded that there were somewhat elevated levels of radioactivity present in three monitoring wells, but overall levels of radioactivity reported were below levels of concern [1]. No analytical results from the May 2004 sampling event were available.

On September 7, 2007, TRIAD Engineering, Inc., a contractor for WVDEP, collected groundwater samples from three on-site monitoring wells and from the nearby Leap Street and Wetzel Street municipal wells. A total of four monitoring well samples were collected: one sample from MW-B (the west monitoring well), one sample and a duplicate from MW-A (the south monitoring well), and one sample from MW-D (an older monitoring well located adjacent to the closed underground storage tank [UST]). TRIAD was unable to locate MW-C (the north monitoring well). All groundwater samples were filtered prior to being analyzed. The maximum detected concentration of each analyzed metal in all samples was compared to the ATSDR health based or USEPA drinking water CVs. As a result, only thallium was the COC identified in onsite groundwater, and thallium was only detected in the sample from the south monitoring well. See Table 7 in Appendix A for a summary of this data.

Municipal Water Supply Well Data

Only one sample (both filtered and unfiltered) was collected from the municipal Leap Street well on June 14, 2001 for analysis. The maximum detected concentration of each metal in the un-filtered sample was compared to the available ATSDR's or USEPA's most protective drinking water CVs. Antimony, arsenic and thallium exceeded their respective environmental guideline CVs, and hence were selected as COCs for further evaluation. See Table 8 in Appendix A for a summary of this data.

According to available information [1], during May 12 -17, 2004, USEPA START personnel collected groundwater samples from municipal wells on Leap and Wetzel Streets. Samples were analyzed for total metals (i.e. unfiltered), radiochemical analyses consisting of gross Alpha/Beta analysis, Gamma analysis, and isotopic (Uranium, Thorium, Radium-226, and Radium-228) analysis before and after filtration. In the filtered samples, no metal was detected at the concentration above USEPA's MCL. Review of radiochemical analysis data by the radiological officer of Ecology & Environmental, Inc., concluded that gamma, alpha and beta results from the two municipal wells were lower than that of the onsite monitoring wells. The overall reported radioactivity was relatively low and not what would commonly be construed as alarming [1]. No data from this sampling event were available to be presented in this PHA.

Four samples were collected from both the Leap Street and Wetzel Street wells on September 7, 2007, by TRIAD Engineering, Inc., All samples were filtered prior to being analyzed. Screening of the maximum detected concentration of each analyzed metal in all samples against the available ATSDR's or USEPA's most protective drinking water CVs, indicated thallium is the only COC in the municipal water supply wells. See Table 8 in Appendix A for a summary of this data.

It should be noted that, according to the West Virginia Drinking Water Watch website (will be available to public in the near future), source waters from Leap and Wetzel Street wells meet USEPA's drinking water regulations.

Exposure Pathway Analysis

WVDHHR evaluated whether the community has been, is, or could be exposed to harmful levels of contaminants in the environment by identifying the human exposure pathways. An exposure pathway is the route by which a contaminant travels from its source to the human body. It consists of five components:

- a source of contamination
- an environmental media through which the contaminant is transported
- a point of exposure
- a route of human exposure
- an exposed population

To determine whether nearby residents are exposed to contaminants migrating from the site, WVDHHR evaluated the environmental and human components that lead to human exposure.

Exposure may occur by breathing, eating or drinking the contaminants, or by skin (dermal) contact with the substance. WVDHHR identifies exposure pathways as completed, potential, or incomplete. Completed pathways are those that meet the five elements listed above. A potential pathway exists when one of the above listed five elements is missing, but could exist. Potential pathways indicate exposure to a contaminant may have occurred, may be occurring, or may occur in the future. An incomplete pathway occurs when at least one of the five elements is missing and will never be present.

A Completed Exposure Pathway – Residential Surface Soil

Human exposure to the COCs in the residential surface soil through accidental ingestion likely occurred in the past, could be occurring at the present time, and may occur in the future via activities like playing, gardening or working in the soil. Children are especially prone to hand-mouth behaviors, and often put hands and toys into mouth without washing them first. Incidental ingestion could occur when people have contacted contaminated soils with their hand and then engaged in hand to mouth activities such as eating, drinking and smoking without washing hands.

A Completed Exposure Pathway – Non-Residential Surface Soil

Historical exposure of onsite workers to contaminants in surface soil may have occurred prior to cessation of the Dalzell Viking Glass Company operations. Due to a lack of available occupational exposure information, WVDHHR was unable to evaluate these exposures.

Currently, the former “new warehouse” and the “retail shop” of the facility are used for storage by three different companies. Warehouse workers can be exposed to COCs in onsite surface soil via accidental ingestion.

Citizens (trespassers) could be exposed to the COCs in the on-site surface soil after the Dalzell Viking Glass Company property became abandoned.

A Completed Exposure Pathway – Municipal Water Supply Wells

Human exposure to a site-related COC in groundwater was expected to occur through the consumption of potable water from the municipal wells located near the site.

A Potential Exposure Pathway – Inhalation of Contaminants in Air

Air emissions from the glass manufacturing operation could have been a potential inhalation exposure pathway during the past. The exposed populations would consist of facility workers and residents who lived in the area prior to 1998. However, this pathway could only be identified as a potential exposure pathway because there is not enough information.

An Incomplete Exposure Pathway - On-site Groundwater

No records indicate that people used on-site groundwater for potable purposes.

An Incomplete Exposure Pathway – Surface Water

An unnamed tributary to the Ohio River flows beneath the property via a culvert. Surface water runoff during storm events is likely discharged to the unnamed tributary flowing toward the Ohio River about 900 feet to the west of the site. The site is located in the 100-year floodplain of the Ohio River.

No public water supply system using surface water was identified within 15-miles of the Dalzell Viking Glass Company Site. The closest surface water supply intake is Sistersville, West Virginia, located about 17 miles south, and downstream of New Martinsville [6].

Table 9 in Appendix A is a summary for all types of exposure pathways associated with the Dalzell Viking Glass Company Site.

Exposure Analysis

1. Estimation of Exposure Dose

Exposure doses are the estimates of how much chemical may enter into a person's body. The calculations rely on the sample data and assumptions. Generally, those assumptions include exposure duration, exposure frequency, intake rates, and body weights. The exposure durations and frequency are determined based on exposure scenarios. Intake rates and body weights are based on recommendations from the USEPA Exposure Handbook [7], and the ATSDR Public Health Assessment Guidance Manual [8]. Table 10 in Appendix A summarizes the assumptions used in exposure dose estimations, exposure scenarios and associated exposure duration.

These assumptions and the respective exposure scenarios are used to determine the estimated doses for each contaminant. The estimated doses will then be compared to health guidelines and the available scientific literature to determine if health effects are likely to occur.

Exposure doses are expressed as the amount of contaminant that a person intakes daily per unit of body weight. It is expressed as milligrams of chemical per kilogram of body weight per day (mg/kg/day).

The equation and assumptions used to estimate exposure doses from ingesting contaminants in surface soil is as follows [8]:

Equation 1: Exposure Dose for Soil Ingestion

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

Where:

ED = exposure dose in milligrams per kilogram per day (mg/kg/day)

C = chemical concentration in milligrams per kilogram (mg/kg)

IR = intake rate in milligrams per day (mg/day), or liter per day (L/day) for water

EF = exposure factor (unitless, acute EF = 100%)

CF = conversion factor, 1×10^{-6} kilograms/milligram (kg/mg)

BF = bioavailability factor (unitless)

BW = body weight in kilograms (kg)

2. Estimation of Theoretical Cancer Risk

An estimate of excess cancer risk is an extrapolation of the number of *additional* cases of cancer in a population that may be caused from exposure to COCs at this site under the assumed exposure scenarios. This estimate is meant to be an estimate of *additional* cancer cases beyond the expected "*background*" rate of cancer. Currently, in the U.S. we estimate that 1 out of every 3 Americans will experience a diagnosis of cancer of some type over his or her lifetime. For additional information, go to http://seer.cancer.gov/statfacts/html/all.html). Excess cancer risk calculations are population-based estimates of excess risk and are not predictive for any single individual.

A cancer slope factor (CSF) expressed as risk per dose (in mg/kg/day), is a chemical-specific estimate of the incidence of cancer associated with an intake of 1 mg/kg/day. Many uncertainties and conservative assumptions were applied to determine the CSF such as:

- Past exposures to carcinogenic chemicals were the same as those at currently measured levels.
- Effects from short exposures are averaged over a 70-year lifetime.
- No threshold of exposure for cancer causing chemicals.
- The cancer slope factor is based on the most sensitive range of responses, the 95% upper bound risk. The excess cancer risk would be lower if the average response was used to calculate the cancer slope factor.

This means the actual risk of cancer is probably lower than the calculated number, perhaps by several orders of magnitude. The true excess cancer risk is unknown and could be as low as zero.

Considering many uncertainties, WVDHHR ranked the exposure doses or cancer risks according to the following criteria: estimated theoretical cancer risks lower than 1 in 10,000 are considered very low and needs no further review, between 1 and 9.9 in 10,000 are classified as low risk, between 10 and 99 in 10,000 are classified moderate risk, and greater than 99 in 10,000 are considered significant risk.

The equation and assumptions used to estimate theoretical cancer risk from ingesting contaminants in surface soil is as following [8]:

Equation 2: Estimated Excess Lifetime Cancer Risk

$$ER = CSF \times Dose$$

Where:

ER	=	estimated theoretical risk (unitless)
Dose	=	estimated daily exposure dose (mg/kg/day) for a life time (70 years)
CSF	=	Cancer Slope Factor $(mg/kg/day)^{-1}$

3. Estimation of Blood Lead Levels in Children

ATSDR and EPA have not developed a CV for ingestion of lead through soil. The usual approach of estimating human exposure to an environmental contaminant and then comparing this dose to a health guideline, or CV, cannot be used. Instead, exposure to lead is evaluated by using a biological model that predicts a blood lead concentration that would result from exposure to the environmental lead contamination. The modeled blood lead concentration is then compared to the level of concern for blood lead concentrations in children as recommended by the Centers for Disease Control and Prevention (CDC). CDC's current level of concern is10 micrograms of lead per deciliter of blood (10 µg/dL) [9]. Using this model, EPA has established a standard cleanup value of 400 parts per million (ppm) for lead concentrations in children's play areas, high traffic areas, and exposed soil areas using the default parameters in this model [10]. The default parameters in the model include many estimated values such as the amount of soil ingestion and time spent outdoors. If the default parameters are found not be accurate in an area being investigated, the cleanup value used at that site may be different.

In this PHA, USEPA's Integrated Exposure Uptake Biokinetic Model (IEUBK) was used to predict blood lead levels of young children (under 7 years of age) exposed to lead in the environment. The model assumes that children will be exposed to lead from a variety of sources, including outdoor soil, dust in the home, air, drinking water, and in their diet. Exposures to the lead-based paint are excluded from this Model. A time-weighted exposure approach was applied to derive an average lead concentration from both the residential and non-residential locations. In this approach, a weighted value is assigned to a medium (e.g., soil), that reflects the fraction of outdoor exposure to residential or site soil [11]. The fraction of outdoor exposure to residential and non-residential soil is determined based upon the assumptions in Table 10.

Equation 3. Weighted Soil Lead Concentration

$$\textbf{Weighted Lead Concentration (Soil)} = C_{RS} \times EF_{RS} + C_{NRS} \times EF_{NRS}$$

Where:

C_{RS} = Lead concentration in residential soil

EF_{RS} = Exposure frequency at the residential area (260 days/year ÷ 365days/year)

C_{NRS} = Lead concentration in non-residential soil

EF_{NRS} = Exposure frequency at the non-residential area (20 days/year ÷ 365 days/year)

The weighted soil lead concentration and the default Soil/Dust Ingestion Weighting Factor of 45% soil and 55% dust (USEPA 1994) were entered into the model to estimate the blood lead concentration of a child. Information about this model and the assumptions used to generate the blood lead level estimates can be found in http://www.epa.gov/superfund/lead/products.htm#ieubk.

Public Health Implication

Introduction

In this section we will discuss the expected health effects in humans exposed to COCs found at the Dalzell Viking Glass Company Site. To evaluate health effects, ATSDR has developed Minimal Risk Levels (MRLs) for contaminants commonly found at hazardous waste sites. The MRL is an estimate of daily human exposure to a contaminant below which non-cancer adverse health effects are unlikely to occur. MRLs are not used to predict specific adverse health effects from exposure, or to establish a safe level of contaminants at a site. MRLs are established as screening tools to use in determining whether further evaluation of the contaminant is warranted. MRLs are developed for each route of exposure, such as inhalation and ingestion, and for various lengths of exposure, such as acute (less than 14 days), intermediate (14 to 365 days), and chronic (greater than 365 days).

When an MRL is not available, USEPA's Reference Dose (RfD) will be used. The RfD is an estimate of daily human exposure to a contaminant for a lifetime (70 years), below which health effects are not expected to occur.

To evaluate the potential health risks associated with the Dalzell Viking Glass Company Site, WVDHHR assessed the risks for both cancer and non-cancer health effects. For the non-cancer health effects, both acute (short-term exposure to highest detected contamination level) and chronic exposure doses (long-term exposure to the average detected contamination level) were estimated. Exposure doses from various media were estimated for three sub-populations: 1-6 years-old preschool child, 7-17 years old teenagers/adolescents, and adults. The site-specific exposure scenarios and associated exposure frequency, as well as other assumptions are applied for estimation of site-specific exposure doses. See Table 10 and 11 in Appendix A for those assumptions. In addition, an extreme case of exposure – children exhibiting pica behavior (pica behavior, refers to the intentional ingestion of soil items) was evaluated. The sensitive population associated with pica behavior is children aged 1–3 years old.

The estimated exposure doses were then compared with ATSDR’s MRL or USEPA’s RfD. The COCs with estimated exposure doses below MRL or RfD would undergo no further review, because exposures to these chemicals at these levels are not expected to result in adverse health effects. The COCs with estimated exposure doses greater than the MRL or RfD, or those without health-based CVs, would undergo further review for possible health consequences from exposures at this site. Literature sources, usually the ATSDR Toxicological Profiles, are reviewed to determine whether the exposure scenarios are associated with specific health effects.

When evaluating possible health effects as a result of exposure to a contaminant, whenever possible, NOAELs and LOAELs obtained from human studies are reviewed. The No Observed Adverse Effect Level (NOAEL) is the exposure dose at which no adverse effect was observed on the animal or human population in a study. The Lowest Observed Adverse Effect Level (LOAEL) for a contaminant is the lowest exposure dose observed that resulted in a measurable adverse health effect in the animal or human population in a study. However, if no human studies exist, studies on laboratory animals are reviewed, and adequate safety factors are used to address human differences when evaluating whether health effects might be possible.

In addition to NOAELs and LOAELs used to evaluate non-cancer health effects, Cancer Effect Levels (CELs) also exist for chemicals known to cause cancer in humans or animals. The CEL is the lowest exposure level associated with the onset of carcinogenesis in experimental or epidemiologic studies.

USEPA evaluates the potential of a chemical to cause carcinogenic effects over a lifetime. To do this, they have estimated cancer slope factors for certain chemicals with sufficient toxicological information on cancerous effects. These cancer slope factors are estimates of the likelihood of a chemical to cause cancer and are used to estimate the cancer risk associated with specific doses. These risk estimates, however, are extremely conservative and are meant to protect the most susceptible population of the public. Until more information on carcinogenesis becomes available, USEPA takes the conservative approach that there is no threshold and any exposure to a carcinogen carries a finite risk.

An analysis of the toxicological implications of past and current exposure at the Dalzell Viking Glass Company Site is presented below.

Toxicology Evaluation after USEPA Removal Operation (2002 to current)

WVDHHR assessed the public health implications between 2002 and the present, based on the information of recent environmental investigations conducted by WVDEP (TRIAD Engineering, Inc., September 7, 2007). The assumed exposure scenarios and associated sub-populations were based on the communication with officials from the local health department, and the companies that currently use a section of the site property for storage (Litman Excavating, Inc., and Bridgeport Equipment and Tool, Inc.,), and are summarized in Table 11 in Appendix A.

After initial screening, arsenic, cadmium, lead, and some of the PAHs are COCs in both residential surface soil and non-residential surface soil. Additionally, antimony, chromium, copper and iron are the COCs in the non-residential surface soil. Due to the limited distribution of chromium and copper concentrations above their screening level (1 in 20 for both chromium and copper, see Table 4 in Appendix A), WVDHHR determined that widespread and repetitive exposures to the chromium and copper in non-residential soil are unlikely. Consequently, chromium and copper were screened out from non-residential soil as contaminants of concern at this site, and site-specific exposure doses were not calculated. Presented below is the toxicological evaluation of PAHs, antimony, arsenic, cadmium, lead, and iron during the period of 2002 to the present.

<u>Polycyclic Aromatic Hydrocarbons</u>

PAHs are a group of over 100 different chemicals formed during the incomplete combustion (burning) of organic material. They usually occur as complex mixtures. Seven PAHs, including benzo(a)pyrene [B(a)P], benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene, are classified as probable human carcinogens by the USEPA based on evidence of carcinogenesis found in animal studies, but inadequate evidence in human studies [12]. Although each of the carcinogenic PAHs is considered a potential cancer-causing chemical, they do not all have the same ability to cause cancer (i.e., some may cause cancer at lower doses than others). Benzo(a)pyrene, one of the most toxic and well-studied carcinogenic PAHs, is the only chemical of this group for which a quantitative estimate of cancer potency is available from long-term animal studies. The relative cancer potencies of the other carcinogenic PAHs are scaled to benzo(a)pyrene in terms of toxicity equivalence factors (TEFs) [12]. The concentration of each carcinogenic PAH is multiplied by its corresponding TEF and then summed to provide an estimate of the "Benzo(a)pyrene Equivalents". Because "Benzo(a)pyrene Equivalents" account for the total cancer-causing ability for the PAHs mixture, they are used in this public health assessment for evaluating the carcinogenic public health implications of potential exposures to these chemicals. The TEFs of some of the carcinogenic PAH compounds are listed below.

PAH Compound	B(a)P TEF
Benzo(a)pyrene	1
Dibenzo(a,h)anthracene	5
Benzo(a)anthracene	0.1
Benzo(b)fluoranthene	0.1
Benzo(k)fluoranthene	0.1
Indeno(1,2,3-cd)anthracene	0.1
Benzo[g,h,i]perylene	0.01

Long-term human exposure to materials containing mixtures of PAHs such as coal tars, mineral oils, soots, and fossil fuel combustion emissions have been associated with cancer of the skin, bladder, lung and scrotum. There are no studies to date that unequivocally establish that PAHs cause cancer in humans. There is sufficient information to conclude that exposure to mixtures containing PAHs increases the risk of cancer in humans. Since their observed health effect levels for carcinogenic endpoints are much lower than for non-cancer endpoints [12], WVDHHR will focus this evaluation on carcinogenic health effects. A quantitative cancer risk estimate has been developed for Benzo(a)pyrene by the USEPA. The cancer slope factor for Benzo(a)pyrene is 7.3 $(mg/kg/day)^{-1}$.

WVDHHR estimated the lifetime (70 years) exposures to the highest levels of “Benzo(a)pyrene Equivalents” in residential surface soil and non-residential surface soil (0.29 mg/kg and 6.08 mg/kg, respectively), and calculated the theoretical cancer risks based on the combined exposure doses from both sources using equation 2. As presented in Table 12 in Appendix A, lifetime exposure to the highest detected concentrations of the PAH COCs in residential and non-residential surface soil results in an excess cancer risk of 2 in 100,000 for preschool children, 8 in a million for teenagers/adolescents, and 1 in 100,000 for adults respectively, which is ranked as a very low risk by WVDHHR. Considering the worst case scenario, the cumulative exposure for a resident who lived near the site from birth through adult years (30 years after reaching adulthood) yields the excess cancer risk of 1 in 10,000, which is still classified as low risk by WVDHHR.

Arsenic

Non-Carcinogenic Health Effects

Arsenic occurs naturally in soil and minerals. People normally take in small amounts of arsenic in air, water, soil, and food. However, food is usually the most common source of arsenic for people.

According to recent sampling results (TRIAD Engineering, Inc., 2007), arsenic was a COC in both the residential soil and the non-residential surface soil, but not in the groundwater (including on-site monitoring wells and municipal drinking water supply well, see Table 7 and 8 in Appendix A). However, arsenic was detected once above the environmental guideline CV from Leap Street well in 2001(USEPA Superfund Technical Assessment Response Team, and no data available to be presented). To protect public health, WVDHHR will address the contributions from all possible sources.

Of the seven residential surface soil samples collected on September 7, 2007, only two samples contained arsenic at the levels greater than the ATSDR chronic non-cancer health effects screening value, or chronic EMEG, which is 20 mg/kg for a child. The highest detected arsenic level in residential surface soil, 68.8 mg/kg, was found in the surface soil east of the new warehouse. The second highest detected arsenic level, 33.7 mg/kg, was found in a residential lawn along Leap Street, north of the site (See Figure 3). The highest detected arsenic level, 486 mg/kg, in non-residential surface soil was found in the basement of the former production building located on the southwest corner, where generally young children would be unlikely to access. Arsenic was detected once above the ATSDR child chronic EMEG of 0.003 mg/L in the Leap Street Well (0.0035 mg/L, in 2001). WVDHHR estimated the acute exposure dose to the maximum detected arsenic concentration from each of the sources: residential surface soil, non-residential surface soil and potable water, and the combined dose from both the non-residential soil and the portable water (the maximum possible acute exposure). As summarized in Table 13 (in Appendix A), the combined dose from two sources of 0.0014 mg/kg/day for teenage/adolescents and 0.00079 mg/kg/day for adults are well below the acute arsenic MRL of 0.005 mg/kg/day. The combined dose of 0.0060 mg/kg/day for a pre-school child exceeded the acute MRL slightly, although it is still eight times lower than the acute LOAEL of 0.05 mg/kg/day, where temporary stomach and intestinal effects with symptoms such as pain, nausea, vomiting, and diarrhea were observed in the humans studied [13]. The combined dose (residential soil + drinking water) for Pica kids of 0.034 mg/kg/day is slightly below the LOAEL. Our assessment based upon the worst case scenario suggests that acute exposure to arsenic does not pose a non-cancer health hazard in general. However, acute exposure of pica kids (a child consuming about a teaspoon of soil) might be at minimal risk of non-cancer health hazard.

The average arsenic concentration in residential surface soil is 21.7 mg/kg, and 103.2 mg/kg in non-residential surface soil, and 0.0035 mg/L in the potable water (detected once in the Leap Street well in 2001). The chronic exposure dose to average concentration from each source was estimated. The combined chronic dose from three sources was then compared to health guidelines. As a result, the combined dose for teenagers/adolescents (0.00014 mg/kg/day), and for adults (0.00014 mg/kg/day) is well below the chronic arsenic MRL of 0.0003 mg/kg/day. The combined chronic exposure dose of 0.00048 mg/kg/day for a pre-school child slightly exceeds the chronic MRL, but is still two times lower than the NOAEL of 0.0008 mg/kg/day, the highest human exposure dose where no non-cancer health effects were observed ([13],Tseng et al., 1968). Considering the worst case scenario: a person living near the site from birth through the adult years (30 years after reaching adulthood), the estimated cumulative exposure dose is 0.00077 mg/kg/day, exceeds the chronic oral MRL but is still below the chronic NOAEL of 0.0008 mg/kg/day. Therefore, the total chronic exposure from the three sources: residential soils, non-residential soil and potable water, is not expected to pose a non-cancer health hazard.

Table 13 in Appendix A summarizes the estimated arsenic non-cancer exposure doses for various populations.

Carcinogenic Health Effects

Long-term ingestion of arsenic is associated with development of cancer, primarily skin, bladder and lung cancers. The lifetime exposure doses of pica-child, pre-school children, teen/adolescents and adults from all sources are several orders of magnitude lower than the CELs for skin, bladder and lung cancers. CEL from human studies for ingestion of arsenic is 0.064

mg/kg/day for bladder, lung and liver cancers (Chen et al. 1986) [13]. The lowest CEL for skin cancer is 0.014 mg/kg/day (Tseng et al. 1968) [13]. Therefore, cancer is not likely to result from exposure to arsenic at this site.

In terms of excess lifetime (70 years) cancer risks for the cumulative exposures to residential surface soil, non-residential surface soil and potable water, as presented in Table 14 in Appendix A, the estimated excess lifetime cancer risks are 6 in 100,000 for pre-school children, 5 in 100,000 for teenagers/adolescents and 8 in 100,000 for adults, which are all very low risk. Considering the worst case scenario: a person living near the site from birth through the adult years (30 years after reaching adulthood), the estimated excess cancer risk is 2 in 10,000, which is still considered a low excess lifetime cancer risk.

Cadmium

Cadmium occurs naturally in the earth's crust and is most often encountered as compounds containing other elements such as oxygen, chlorine, or sulfur. It has a number of industrial applications, mainly in metal coatings, pigments, batteries, and plastics [14].

Cadmium enters the body via inhalation or ingestion, but little enters through dermal absorption. Humans absorb 25 to 60% of the cadmium in air via inhalation, and 5–10% in food via ingestion. The potential for cadmium to harm your health depends upon the form of cadmium, the amount taken into your body, and whether it is eaten or inhaled. Ingesting high levels of cadmium severely irritates the stomach, leading to vomiting and diarrhea, and sometimes death. Ingesting lower levels of cadmium over a long period of time can lead to a build-up of cadmium in the kidneys. When internal cadmium concentrations reach a high enough level, the cadmium in the kidneys will cause kidney damage, and also causes bones to become fragile. No adequate information indicates that a level of cadmium ingestion might affect human reproductive ability. Animals ingesting cadmium sometimes are observed to display high blood pressure, iron-poor blood, liver disease, and nerve or brain damage. Studies of humans or animals ingesting cadmium have not found increases in cancer, although additional research is needed. The USEPA has determined that cadmium is a probable human carcinogen by inhalation [14]. The cadmium chronic MRL established by ATSDR for non-cancer health effects is 0.0002 mg/kg/day.

Cadmium is a COC in both residential and non-residential surface soil. Only two of the seven residential surface soil samples contained cadmium at levels greater than the ATSDR chronic non-cancer screening value, or the EMEG for children, which is 10 mg/kg. The highest detected cadmium level in residential soil of 32.2 mg/kg was found in the area east of the new warehouse (storage area) building. The second highest detected cadmium level of 16.8 mg/kg was found in a residential lawn, north of the site. Coincidently, both elevated cadmium levels were found in the same samples containing elevated arsenic. Apparently, these are hot spots. For non-residential soil, the highest detected cadmium level (709 mg/kg) was found in the basement of the former production building on the southwest corner of the site, a place where young children are unlikely to access. Therefore, the acute exposure dose of young children is only estimated for the highest detected cadmium concentration in residential soil.

As presented in Table 15 in Appendix A, a pica child's estimated acute oral exposure dose is 0.016 mg/kg/day. The estimated acute oral exposure dose from non-residential soil (the worse of the two sources) for pre-school child is 0.0089 mg/kg/day, for teens/adolescents is 0.0019 mg/kg/day, and for adults is 0.0010 mg/kg/day. These estimated exposure doses were compared to a human exposure dose known to likely cause gastrointestinal effects of 0.07 mg/kg/day (Nordberg et al. 1973) [14], such as nausea and vomiting. Consequently, acute health effects are unlikely for all exposure scenarios and sub-populations as all are lower than the 0.07 mg/kg/day.

The average concentration of cadmium in residential surface soil is 10.9 mg/kg, and 103.9 mg/kg in non-residential surface soil. The estimated chronic oral exposure doses of 0.00017 mg/kg/day for pre-school children, 0.000041 mg/kg/day for teenagers/adolescents, and 0.000040 mg/kg/day for adults from all sources are well below the chronic MRL of 0.0002 mg/kg/day. Considering the worst case scenario: a person living near the site from birth through the adult years (30 years after reaching adulthood), the estimated cumulative chronic exposure dose is 0.00025 mg/kg/day, which is slightly above the chronic MRL, but still eight times lower than NOAEL of 0.0021 mg/kg/day.

As a result, exposure to the cadmium at the level detected in both residential and non-residential surface soil would not be expected to cause adverse non-cancer health effects.

Antimony

Antimony is a metal that occurs naturally in the earth's crust. Most antimony oxide produced is added to textiles and plastics to prevent their catching on fire. Antimony alloy (mixed with other metals) is used in lead batteries, solder, sheet and pipe metal, etc. In addition, antimony can have beneficial effects when used for medical reasons. It has been used as a medicine to treat people infected with parasites. However, people who had too much of this medicine or are sensitive to it may experience adverse health effects when it is injected into their blood or muscle. These health effects include diarrhea, joint and/or muscle pain, vomiting, problems with the blood (anemia) and heart problems (altered electrocardiograms).

Antimony can enter your body through ingestion, and inhalation. It is unknown whether antimony can enter human body through skin contact. The primary human health effects associated with oral exposure to high levels of antimony are gastrointestinal irritation, and vomiting ([15], Dunn 1928). Diarrhea, vomiting and effects on the liver and red blood cells have been observed in animals following acute exposure to high level of antimony [15]. Antimony has not been classified for cancer effects by the Department of Health and Human Services, the International Agency for Research on Cancer or the USEPA [15]. An EPA chronic RfD of 0.0004 mg/kg/day has been established for antimony for non-cancer health effects. The RfD was derived from the LOAEL of 0.35 mg/kg/day obtained from life term study of antimony in rats, and is the lowest exposure dose for rats to experience the health effects such as changes in blood chemistry and life span, and increased blood cholesterol level [15]. The RfD for humans is 1,000 times lower than the dose for the observed health effects in the animal studies.

Antimony is a COC in both non-residential surface soil and potable water. None of the residential surface soil samples contained antimony concentrations above the ATSDR environmental screening value for surface soil, also known as the reference dose media evaluation guides (RMEG), which is 20 mg/kg for children. A total of 21 non-residential surface soil samples were found to contain antimony at concentration ranging from 1.3 mg/kg to 11,100 mg/kg, but only seven were above the RMEG for children of 20 mg/kg. The highest level of antimony was found in the basement of the former packing area (See Figure 3), where young children are unlikely to access, but adolescents and adults could access by trespassing. Based on the available information, WVDHHR estimated the acute oral exposure doses for pica children, and pre-school children from both sources of residential soil and potable water, and the doses for teen/adolescents and adult from both the non-residential soil and water (the maximum possible acute exposure), see Table 16 in Appendix A. Since ATSDR or EPA have not established acute MRL for antimony, the estimated oral acute exposure doses from all sources were evaluated by comparing to the acute LOAEL of 0.529 mg/kg/day for a human study, where the gastrointestinal symptom of vomiting was observed. The estimated acute dose of 0.0046 mg/kg/day for a pica child, 0.0004 mg/kg/day for pre-school children, 0.03 mg/kg/day for teen/adolescents, and 0.016 mg/kg/day for adults were all below the LOAEL.

Long-term oral exposure doses to the average level of antimony detected in non-residential (913.5 mg/kg), residential surface soil (3.6 mg/kg) at the site, and in the potable water (0.0049 mg/L) were also estimated, and combined. The chronic oral exposure doses from all sources (0.0003 mg/kg/day for teen/adolescents, and 0.00034 mg/kg/day for adults), are below the RfD of 0.0004 mg/kg/day for antimony. The pre-school child's chronic exposure dose from all sources of 0.00069 mg/kg/day exceeds the RfD slightly, but is still 500 times lower than the LOAEL, the dose known for the non-cancer health effects in the animal study. Considering the worst case scenario: a person living near the site from birth through the adult years (30 years after reaching adulthood), the estimated cumulative chronic exposure dose is 0.0013 mg/kg/day, exceeds the chronic oral RfD, but is still 269 times below the chronic LOAEL. Therefore, the total chronic exposure from the three sources: residential soils, non-residential soil and potable water, is not expected to pose a non-cancer health hazard.

In conclusion, the exposure to antimony at the levels found at the site would not be expected to pose non-cancer health risks to the community.

Lead

Lead was detected in all seven residential surface soil samples at concentration ranging from 40.7 mg/kg to 612 mg/kg. The highest level of lead was 612 mg/kg and was found in the residential lawn east of First Street and north of the site, which is also the only one of the seven samples which contained lead at a concentration above 400 mg/kg, the level where USEPA considers a cleanup action (more specifically, 400 mg/kg lead in play areas or 1,200 mg/kg lead in a vegetated yard) (US EPA, 2001).

Lead was detected in all 21 non-residential surface soil samples at concentrations ranging from 23.1 mg/kg to 5,040 mg/kg, with only four samples containing levels above 400 mg/kg. It should be noted that to use the 400 mg/kg USEPA Soil Screening Level to screen the non-residential surface soil is a very conservative approach because no one would likely use the site property as a frequent play area. The highest detected lead level was found in the former degreasing area (Figure 3), and the second highest level (787 mg/kg) was found in the basement of the new warehouse storage area. Fences were installed on the east (along First Street) and the north of the site, where accessibility to these areas would be minimal. In addition, a lead level of 433 mg/kg was found in the southeast corner near the former offices, and 705 mg/kg at the southwest corner of the site. Both are accessible to the public.

Pregnant women, developing fetuses, and young children are particularly vulnerable to the effects of lead. Young children are more likely to play in dirt and to place hands and other objects in their mouths, thereby increasing the opportunity for exposure via ingestion of lead-contaminated soil and dust.

Exposure to lead is predominantly associated with effects on the nervous system and blood (e.g., anemia and increased blood pressure), cardiovascular systems, and the kidneys. Lead exposure is associated with premature birth and low birth weights, and may affect mental and physical development in children [16]. The current blood lead action level for children of 0.5 to 7 years old is 10 microgram per deciliter (μg/dL), set by the US Centers for Disease Control (CDC).

USEPA's IEUBK model is used to predict the potential blood lead levels (BLLs) of children exposed to lead from residential and non-residential surface soil. The most likely exposure pathway for these children is ingestion of soil through hand to mouth activity. The weighted lead soil concentration of residential soil and site soil (non-residential soil) were estimated using Equation 3. Due to the limited distribution of lead concentrations above its screening level (1 in 7 in residential soil samples, and 4 in 21 in non-residential soil samples), WVDHHR decided to derive the weighted lead soil concentration with average concentrations from both sources.

The following assumptions were made in running the IEUBK model:

1. An exposure period of 280 days/year was selected. Of which, 260 days were for residential soil exposure and 20 days for non-residential soil. See Table 11 in Appendix A for justification.
2. The weighted lead soil concentration is 222.6 mg/kg (derived from the average lead concentrations of residential and non-residential soil, as well as the associated exposure frequencies of 260 days/280 days and 20 days/280 days respectively).
3. An ATSDR default soil/dust intake rate of 200 mg/day (for non-pica children) over 280 exposure days was averaged over 365 days, resulting in the soil ingestion rate of 154 mg/day.

As a result, the predicted blood lead level in non-pica children age 0.5 – 1 year old is 5.7 μg/dL and 3.6 μg/dL for children from 6 – 7 years-old. The maternal blood lead level is predicted to be 2.5 μg/dL. Each of these predicted BLLs are lower than the CDC blood lead level of concern 10 μg/dL. It should be noted that, the predicted blood lead levels did not include exposure from lead-based paint. Children residing in the vicinity of the site would be expected to have a higher blood lead level if they lived in a house built before 1978, when lead paint was prevalent. BLLs for children exhibiting pica behavior exceed the CDC's blood lead action level.

Iron

Iron is a COC only in non-residential surface soil. Of 21 samples collected, three were found to contain iron above the Region III Risk Based Concentration (RBC), and were in the areas of former degreasing area (55,500 mg/kg), the basement between the annealing area and furnace (64,200 mg/kg), and the former office areas (59,400 mg/kg). Young children and adults were unlikely to access those areas (See Figure 3). The USEPA provisional peer-review RfD for iron is 0.7 mg/kg/day, which is based on a clinical study performed in a cohort of Swedish patients receiving iron supplement (ferrous fumerate) therapy. The health response is intestinal effects with a reported LOAEL of 1 mg/kg/day.

Acute oral exposures to the highest detected iron concentration and the chronic exposure to average iron concentration from both non-residential and residential soil were estimated for teen/adolescents. The resultant acute and chronic exposure doses from both sources were then compared with the RfD. As indicated in Table 17 in Appendix A, all estimated exposure doses are below the RfD, except the acute exposure dose for pre-school children which exceeds the RfD. Considering many uncertainties, the areas with iron levels above Region III RBCs are unlikely to be accessible to young children, and that the RfD is for chronic health effects, the health risk for pre-school children would be expected to be minimal.

Thallium

Thallium is a soft, bluish-white metal that is widely but sparingly distributed in the earth. It can be found chemically combined with other substances such as oxygen, sulfur, and halogens to form soluble salts. The general public is exposed to low levels of thallium through diet, smoking tobacco, and breathing second-hand tobacco smoke. The average person takes in about 2 micrograms of thallium per gram of food consumed daily. Once ingested, thallium distributes throughout the human body; it can cross the placenta in pregnant women and be distributed to the developing fetus.

Limited historical sampling events at both the Leap Street and Wetzel Street municipal wells have found measurable concentrations of thallium on two occasions. Thallium was present in a Leap Street Well sample at 5.6 µg/L in 2001, and a Wetzel Street Well sample at 3.4 µg/L in 2007. It was also detected in the finished water (combined from both sources) in 2007, at 3.2 µg/L. Although detected infrequently, each of these values exceeded USEPA's Lifetime Health Advisory (LTHA) for Drinking Water of 0.5 µg/L. Therefore, thallium was further evaluated as a COC in the potable water. Based upon the maximum concentration (5.6 µg/L), and assumptions listed in the Table 8 in Appendix A, we estimated that ingestion of water from Leap Street Well would result in an exposure to thallium at a dose of 0.00016 mg/kg/day for adults, and 0.00035 mg/kg/day for children, aged one to six years old.

Although ATSDR provides no health-based guidelines for ingestion of thallium, USEPA provides an oral RfD of 0.00007 mg/kg/day for thallium, based on a study of rats exposed to aqueous thallium sulfate by gavage (stomach tube) at concentrations up to 0.2 mg/kg/day. The observed effects included alterations in blood chemistry, hair loss, and enhanced tear production, although none were considered to be adverse. Thus, the 0.2 mg/kg/day was considered a NOAEL. The RfD was obtained by dividing the NOAEL with an uncertainty factor of 3,000 to account for humans being more sensitive than rats to thallium, for some humans being more sensitive than others, and for a lack of chronic toxicity data. Thallium is classified as group D (not classifiable as human carcinogenicity) based on a lack of adequate data [17].

The thallium exposure doses that WVDHHR estimated from potable water ingestion exceeded the USEPA's RfD by twofold for adults, and by fourfold for children. However, the highest thallium dose that did not cause toxicity to rats (i.e., 0.20 mg/kg/day) was 571 times higher than the estimated children's exposure dose, and 1,250 times higher than that for adults, despite the fact that we used very conservative assumptions to estimate dose. For example, our dose estimation is based on the highest concentration observed. Similarly, it does not account for any dilution occurring when water from both Leap and Wetzel Street wells are combined prior to distribution. Thus, applying more realistic exposure assumptions would likely result in lower doses. Therefore, WVDHHR concludes that ingestion of thallium in potable water from municipal Leap and Wetzel Streets wells is not expected to result in adverse human health effects. Likewise, short-term exposures to the maximum concentration (5.6 µg/L) were considered "safe", even for a 10-kg (22 lb.) child consuming one liter of water per day.

Toxicology Evaluation before USEPA Removal Operation (1998 – December 1999)

After Dalzell Viking Glass Company entered bankruptcy in 1998, there was no information indicating that access to the facility was restricted until USEPA emergency action was initiated in November 1999. Surface soil on site has been impacted by past glass manufacturing operations. Teenager and adolescent trespassers may have come in contact with chemicals present in surface soil. Exposure may have occurred via incidental ingestion, inhalation of fugitive dust, and direct skin contact from occasional trespassing.

Antimony, arsenic, cadmium, chromium, copper, iron, lead, selenium, and thallium were the COCs in surface soil due to their highest detected concentrations above the environmental guideline CVs. A close look at those COCs, chromium was detected above its screening CV in 1 of 35 samples, copper and iron were detected above their respective screening levels in 2 of 35 samples (See Table 1 in Appendix A). Due to the very limited frequency of these contaminants concentration above their screening CV, WVDHHR determined that widespread and frequent exposure to chromium, copper, and iron at the industrial site are unlikely and these infrequent exposures would not be expected to result in adverse health effects. Lead was detected above its screening CV in 8 of 35 samples, with the average concentration of 297 mg/kg, well below the USEPA lead soil screening level of 400 mg/kg (for residential play area). In addition, young children were unlikely to access the site soil. Consequently, WVDHHR screened out chromium, copper, iron, and lead for the specified period as COCs, and did not calculate site-specific chromium, copper, iron, and lead exposure doses.

WVDHHR estimated both acute and chronic site-specific exposure doses of antimony, arsenic, cadmium, selenium and thallium for teen/adolescents. The chronic exposure was estimated assuming that teen/adolescents had trespassed on the abandoned industrial property once a week. As presented in Table 18 in Appendix A, all estimated doses did not exceed their respective MRL/RfD, or LOAEL (when no MRL/RfD were available), suggesting teen/adolescents would not be at health risk by occasionally trespassing on the Dalzell Viking Glass Company Site during the specified period.

Evaluation of Health Outcome Data

The WVDHHR has developed a strategic plan for the elimination of childhood lead poisoning and for the implementation of a statewide blood lead screening program. This plan includes a geographic targeting of program activities in high risk areas, with enhanced efforts in the nine highest risk counties, including Wetzel County. To determine the scope of the childhood lead problem, WVDHHR has a targeted program to look at the distribution of elevated blood lead levels greater than or equal to 10 µg/dl among children zero to six years of age (2004 WVDHHR Strategic Plan).

The WVDHHR uses risk predictors identified by the National Health and Nutrition Examination Survey (NHANES) to predict communities at high risk for childhood blood lead poisoning including percent of older houses, poverty level, and percent of population between the ages of zero and six years. Lead-based paint in old houses is the most common source of lead exposure in West Virginia (2004 WVDHHR Strategic Plan).

According to WVDHHR program data, in the 26155 zip code area of Wetzel County, one of the 30 children six years or younger (the target age group) tested for blood lead level (BLL) in 2004 exceeded the CDC action level of 10 µg/dl. Two of the 34 children tested in 2005, four of the 100 children tested in 2006, and two of the 65 children tested in 2007 had BLL above 10 µg/dl. The rates of elevated blood lead level (EBLL) for the number of children tested are 3.3 percent in 2004, 5.9 in 2005, 4.0 in 2006 and 3.1 in 2007. In comparison with the corresponding annual rates of EBLL for Wetzel County, the rates in the 26155 zip code area are slightly higher, although the small sample populations don't allow for any statistically valid conclusions.

According to the Child Blood Level Screening (CBLS) County-level Summary Data for West Virginia published on the CDC website [18], of the 55 West Virginia Counties, Wetzel County has a relative higher rate of EBLL for the number of children tested. Many factors could contribute to the EBLL, such as the percentage of children in the target age group under the poverty level, the percentage of older housing units in this area, or frequent exposure to "hot spots" (places where elevated lead levels were found). However, since zip code 26155 area geographically covers almost 1/3 of Wetzel County, the EBLL is not likely to be an indicator of proximity to the Dalzell Viking Glass Company Site.

In the 2000 Census and relative to the nation (see Table 19 in Appendix A), the West Virginia State, Wetzel County, Zip Code 26155, and the City of New Martinsville had higher percentages of pre-1960 structures and earlier median construction years. Although the state, county, and local populations have proportionately fewer children relative to the nation, the percent of children living in poverty in West Virginia is higher. In particular, the percent of children in the target age group for the program who live in poverty at the state, county, zip code and local levels are 27.0, 29.4, 35.1, and 41.7 percent, respectively. Medicaid-eligible and Children's Health Insurance Program (CHIP)-eligible children are considered to be high risk groups for childhood lead poisoning.

Children's Health Consideration

ATSDR/WVDHHR considers children in the evaluation of all exposures, and uses health guidelines that are protective for children. In general, children are assumed more susceptible to chemical exposures. In evaluating health effects from the site-specific environmental exposures, children were considered as a special population because:

- Children weigh less than adults, resulting in relative higher doses of chemical exposures;
- Children have higher rates of respiration;

- Metabolism and detoxification mechanisms differ in both the very young and very old and may increase or decrease susceptibility;
- A child's developing body systems can sustain permanent damage if toxic exposures occur during critical growth stages; and,
- Outdoor playing and hand-to-mouth habits increase children's exposure potential. The fact that children are smaller than adults makes them more susceptible to the dust, soil, and vapors that are close to the ground.

Based on communication with local officials, children/adolescents are likely to ride bicycles trespassing on the open areas at the north and south ends of the site. During the site visit on May 14, 2008, WVDHHR staff did not observe children playing on this former industrial site. WVDHHR closely reviewed possible exposure situations for children (for example, trespassing, and soil in a residential lawn), and used EMEGs for children to screen the contaminants, as children are considered the most sensitive subgroup of the population.

This public health assessment considered these child-specific factors in the evaluation of potential health effects to children, and in the development of conclusions and recommendation for this site.

Conclusions

The five public health hazard categories used by ATSDR are: (1) no public health hazard, (2) no apparent public health hazard, (3) indeterminate public health hazard, (4) public health hazard, and (5) urgent public health hazard.

The WVDHHR assessed the public health implications of chemical contaminants found in the environmental medium on/near Dalzell Viking Glass Company Site for both periods of before and after the USEPA removal operation (November 1999 to September 2002), based on the available environmental information. Of the exposures evaluated, assumptions made by WVDHHR regarding contact with observed contamination are generally very conservative (protective). The actual or potential risks are likely to be much less. As with all projections of potential risk, uncertainties exist that could impact conclusions to varying degrees.

Based on the evaluation of available environmental information and data associated with the site, WVDHHR concluded:

- Between September 2002 and the present time (i.e. after the completion of all removal operations), estimates of exposures to chemicals from all sources (residential soil, non-residential soil) via accidental ingestion and drinking (were) are not expected to harm people's health. The estimated theoretical cancer risks from exposures to the carcinogenic COCs such as PAHs and arsenic are below acceptable risk level.
- Between 1998 and December 1999, (following cessation of the manufacturing activities but prior to any removal activities), estimated exposures of teenager and adolescent trespassers to chemicals via accidental ingestion were not expected to harm their health.

- Exposure to lead at the concentration in the surface soil on-site via accidental ingestion (was) is not expected to harm young children's health, because the predicted blood lead levels of non-pica (normal behavior) children, and developing fetuses were below the level of concern (10 µg/dL) as recommended by the Center for Disease Control and Prevention (CDC) (CDC, 2005). The blood lead levels were predicted based upon lead concentrations in surface soil (2007)
- Past exposure to chemicals via air inhalation during active glass manufacturing operations cannot be concluded from currently, because there is no information available to evaluate.
- Exposure to radioactive chemicals from drinking water (was) is not expected to harm people's health. Because the available records in West Virginia Safe Drinking Water Information System, indicate that the radiation levels in finished water of Wetzel and Leap Street well meet the USEPA's National Primary Drinking Water Regulation standards. In addition, USEPA concluded in June 2005 that overall reported radioactivity was relatively low and not what would commonly be construed as alarming [1].
- According to WVDHHR program data, the rate of elevated blood lead level (EBLL) in the 26155 zip code area is slightly higher than that in Wetzel County, although the small sample populations does not allow for any statistically significant conclusions. WVDHHR believe that the EBLL is not likely to be an indicator of proximity to the Dalzell Viking Glass Company Site. Many factors could contribute to the EBLL, such as the percentage of children in the target age group under the poverty level, the percentage of older housing units in this area, and the zip code 26155 area geographically covers almost 1/3 of Wetzel County.

Recommendation

1. Ensure that access to the site is restricted.
2. Continued monitoring of the two municipal water supply wells located north of the site. Both raw and treated samples should be analyzed.
3. Health Education: Parents should observe their children to verify they do not exhibit pica behaviors. Parents should also encourage good hygiene, including regular hand washing after playing and before they eat and drink. Parents should use precaution and warn their children that the site poses unsafe health conditions.
4. Additional residential soil sampling may be needed to ensure that the data reviewed in this PHA is representative.

Public Health Action Plan

WVDHHR will be developing a fact sheet outlining the keys points of this report, and educational fact sheets for some of the contaminants found at the site for the concerned community members; the local health official; New Martinsville Water Department; current owner of the site, and, Bridgeport Equipment and Tool, Inc. WVDHHR will be planning a public meeting at the town of New Martinsville to present this report and conclusions. In addition, the WVDHHR will provide health education to community members when concerns are expressed.

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Certification

This Dalzell Viking Glass Company Site Public Health Assessment was prepared by West Virginia Department of Health and Human Resources (WVDHHR) under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It was completed in accordance with approved methodologies and procedures existing at the time the Public Health Assessment was initiated. Editorial review was completed by the Cooperative Agreement partner.

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The Division of Health Assessment and Consultation of ATSDR has reviewed this public health assessment and concurred with its findings.

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Appendix A. Tables

Table 1. Contaminants of Concern - Onsite Surface Soil (WESTON, 12/28/1999 & 2/23/2000)

Analyte	Detection Frequency	Frequency of Concentration above the CVs	Arithmetic Average Concentration (mg/kg)	Minimum - Maximum Concentrations (mg/kg)	Comparison Values (CVs) mg/kg	
					Value	Sources
Antimony	35 / 35	16 / 35	67.0	1.1 - 948	20	ATSDR Child RMEG
Arsenic	35 / 35	26 / 35	320.0	7.9 - 1,970	20	ATSDR Child EMEG
Cadmium	35 / 35	24 / 35	103.9	0.24 - 1,920	10	ATSDR Child EMEG
Chromium	35 / 35	1 / 35	33.0	4.3 - 468	200	ATSDR Child RMEG For Cr^{6+}
Copper	35 / 35	2 / 35	138.0	16.4 - 793	500	ARSDR Child Int. EMEG
Iron	35 / 35	2 / 35	25,580.0	4,910 - 66,500	55,000	USEPA Region III RBC Residential Soil, September, 2008
Lead	35 / 35	8 / 35	297.0	13.4 - 1,970	400	USEPA Soil Screen Level
Selenium	35 / 35	7 / 35	295.0	1.1 - 2,560	300	ATSDR Child RMEG
Thallium	35 / 35	6 / 35	2.6	1.4 - 8.1	5.5	USEPA Region III RBC Residential Soil

Notes:

ATSDR - *Federal Agency for Toxic Substances and Disease Registry*

RMEG - *Reference Dose Media Evaluation Guide*

EMEG - *Environmental Media Evaluation Guides*

RBC - *Risk Based Concentration*

CREG - *Cancer Risk Guides*

** - ATSDR does not have a CV for B(ghi)P, the BaP was used as a surrogate for screening purposes*

Table 2. Metals Summary - Residential Surface Soil Results (9/7/2007, TRIAD)

Analyte	Sample Results (Concentration, mg/kg)							Detection Frequency		Arithmetic Average Conc. (mg/kg)	Maximum Detected Conc. (mg/kg)	Comparison Values (CVs) (mg/kg)		Contaminants of Concerns (COCs)?
	SS7	SS8	SS10	SS11	SS21	SS23	SS32 Duplicate of SS21							
Aluminum	16100	9700	7740	8340	8090	8330	7890	7 / 7	0 / 7	9455.7	16100	50000	1	No
Antimony	1.6	1.6	8.3	8.1	2.1	1.1	2.2	7 / 7	0 / 7	3.6	8.3	20	2	No
Arsenic	**7.5**	**10.4**	**68.8**	**33.7**	**11.9**	**7.8**	**11.6**	**7 / 7**	**2 / 7**	**21.7**	**68.8**	**20**	**1**	**Yes**
Barium	233	172	190	223	179	138	175	7 / 7	0 / 7	187.1	233	10000	1	No
Beryllium	3.2	0.98	0.87	0.82	0.87	0.96	0.82	7 / 7	0 / 7	1.2	3.2	100	1	No
Cadmium	**4.4**	**5.2**	**32.3**	**16.8**	**6.6**	**3.6**	**7.2**	**7 / 7**	**2 / 7**	**10.9**	**32.3**	**10**	**1**	**Yes**
Calcium	98500	18100	24200	3650	3860	17600	3780	7 / 7	0 / 7	24241.4	98500	NA	5	No
Chromium	9.8	16.9	19.8	17	16.7	149	16.6	7 / 7	0 / 7	35.1	149	200	2	No
Cobalt	2.9	9.1	10.3	9.7	10.4	8.4	9.8	7 / 7	0 / 7	8.7	10.4	500	3	No
Copper	20.9	29	63.1	33.4	24.5	25.5	24.4	7 / 7	0 / 7	31.5	63.1	500	3	No
Iron	19500	24600	41700	24600	25400	20800	24000	7 / 7	0 / 7	25800.0	41700	55000	4	No
Lead	**40.7**	**147**	**157**	**211**	**122**	**612**	**125**	**7 / 7**	**1 / 7**	**202.1**	**612**	**400**	**6**	**Yes**
Magnesium	16700	2590	2990	1800	1940	4010	1850	7 / 7	0 / 7	4554.3	16700	NA	2	No
Manganese	951	655	1140	847	786	658	730	7 / 7	0 / 7	823.9	1140	3000	2	No
Mercury	0.084	0.093	0.22	0.99	0.13	0.057	0.15	7 / 7	0 / 7	0.2	0.99	23	4	No
Nickel	12.6	13.3	18.9	13	12.4	12.9	12.7	7 / 7	0 / 7	13.7	18.9	1000	2	No
Potassium	1080	1220	542	1430	1180	1320	1160	7 / 7	0 / 7	1133.1	1430	NA	5	No
Selenium	3.9	1.5	31	1.8	0.58	3.6	0.47	7 / 7	0 / 7	6.1	31	300	1	No
Silver	ND	ND	ND	ND	ND	ND	ND	0 / 7	0 / 7	NA	0	300	2	No
Sodium	384	141	58.7	61.4	68.4	116	57.2	7 / 7	0 / 7	126.7	384	NA	5	No
Thallium	ND	ND	ND	ND	ND	ND	ND	0 / 7	0 / 7	NA	0	5.1	4	No
Vanadium	9.9	21.8	17.7	19.6	21	17.9	20.6	7 / 7	0 / 7	18.4	21.8	200	3	No
Zinc	91.4	205	734	415	117	116	122	7 / 7	0 / 7	257.2	734	20000	1	No

NOTES:

ND - Not detected at a concentration greater than the Contract Required Detection Limit (CRDL).

NA - Not Applicable or available;

Background - West Virginia Voluntary Remediation and Redevelopment Act, Guidance Manual Version 2.1, Table 2-3: Natural Background Levels of Inorganic in Soil in West Virginia and Surrounding Areas.

1 - ATSDR Chronic Environmental Media Evaluation Guides(EMEG) for child;

2 - ATSDR Reference Dose Media Evaluation Guide (RMEG) for child;

3 - ATSDR Intermediate Environmental Media Evaluation Guides (Int. EMEG) for child;

4 - USEPA Region III Residential Soil Risk Based Concentration, for Residential Soil, September 2008;

5 - Essential Nutrient. Eliminated from consideration as COC.

6 - Memorandum: OSWER Directive: Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities. United States Environmental Protection Agency, August 1994. Office of Solid Waste and Emergency Response. Directive 9355.4-12.

Table 3. Semi-Volatile Organic Compounds Summary - Residential Surface Soil (9/7/2007, TRIAD)

Semi-Volatile Organic Compounds Analyte	Soil Samples Concentration (µg/kg)			Detection Frequency	Frequency above CVs	Arithmetic Average Concentration (µg/kg)	Maximum Detected Conc. (µg/kg)	Comparison Values (CVs) (µg/kg)		Contaminants of Concerns (COCs)?
	SS7	SS8	SS10							
Benzaldehyde	ND	ND	ND	0 / 3	0 / 3	NA	ND	NA		NO
Phenol	ND	ND	ND	0 / 3	0 / 3	NA	ND	NA		NO
Bis(2-chloroethyl)ether	ND	ND	ND	0 / 3	0 / 3	NA	ND	NA		NO
2-Chlorophenol	ND	ND	ND	0 / 3	0 / 3	NA	ND	NA		NO
2-Methylphenol	ND	ND	ND	0 / 3	0 / 3	NA	ND	NA		NO
2,2'-Oxybis(1-chloropropane)	ND	ND	ND	0 / 3	0 / 3	NA	ND	NA		NO
Acetophenone	ND	ND	ND	0 / 3	0 / 3	NA	ND	NA		NO
4-Methylphenol	ND	ND	ND	0 / 3	0 / 3	NA	ND	NA		NO
N-Nitroso-di-n-propylamine	ND	ND	ND	0 / 3	0 / 3	NA	ND	NA		NO
Hexachloroethane	ND	ND	ND	0 / 3	0 / 3	NA	ND	NA		NO
Nitrobenzene	ND	ND	ND	0 / 3	0 / 3	NA	ND	NA		NO
Isophorone	ND	ND	ND	0 / 3	0 / 3	NA	ND	NA		NO
2-Nitrophenol	ND	ND	ND	0 / 3	0 / 3	NA	ND	NA		NO
2,4-Dimethylphenol	ND	ND	ND	0 / 3	0 / 3	NA	ND	NA		NO
Bis(2-chloroethoxy)methane	ND	ND	ND	0 / 3	0 / 3	NA	ND	NA		NO
2,4-Dichlorophenol	ND	ND	ND	0 / 3	0 / 3	NA	ND	NA		NO
Naphthalene	100	ND	ND	1 / 3	0 / 3	NA	100	1,000,000	1	NO
4-Chloroaniline	ND	ND	ND	0 / 3	0 / 3	NA	ND	NA		NO
Hexachlorobutadiene	ND	ND	ND	0 / 3	0 / 3	NA	ND	NA		NO
Caprolactam	ND	ND	ND	0 / 3	0 / 3	NA	ND	NA		NO
4-Chloro-3-methylphenol	ND	ND	ND	0 / 3	0 / 3	NA	ND	NA		NO
2-Methylnaphthalene	140	120	120	3 / 3	0 / 3	126.67	140	2,000,000	2	NO
Hexachlorocyclopentadiene	ND	ND	ND	0 / 3	0 / 3	NA	ND	NA		NO
2,4,6-Trichlorophenol	ND	ND	ND	0 / 3	0 / 3	NA	ND	NA		NO

Table 3. Continued

Semi-Volatile Organic Compounds Analyte	Soil Samples Concentration (µg/kg)			Detection Frequency	Frequency Above CVs	Arithmetic Average Concentration (µg/kg)	Maximum Detected Conc. (µg/kg)	Comparison Values (CVs) (µg/kg)		Contaminants of Concerns (COCs)?
	SS7	SS8	SS10							
2,4,5-Trichlorophenol	ND	ND	ND	0 / 3	0 / 3	NA	ND	NA		NO
1,1'-Biphenyl	ND	ND	ND	0 / 3	0 / 3	NA	ND	NA		NO
2-Chloronaphthalene	ND	ND	ND	0 / 3	0 / 3	NA	ND	NA		NO
2-Nitroaniline	ND	ND	ND	0 / 3	0 / 3	NA	ND	NA		NO
Dimethylphthalate	ND	ND	ND	0 / 3	0 / 3	NA	ND	NA		NO
2,6-Dinitrotoluene	ND	ND	ND	0 / 3	0 / 3	NA	ND	NA		NO
Acenaphthylene	ND	120	ND	1 / 3	0 / 3	NA	120	3,800,000	6	NO
3-Nitroaniline	ND	ND	ND	0 / 3	0 / 3	NA	ND	NA		NO
Acenaphthene	ND	150	ND	1 / 3	0 / 3	NA	150	3.00E+07	3	NO
2,4-Dinitrophenol	ND	ND	ND	0 / 3	0 / 3	NA	ND	NA		NO
4-Nitrophenol	ND	ND	ND	0 / 3	0 / 3	NA	ND	NA		NO
Dibenzofuran	140	220	ND	2 / 3	2 / 3	NA	220	75,000	6	NO
2,4-Dinitrotoluene	ND	ND	ND	0 / 3	0 / 3	NA	ND	NA		NO
Diethylphthalate	ND	ND	ND	0 / 3	0 / 3	NA	ND	NA		NO
Fluorene	ND	290	ND	1 / 3	1 / 3	NA	290	2,000,000	1	NO
4-Chlorophenyl-phenylether	ND	ND	ND	0 / 3	0 / 3	NA	ND	NA		NO
4-Nitroaniline	ND	ND	ND	0 / 3	0 / 3	NA	ND	NA		NO
4,6-Dinitro-2-methylphenol	ND	ND	ND	0 / 3	0 / 3	NA	ND	NA		NO
N-Nitrosodiphenylamine	ND	ND	ND	0 / 3	0 / 3	NA	ND	NA		NO
1,2,4,5-Tetrachlorobenzene	ND	ND	ND	0 / 3	0 / 3	NA	ND	NA		NO
4-Bromophenyl-phenylether	ND	ND	ND	0 / 3	0 / 3	NA	ND	NA		NO
Hexachlorobenzene	ND	ND	ND	0 / 3	0 / 3	NA	ND	NA		NO
Atrazine	ND	ND	ND	0 / 3	0 / 3	NA	ND	NA		NO
Pentachlorophenol	ND	ND	ND	0 / 3	0 / 3	NA	ND	NA		NO
Phenanthrene	2,700	3,400	730	3 / 3	0 / 3	2,276.7	3400	22,000,000	6	NO
Anthracene	ND	770	ND	1 / 3	0 / 3	NA	770	20,000,000	1	NO
Carbazole	370	310	ND	2 / 3	0 / 3	NA	370	24,000	6	NO

Table 3. Continued

Semi-Volatile Organic Compounds Analyte	Soil Samples Concentration (µg/kg)			Detection Frequency	Frequency Above CVs	Arithmetic Average Concentration (µg/kg)	Maximum Detected Conc. (µg/kg)	Comparison Values (CVs) (µg/kg)		Contaminants of Concerns (COCs)?
	SS7	SS8	SS10							
Di-n-butylphthalate	100(B)	150(B)	ND	2 / 3	0 / 3	NA	150	5,000,000	1	NO
Fluoranthene	3,600	4,800	120	2 / 3	0 / 3	2,840.0	4,800	2,000,000	1	NO
Pyrene	3,500	5,600	1,300	3 / 3	0 / 3	3,466.7	5,600	2,000,000	1	NO
Butylbenzylphthalate	ND	ND	ND	0 / 3	0 / 3	NA	NA	NA		NO
3,3'-Dichlorobenzidine	ND	ND	ND	0 / 3	0 / 3	NA	NA	NA		NO
Benzo(a)anthracene	790	2,700	530	3 / 3	3 / 3	1,340.0	2,700	150	4	Yes
Chrysene	1,600	2,300	710	3 / 3	0 / 3	1,536.7	2,300	15,000	4	NO
Bis(2-ethylhexyl)phthalate	180	ND	300	2 / 3	0 / 3	NA	180	35,000	4	NO
Di-n-octylphthalate	ND	ND	ND	0 / 3	0 / 3	NA	NA	NA		NO
Benzo(b)fluoranthene	2,100	2,800	1,000	3 / 3	3 / 3	1,966.7	2,800	150	4	Yes
Benzo(k)fluoranthene	740	1,300	300	3 / 3	0 / 3	780.0	1,300	1,500	4	NO
Benzo(a)pyrene	1,100	2,100	540	3 / 3	3 / 3	1,246.7	2,100	100	5	YES
Indeno(1,2,3-cd)pyrene	820	1,200	390	3 / 3	3 / 3	803.3	1,200	150	4	Yes
Dibenzo(a,h)anthracene	ND	ND	ND	0 / 3	0 / 3	NA	NA	NA		NO
Benzo(g,h,i)perylene	630	880	320	3 / 3	3 / 3	610.0	880	100	5	Yes
2,3,4,6-Tetrachlorophenol	ND	ND	ND	0 / 3		NA	NA	NA		NO

NOTES:

ND - Not detected ; *NA - Not applicable*

1 - ATSDR's Child RMEG, Reference Media Evaluation Guides, Feb 12, 2008

2 - ATSDR's Child EMEG, Environmental Media Evaluation Guides, Feb 28, 2008

3 - ATSDR's int. child EMEG, Intermediate child Environmental Evaluation Guides

4 - USEPA's Reg III RBC, Region III Risk Based Concentrations for residential soil, September, 2008

5 - ATSDR's CREG, Cancer Reference Dose Evaluation Guides

6 - West Virginia Department of Environmental Protection, Supplemental Guidance, Polycyclic Aromatic Hydrocarbon (PAHs) Deminimis Standards, Revised draft, 12/2007

Table 4. Metals Summary - Non-Residential Soil (9/7/2008, TRIAD)

Analyte	Soil Samples Results (Concentration, mg/kg)														
	SS2	SS3	SS4	SS5	SS9	SS12	SS13	SS14	SS16 Duplicate	SS17	SS18	SS19	SS20 Duplicate	SS24	SS25
Aluminum	5,740	9,690	11,000	3,720	11,300	8,310	9,280	7,990	8,960	11,500	15,000	7,080	7,270	7,880	6,600
Antimony	**377**	**1.3**	**6.8**	**38.9**	**14.1**	**6.6**	**6.3**	**6.2**	**3.7**	**19.1**	**11.2**	**8.9**	**8.2**	**5.2**	**117**
Arsenic	**338**	**10.2**	**50.1**	**52.4**	**38.5**	**28**	**34.3**	**67.3**	**66.9**	**90.4**	**35.7**	**13.6**	**95.6**	**87.6**	**486**
Barium	663	177	360	135	330	197	171	209	128	819	262	310	176	220	1,390
Beryllium	0.44	1	1.5	0.37	1.6	0.85	0.88	0.78	1.3	2	2.8	0.81	0.63	0.67	0.044 (B)
Cadmium	397	2.1	56.5	35	43.9	11.9	16.5	33.3	20.2	217	56.7	12.4	27.9	24.7	709
Calcium	8,730	7,850	38,400	9,090	46,100	5,600	6,370	17,200	28,800	50,700	60,200	18,400	5,180	3,870	20,000
Chromium	**433**	**16.5**	**31.7**	**21.3**	**22.6**	**14.6**	**16.8**	**18.2**	**6**	**44.1**	**38.3**	**21**	**28.9**	**33.8**	**51.8**
Cobalt	21.8	13.6	8.5	4	7.7	9.9	10.4	8.9	3.3	10.3	6.1	8.3	8.4	9.7	23.5
Copper	**549**	**26.3**	**86.5**	**44.5**	**51.4**	**40.4**	**410**	**77.1**	**32.1**	**72.9**	**54.3**	**46.5**	**75.8**	**88.8**	**453**
Iron	**55,500**	**31,000**	**38,000**	**12,400**	**26,400**	**29,400**	**34,000**	**27,600**	**24,700**	**20,900**	**22,400**	**24,500**	**31,000**	**28,000**	**64,200**
Lead	**5,040**	**23.1**	**299**	**189**	**177**	**80.8**	**73.4**	**124**	**56.5**	**705**	**227**	**433**	**335**	**360**	**390**
Magnesium	1,660	3,290	7,920	1,580	6,520	1,880	2,900	3,860	4,830	9,250	14,500	3,680	2,470	2,010	7,160
Manganese	546	1,140	838	443	1,130	947	905	628	525	1,070	960	1,000	620	630	1,010
Mercury	1.6	0.049	0.22	7	0.12	0.25	0.13	0.088	0.077	0.33	0.094	0.21	0.36	0.29	15.7
Nickel	396	19.4	16.9	13.1	15.4	13.6	24.8	16.5	1.7	24.9	38.5	16.5	13.8	11.7	41.5
Potassium	375	1,600	1,310	379	912	1,420	1,070	1,020	522	1,690	848	787	847	960	2,620
Selenium	84.6	3.8	6.4	10.9	65.5	3.1	15.1	24.1	3	44.9	19	2.8	5.2	3.7	224
Silver	0.32	1.1	ND	ND	0.086	ND	ND	ND	ND	ND	ND	ND	ND	0.17	ND
Sodium	165	47.5	241	71.1	198	61.9	101	157	188	290	327	88	168	140	4,280
Thallium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium	25.3	21.5	19.4	6.6	13.5	18.2	19.8	17	8.6	14.9	9.5	16.5	17.1	17.7	31.8
Zinc	2,380	83	748	1,340	636	520	289	717	275	1,410	2,840	1,160	498	508	3,490

NOTES:

ND *- Not detected at a concentration greater than the Contract Required Detection Limit (CRDL);* ***B*** *- Not detected substantially above the level reported in Lab or field blanks;*

NA *- Not Applicable or available;*

1 *- ATSDR Chronic Environmental Media Evaluation Guides(EMEG) for Adult;* *2 - ATSDR Reference Dose Media Evaluation Guide (RMEG) for Adult*

3 *- ATSDR Intermediate Environmental Media Evaluation Guides (Int. EMEG) for Adult;*

4 *- USEPA Region III Residential Soil Risk Based Concentration for Industrial Soil, October 2007*

5 *- Region III Risk Based Concentration for Mercury Chloride for Industrial Soil, October, 2007*

6 - Essential Nutrient. Eliminated from consideration as COC.

7 *- Memorandum: OSWER Directive: Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities. United States Environmental Protection Agency, August 1994. Office of Solid Waste and Emergency Response. Directive 9355.4-12.*

Table 4. Continued

Analyte	Concentration (mg/kg)						Detection Frequency	Frequency Above CVs	Average Conc. (mg/kg)	Max. Detected Conc. (mg/Kg)	Comparison Values (CVs) (mg/kg)		Contaminants of Concerns
	SS26	SS27	SS28	SS29	SS30	SS31 Field Dup SS28							
Aluminum	3,950	4,680	8,840	5,170	5,340	12,100	21 / 21	0 / 21	8,172.7	15,000	50,000	1	No
Antimony	**7.6**	**14.5**	**7,390**	**33.5**	**6.6**	**11,100**	**21 / 21**	**6 / 21**	**913.5**	**11,100**	**300**	**2**	**Yes**
Arsenic	**184**	**119**	**89.8**	**87.4**	**27**	**165**	**21 / 21**	**2 / 21**	**103.1**	**486**	**200**	**1**	**Yes**
Barium	105	210	230	397	125	236	21 / 21	0 / 21	318.0	1,390	10,000	1	No
Beryllium	0.34	0.3	0.52	0.34	0.74	0.5	21 / 21	0 / 21	0.9	2.8	100	1	No
Cadmium	**18.2**	**60.5**	**83.8**	**86.6**	**18**	**251**	**21 / 21**	**2 / 21**	**103.9**	**709**	**100**	**1**	**Yes**
Calcium	25,600	30,300	13,900	10,700	13,900	17,900	21 / 21	0 / 21	20,010.0	60,200	NA	6	No
Chromium	**5.9**	**38.3**	**41.3**	**12.9**	**7.5**	**17.1**	**21 / 21**	**1 / 21**	**43.9**	**433**	**200**	**2**	**Yes**
Cobalt	2.5	6.9	5.7	5.4	15.4	6.8	21 / 21	0 / 21	9.5	23.5	500	3	No
Copper	**34.3**	**243**	**87.2**	**40.6**	**87.7**	**104**	**21 / 21**	**1 / 21**	**128.8**	**549**	**500**	**3**	**Yes**
Iron	**9,900**	**59,400**	**19,000**	**13,200**	**17,100**	**21,200**	**21 / 21**	**3 / 21**	**28,813.6**	**64,200**	**55,000**	**4**	**Yes**
Lead	**144**	**184**	**174**	**273**	**787**	**231**	**21 / 21**	**4 / 21**	**490.7**	**5,040**	**400**	**7**	**Yes**
Magnesium	2,100	3,080	3,240	3,540	625	4,820	21 / 21	0 / 21	4,206.6	14,500	NA	2	No
Manganese	408	479	3,320	296	78.4	455	21 / 21	0 / 21	835.6	3,320	3,000	2	No
Mercury	0.19	0.69	1.6	1.2	1.1	1.6	21 / 21	0 / 21	1.6	15.7	23	5	No
Nickel	6.3	28.9	15	11.9	12.1	13.8	21 / 21	0 / 21	34.8	396	1,000	2	No
Potassium	885	1,110	1,810	3,150	1,690	2,030	21 / 21	0 / 21	1,267.3	3,150	NA	6	No
Selenium	1.5	22.6	30.3	94.8	33.7	40.5	21 / 21	0 / 21	33.8	224	300	1	No
Silver	0.16	ND	3.4	0.28	0.88	0.052	21 / 21	0 / 21	0.7	3.4	300	2	No
Sodium	1,810	2,760	9,510	33,800	4,960	8,290	21 / 21	0 / 21	3,076.4	33,800	NA	6	No
Thallium	ND	ND	ND	ND	ND	ND	0 / 21	0 / 21	0.0	0	5.1	4	No
Vanadium	7.3	12	21.7	11.3	6.3	16.1	21 / 21	0 / 21	15.9	31.8	200	3	No
Zinc	177	788	892	407	141	899	21 / 21	0 / 21	921.5	3,490	20,000	1	No

NOTES:

ND - Not detected at a concentration greater than the Contract Required Detection Limit (CRDL); B - Not detected substantially above the level reported in Lab or field blanks; Detection Limit

NA - Not Applicable or available;

1 - ATSDR Chronic Environmental Media Evaluation Guides(EMEG) for Adult;

2 - ATSDR Reference Dose Media Evaluation Guide (RMEG) for Adult

3 - ATSDR Intermediate Environmental Media Evaluation Guides (Int. EMEG) for Adult;

4 - USEPA Region III Risk Based Concentration for Residential Soil, September 2008

5 - Region III Risk Based Concentration for Mercury, Inorganic Salt in Residential Soil, September, 2008

6 - Essential Nutrient. Eliminated from consideration as COC.

7 - Memorandum: OSWER Directive: Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities. United States Environmental Protection Agency, August 1994. Office of Solid Waste and Emergency Response. Directive 9355.4-12.

Table 5. Semi-Volatile Organic Compounds Summary – Non-Residential Surface Soil (9/7/2008, TRIAD)

Semi-Volatile Organic Compounds (SVOCs) Analyte	Sample Results (Concentration, mg/kg)								Detection Frequency	Frequency Above CVs	Max. Detected Conc. (µg/kg)	Comparison Values(CVs) (µg/kg)		Contaminates of Concerns (COCs)?
	SS2	SS3	SS4	SS5	SS9	SS13	SS14	SS16 Duplicate						
Benzaldehyde	ND	ND	ND	ND	ND	ND	ND	ND	0 / 8	0 / 8	ND	NA		No
Phenol	ND	ND	ND	ND	ND	ND	ND	ND	0 / 8	0 / 8	410	2,000,000	1	No
Bis(2-chloroethyl)ether	ND	ND	ND	ND	ND	ND	ND	ND	0 / 8	0 / 8	ND	NA		No
2-Chlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	0 / 8	0 / 8	ND	NA		No
2-Methylphenol	ND	ND	ND	ND	ND	ND	ND	ND	0 / 8	0 / 8	ND	NA		No
2,2'-Oxybis(1-chloropropane)	ND	ND	ND	ND	ND	ND	ND	ND	0 / 8	0 / 8	ND	NA		No
Acetophenone	ND	ND	ND	ND	ND	ND	ND	ND	0 / 8	0 / 8	ND	NA		No
4-Methylphenol	ND	ND	ND	ND	ND	ND	ND	ND	0 / 8	0 / 8	ND	NA		No
N-Nitroso-di-n-propylamine	ND	ND	ND	ND	ND	ND	ND	ND	0 / 8	0 / 8	ND	NA		No
Hexachloroethane	ND	ND	ND	ND	ND	ND	ND	ND	0 / 8	0 / 8	ND	NA		No
Nitrobenzene	ND	ND	ND	ND	ND	ND	ND	ND	0 / 8	0 / 8	ND	NA		No
Isophorone	ND	ND	ND	ND	ND	ND	ND	ND	0 / 8	0 / 8	ND	NA		No
2-Nitrophenol	ND	ND	ND	ND	ND	ND	ND	ND	0 / 8	0 / 8	ND	NA		No
2,4-Dimethylphenol	ND	ND	ND	ND	ND	ND	ND	ND	0 / 8	0 / 8	ND	NA		No
Bis(2-chloroethoxy)methane	ND	ND	ND	ND	ND	ND	ND	ND	0 / 8	0 / 8	ND	NA		No
2,4-Dichlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	0 / 8	0 / 8	ND	NA		No
Naphthalene	130	39	120	47	ND	130	200	500	7 / 8	0 / 8	500	1,000,000	1	No
4-Chloroaniline	ND	ND	ND	ND	ND	ND	ND	ND	0 / 8	0 / 8	ND	NA		No
Hexachlorobutadiene	ND	ND	ND	ND	ND	ND	ND	ND	0 / 8	0 / 8	ND	NA		No
Caprolactam	ND	ND	ND	ND	ND	ND	ND	ND	0 / 8	0 / 8	ND	NA		No
4-Chloro-3-methylphenol	ND	ND	ND	ND	ND	ND	ND	ND	0 / 8	0 / 8	ND	NA		No
2-Methylnaphthalene	230	63	180	74	130	190	280	740	8 / 8	0 / 8	740	2,000,000	2	No
Hexachlorocyclopentadiene	ND	ND	ND	ND	ND	ND	ND	ND	0 / 8	0 / 8	ND	NA		No
2,4,6-Trichlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	0 / 8	0 / 8	ND	NA		No
2,4,5-Trichlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	0 / 8	0 / 8	ND	NA		No
1,1'-Biphenyl	ND	ND	ND	ND	ND	ND	ND	96	1 / 8	0 / 8	96	3,000,000	1	No

Table 5. Continued

Semi-Volatile Organic Compounds Analyte	Sample Results (Concentration, mg/kg)								Detection Frequency	Frequency Above CVs	Max. Detected Concentration (µg/kg)	Comparison Values(CVs) (µg/kg)		Contaminates of Concerns (COCs)?
	SS2	SS3	SS4	SS5	SS9	SS13	SS14	SS16 Duplicate						
2-Chloronaphthalene	ND	ND	ND	ND	ND	ND	ND	ND	0 / 8	NA	ND	NA		No
2-Nitroaniline	ND	ND	ND	ND	ND	ND	ND	ND	0 / 8	NA	ND	NA		No
Dimethylphthalate	ND	ND	ND	ND	ND	ND	ND	ND	0 / 8	NA	ND	NA		No
2,6-Dinitrotoluene	ND	ND	ND	ND	ND	ND	ND	ND	0 / 8	NA	ND	NA		No
Acenaphthylene	ND	ND	ND	ND	ND	ND	110	500	2 / 8	NA	500	3,800,000	3	No
3-Nitroaniline	ND	ND	ND	ND	430	ND	ND	ND	1 / 8	NA	430	6100	1	No
Acenaphthene	ND	ND	ND	ND	ND	ND	ND	ND	0 / 8	NA	ND	NA		No
2,4-Dinitrophenol	ND	ND	ND	ND	1,500	ND	ND	ND	1 / 8	NA	1500	100,000	1	No
4-Nitrophenol	ND	ND	ND	ND	ND	ND	ND	ND	0 / 8	NA	ND	NA		No
Dibenzofuran	ND	21	ND	ND	ND	100	160	310	4 / 8	NA	310	75,000	3	No
2,4-Dinitrotoluene	ND	ND	ND	ND	ND	ND	ND	ND	0 / 8	NA	ND	NA		No
Diethylphthalate	ND	22	ND	ND	ND	ND	ND	ND	1 / 8	NA	22	40,000,000	1	No
Fluorene	ND	ND	ND	ND	ND	ND	140	ND	1 / 8	NA	140	2,000,000	1	No
4-Chlorophenyl-phenylether	ND	ND	ND	ND	ND	ND	ND	ND	0 / 8	NA	ND	NA		No
4-Nitroaniline	ND	ND	ND	ND	ND	ND	ND	ND	0 / 8	NA	ND	NA		No
4,6-Dinitro-2-methylphenol	ND	ND	ND	ND	ND	ND	ND	ND	0 / 8	NA	ND	NA		No
N-Nitrosodiphenylamine	ND	ND	ND	ND	ND	ND	ND	ND	0 / 8	NA	ND	NA		No
1,2,4,5-Tetrachlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	0 / 8	NA	ND	NA		No
4-Bromophenyl-phenylether	ND	ND	ND	ND	ND	ND	ND	ND	0 / 8	NA	ND	NA		No
Hexachlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	0 / 8	NA	ND	NA		No
Atrazine	ND	ND	ND	ND	ND	ND	ND	ND	0 / 8	NA	ND	NA		No
Pentachlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	0 / 8	NA	ND	NA		No
Phenanthrene	110	150	1,200	170	690	1,400	2,100	1,400	8 / 8	NA	2100	22,000,000	3	No
Anthracene	110	ND	130	ND	100	190	370	360	6 / 8	NA	370	20,000,000	1	No
Carbazole	170	ND	110	ND	ND	150	140	170	5 / 8	NA	170	24,000	3	No

Table 5. Continued

Semi-Volatile Organic Compounds Analyte	Sample Results (Concentration, mg/kg)								Detection Frequency	Frequency Above CVs	Max. Detected Conc. (µg/kg)	Comparison Values(CVs) (µg/kg)		Contaminates of Concerns (COCs)?
	SS2	SS3	SS4	SS5	SS9	SS13	SS14	SS16 Duplicate						
Di-n-butylphthalate	240(B)	140(B)	220(B)	94(B)	140(B)	ND	100(B)	150(B)	7 / 8	NA	75	5,000,000	1	No
Fluoranthene	ND	240	1,900	410	1,100	2,400	4,200	5,000	7 / 8	NA	5,000	2,000,000	1	No
Pyrene	180	280	2,100	340	1,400	2,800	4,000	9,100	8 / 8	NA	9,100	2,000,000	1	No
Butylbenzylphthalate	1500	ND	180	ND	520	ND	ND	ND	3 / 8	NA	1,500	10,000,000	1	No
3,3'-Dichlorobenzidine	ND	ND	ND	ND	ND	ND	ND	ND	0 / 8	NA	ND	NA		No
Benzo(a)anthracene	**ND**	**120**	**820**	**160**	**540**	**1,200**	**2,000**	**4,800**	**7 / 8**	**5 / 8**	**4,800**	**150**	**4**	**Yes**
Chrysene	130	140	980	240	570	1,300	2,300	5,800	8 / 8	NA	5,800	22,000	4	No
Bis(2-ethylhexyl)phthalate	380(B)	120(B)	120(B)	350(B)	450(B)	100(B)	86(B)	ND	7 / 8	NA	180	46,000	4	No
Di-n-octylphthalate	ND	ND	ND	ND	ND	ND	ND	ND	0 / 8	NA	ND	NA		No
Benzo(b)fluoranthene	110	180	1,400	340	810	1,600	3,100	9,800	8 / 8	NA	9,800	150	4	No
Benzo(k)fluoranthene	**ND**	**80**	**510**	**120**	**290**	**580**	**1,000**	**2,700**	**7 / 8**	**1 / 8**	**2,700**	**1,500**	**4**	**Yes**
Benzo(a)pyrene	**120**	**120**	**740**	**190**	**510**	**1,100**	**1,800**	**5,300**	**8 / 8**	**8 / 8**	**5,300**	**100**	**5**	**Yes**
Indeno(1,2,3-cd)pyrene	**ND**	**75**	**630**	**150**	**340**	**740**	**1,200**	**3,800**	**7 / 8**	**5 / 8**	**3,800**	**150**	**4**	**Yes**
Dibenzo(a,h)anthracene	ND	ND	ND	ND	ND	ND	ND	ND	0 / 8	NA	ND	NA		No
Benzo(g,h,i)perylene	**140**	**70**	**450**	**110**	**280**	**590**	**930**	**2,900**	**8 / 8**	**7 / 8**	**2,900**	**100**	**5**	**Yes**
2,3,4,6-Tetrachlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	0 / 8	NA	ND	NA		No

NOTES:

ND - Not Detected;

B - Not detected substantially above the level reported in lab or field blanks

NA - Not Applicable

1 - ATSDR's Child RMEG, Reference Dose Media Guides, Feb 12, 2008

2 - ATSDR's Child EMEG, Environmental Media Evaluation Guides, Feb 28, 2008

3 - West Virginia Department of Environmental Protection, Supplemental Guidance, Polycyclic Aromatic Hydrocarbon (PAHs) Deminimis Standards, Revised draft, 12/2007

4 - USEPA Region III RBCs for Residential Soil Risk Based Concentration, September 2008.

5 - ATSDR's CREG, Cancer Risk Evaluation Guides

Table 6. Metals Summary - On-Site Monitoring Wells **(October 2000 and June 2001)**

Analyte	Maximum Detected Conc. (µg/L)	Detection Frequency	Comparison Values(CVs) (µg/L)		Contaminants of Concerns (COCs)?
			Value	Sources	
Aluminum	1,270	12 / 12	10,000	ATSDR C. C. EMEG	No
Antimony	4.9	12 / 12	10	ATSDR Adult. RMEG	No
Arsenic	71.7	12 / 12	10	ATSDR Chronic Adult EMEG	Yes
Barium	77.3	12 / 12	6,000	ATSDR C. C. EMEG	No
Beryllium	0.56	12 / 12	20	ATSDR C.C. EMEG	No
Cadmium	1.8	12 / 12	2	ATSDR C. C. EMEG	No
Calcium	81,700	12 / 12	NA	NA	No
Chromium	2.1	12 / 12	20	ATSDR Child RMEG	No
Cobalt	10.8	12 / 12	100	ATSDR Child Int. EMEG	No
Copper	117	12 / 12	400	ATSDR Adult Int. EMEG	No
Iron	3,420	12 / 12	26,000	USEPA Reg III RBC	No
Lead	17.3	12 / 12	15	USEPA MCL	Yes
Magnesium	11,400	12 / 12	NA	NA	No
Manganese	502	12 / 12	2,000	ATSDR Adult RMEG	No
Mercury	0.1	12 / 12	11	USEPA Reg III RBC for Inorganic Salt	No
Nickel	10	12 / 12	200	ATSDR C. RMEG	No
Potassium	50,700	12 / 12	NA	NA	No
Selenium	4.9	12 / 12	50	ATSDR C. C. EMEG	No
Silver	1.5	12 / 12	50	ATSDR C. RMEG	No
Sodium	28,100	12 / 12	NA	NA	No
Thallium	5.6	12 / 12	2	USEPA MCL	Yes
Vanadium	1.2	12 / 12	30	ATSDR Child Int. EMEG	No
Zinc	129	12 / 12	3,000	ATSDR C. C. EMEG	No

Notes

ATSDR C. C. EMEG - *ATSDR Drinking Water Chronic Environmental Media Evaluation Guides (EMEG) for Children*

ATSDR C. RMEG - *ATSDR Drinking Water Reference Dose Media Evaluation Guides (RMEG) for Children*

ATSDR Child Int. EMEG - *ATSDR Drinking Water Intermediate Environmental Media Evaluation Guides for Children*

MCL - *Maximum Contamination Level for Drinking Water (EPA)*

USEPA Reg III RBC - *USEPA Regional III Risk Based Concentrations for tap water, September 2008*

Table 7. Metal Summary - Onsite Monitoring Wells (9/7/2007, TRIAD)

Analyte	Monitoring Wells Sample results (Concentration, µg/L)				Detection Frequency	Maximum Detected Conc. (µg/L)	Comparison Values (CVs) (µg/L)		Contaminant of Concern (COCs)?
	MW A (South)	MW B (West)	MW D	Dup of MW-A					
Aluminum	14	ND	9.8	ND	2 / 4	14	10,000	1	No
Antimony	ND	4.3	ND	ND	1 / 4	4.3	10	2	No
Arsenic	ND	ND	ND	ND	0 / 4	ND	3	1	No
Barium	44	52.8	45.9	42.1	4 / 4	52.8	6,000	1	No
Beryllium	ND	ND	ND	ND	0 / 4	ND	20	1	No
Cadmium	0.22	ND	ND	0.21	2 / 4	0.22	2	1	No
Calcium	61,100	60,600	60,500	59,400	4 / 4	61,100	NA	NA	No
Chromium	ND	ND	ND	ND	0 / 4	ND	20	3	No
Cobalt	ND	ND	ND	ND	0 / 4	ND	100	4	No
Copper	2.4	ND	1.8	1.6	3 / 4	2.4	100	4	No
Iron	8.8	ND	ND	ND	1 / 4	8.8	26,000	5	No
Lead	1.8	ND	1.9	2	3 / 4	2	15	6	No
Magnesium	7,570	7,890	8,080	7,410	4 / 4	8,080	NA	NA	No
Manganese	5.2	1.1	1.3	1.1	4 / 4	5.2	300	7	No
Mercury	ND	ND	ND	ND	0 / 4	ND	11(Salt)	5	No
Nickel	ND	ND	ND	ND	0 / 4	ND	200	3	No
Potassium	1,770	1,340	1,870	1,530	4 / 4	1,870	NA	NA	No
Selenium	5.3	ND	6	ND	2 / 4	6	50	1	No
Silver	ND	ND	ND	ND	0 / 4	ND	50	3	No
Sodium	15,900	16,000	21,200	14,900	4 / 4	21,200	NA	NA	No
Thallium	4.1	ND	ND	ND	1 / 4	4.1	2	6	Yes
Vanadium	ND	ND	ND	ND	0 / 4	ND	30	4	No
Zinc	66.4	31.5	11.9	26	4 / 4	66.4	3,000	1	No

Note

1 - ATSDR Drinking Water Chronic Environmental Media Evaluation Guides (EMEG) for Children

2 - ATSDR Drinking Water Reference Dose Media Evaluation Guides (RMEG) for adult

3 - ATSDR Drinking Water Reference Dose Media Evaluation Guides (RMEG) for Children

4 - ATSDR Drinking Water Intermediate Environmental Media Evaluation Guides (EMEGs) for Children

5 - USEPA Regional III Risk Based Concentrations (Reg III RBCs), September 2008

6 - EPA Maximum Contamination Level for Drinking Water (MCLs)

7 - Lifetime Health Advisory for Drinking Water (EPA)

Table 8. Metals Summary - Municipal Water Well (6/14/2001 and 9/7/2007 by TRIAD)

Analyte	Municipal Water Well Sample Results, Concentration µg/L						Detection Frequency	Max Detected Conc. (µg/L)	Comparison Values(CVs) (µg/L)		Contaminants of Concerns (COCs)?
	Leap St. Well Raw Sample, 6/14/2001	Leap St. Well Sample Filtered 6/14/2001	Untreated-Leap St. Well 9/7/2007	Untreated-Leap St. Well (duplicate) 9/7/2007	Untreated-Wetzel St. Well, 9/7/2007	Treated-Leap St. &Wetzel St. Wells, 9/7/2007					
Aluminum	89.5	54	ND	ND	ND	ND	2 / 6	89.5	10,000	1	No
Antimony	4.9	4.9	ND	ND	ND	ND	2 / 6	4.9	4	2	Yes
Arsenic	3.5	10.9	ND	ND	ND	ND	2 / 6	10.9	3	1	Yes
Barium	73.9	77.3	65.5	63.7	63.2	65	6 / 6	77.3	6,000	1	No
Beryllium	0.38	0.46	ND	ND	ND	ND	2 / 6	0.46	20	1	No
Cadmium	0.4	0.4	ND	ND	0.16	ND	3 / 6	0.4	2	1	No
Calcium	79,500	81,700	67,800	65,900	67,600	69,200	6 / 6	81,700	NA	NA	No
Chromium	1.8	0.74	ND	ND	ND	ND	2 / 6	1.8	20	2	No
Cobalt	0.7	0.7	ND	0.33	ND	ND	3 / 6	0.7	100	3	No
Copper	19.6	65.3	19.1	15.5	2.1	38	6 / 6	65.3	100	3	No
iron	194	21.6	35	25.6	ND	ND	4 / 6	194	26,000	4	No
Lead	5.9	9.3	3.9	4.3	2.6	2.4	6 / 6	9.3	15	5	No
Magnesium	11,100	11,400	8,750	8,540	10,100	9,640	6 / 6	11,400	NA	NA	No
Manganese	60	9	8.7	8.1	126	62.4	6 / 6	126	300	6	No
Mercury	0.1	0.1	ND	ND	ND	ND	2 / 6	0.1	11(Salt)	4	No
Nickel	2.7	1.6	ND	ND	ND	ND	2 / 6	2.7	200	2	No
Potassium	1,770	8,610	2,480	1,290	1,490	1,480	4 / 4	8610	NA	NA	No
Selenium	4.4	4.4	4.8	8.2	ND	ND	4 / 6	8.2	50	1	No
Silver	0.7	1	0.36	ND	ND	ND	3 / 6	1	50	2	No
Sodium	26,600	28,000	16,500	16,300	23,600	22,000	6 / 6	28,000	NA	NA	No
Thallium	5.6	5.6	ND	ND	3.4	3.2	4 / 6	5.6	0.5	6	Yes
Vanadium	0.9	1.2	ND	ND	0.21	ND	3 / 6	0.9	30	3	No
Zinc	37.8	30	14.7	13	9.1	13.1	6 / 6	37.8	3,000	1	No

Note

1 - ATSDR Drinking Water Chronic Environmental Media Evaluation Guides (EMEGs) for Children
2 - ATSDR Drinking Water Reference Dose Media Evaluation Guides (RMEGs) for Children
3 - ATSDR Drinking Water Intermediate Environmental Media Evaluation Guides (EMEGs)for Children
4 - USEPA Regional III Risk Based Concentrations (Reg III RBCs), September 2008
5 - EPA Maximum Contamination Level for Drinking Water (MCLs)
6 - Lifetime Health Advisory for Drinking Water (EPA)

Table 9. Exposure Pathways

Pathway Name	Exposure Pathway Elements: Sources of Contamination	Environmental Medium	Point of Exposure	Routes of Exposure	Potentially Exposed Population	Time Frame for Exposure
Completed Pathways						
Residential Surface Soil	Possibly former Dalzell Viking Glass Company	Soil	Residential lawn north and east of the site	Ingestion Skin contact	Residents live adjacent to the site	Past Current Future
Non-Residential Surface Soil	Former Dalzell Viking Glass Company	Soil	Onsite surface soil	Ingestion Skin contact	Residents live nearby the site	Past Current Future
Potable water	Unknown	Groundwater (No evidence of migration of onsite contaminants to off site)	Potable water in home	Ingestion Skin contact	Residents using tap water sourced from Leap Street Well	Past Current Future
Potential Pathways						
Inhaling air when the facility operated	Emissions from glass manufacture and other sources	Air (Winds carried emissions off-site locations)	Locations in the immediate vicinity of the facility	Inhalation	Residents who lived in the area prior to 1998	Past
Eliminated Pathways						
Onsite groundwater	Some natural occur and some from the Dalzell Viking Glass Company site	Groundwater	None. There is no evidence of people using onsite groundwater as potable water	None	None	None
Surface water	Onsite storm water run off	Surface Water (There is no evidence of onsite contaminants migrating to down stream location)	None. There is no evidence of people using surface water as potable water	None	None	None

Table 10. Assumptions for Estimation of Exposure Doses

Exposure Population	Soil Intake Rate	Water Intake Rate	Body Weight	Time Frame for Cancer Evaluation
Toddler (pica kids)	5, 000 mg/day (0.7 tsp/event)	1 Liter /day (4.2 cups/day)	10 kg (22 lbs.)	Single pica event for Acute Exposure
Preschool child (non-pica)	200 mg/day (0.02 tsp/day)	1 Liter /day (4.2 cups/day)	16 kg (35 lbs.)	6 years
Teenagers/Adolescents	150 mg/day (0.015 tsp/day)	1.5 Liter/day (6.3 cups/day)	55 kg (122 lbs)	15 years
Adult	100 mg/day (0.01 tsp/day)	2 Liter/day (8.4 cups/day)	70 kg (154 lbs.)	30 years

Notes:

Soil intake rates*: Pica kids, child and adult soil ingestion rates are based on EPA Exposure Factors Handbook, others are ATSDR or EPA recommended rates (central tendency) for children and adults (EPA Exposure Factors Handbook).*

The soil intake rates, as converted to teaspoons, are based on a soil bulk density of 1.5 g/cm^3 *and a volumetric conversion of 1 tsp = 4.93 cm*^{3}*.*

Table 11. Exposure Scenarios and Frequency

Exposure Population	Exposure Medium	Exposure Frequency	Outdoor Activity/Work Days per Year	Explanation/Exposure Scenarios
Residential Child 1 – 6 years old	Residential Surface Soil	260 days/year	280 days	Play outdoors 6.5 days a week for 40 weeks during a year. Play indoors during the 12 winter weeks.
	Nearby Abandoned Industrial Site	20 days/year		Trespassing 0.5 day per week for 40 weeks except 12 winter weeks.
Elementary, middle and high school child, 7-17 years old	Residential Surface Soil	109 days/year	150 days	Play outdoors 1.5 days a week for 26 school weeks, and 5 days a week for 14 off school weeks. No outdoors play for 12 winter weeks.
	Nearby Abandoned Industrial Site	41days/year		Trespassing 0.5 day per week for 26 school weeks, 2 days per week for 14 off school weeks, except 12 winter weeks.
Onsite Warehouse workers* (assumes workers are also nearby residents)	Residential Surface Soil	60 days/year	152 days	Outdoors yard work 1.5 days a week for 40 weeks except the 12 winter weeks.
	Onsite Surface Soil (Warehouse & Retail shop)	92 days/year		2 days/week for 40 weeks, and 1day/week for 12 winter weeks

Notes:
** - According to available information, Litman Excavating, Inc., has owned the site property since 2005, and used partial former "warehouse" as their storage. Bridgeport Equipment and Tool, Inc., use northern half of the former "warehouse" for storage. The former "retail shop" is used as a warehouse by an Auto Glass company.*

Table 12. Estimated Exposure Doses and Theoretical Cancer Risk - PAHs

Contaminants	Toxicity Equivalency Factor (TEF)	Maximum Detected Concentration (mg/kg)	Max Equivalents of B[a]P (mg/kg)	Estimated Acute Exposure Dose for Pica Kids (1-3 yrs)	Lifetime Exposure Dose (mg/kg/day)			
					Child (1-6 yrs)	Teen/ Adolescents (7-17 yrs)	Adult (18 years or older)	Lifetime Residences (cumulative)
Exposure to Residential Surface Soil								
Benzo(a)anthracene	0.1	2.7	0.27					
Benzo(a)pyrene(B[a]P)	1	2.1	2.1					
Benzo(b)fluoranthene	0.1	2.8	0.28					
Benzo(g,h,i)perylene	0.01	0.88	0.0088					
Indeno(1,2,3-cd)pyrene	0.1	1.2	0.12					
Total B[a]P Equivalent	NA	NA	2.78	0.0014	0.000002	0.0000005	0.0000003	0.000003
Exposure to Non-Residential Surface Soil								
Benzo(a)anthracene	0.1	4.8	0.48					
Benzo(a)pyrene	1	5.3	5.3					
Benzo(k)fluoranthene	0.1	2.7	0.27					
Benzo(g,h,i)perylene	0.01	2.9	0.029					
Indeno(1,2,3-cd)pyrene	0.1	3.8	3.8					
Total B[a]P Equivalent	NA	NA	9.88	NA	0.0000006	0.0000006	0.000002	0.000003
Estimated Theoretical Cancer Risk from Exposure to Both Sources								
					0.000020	0.000008	0.000013	0.000041

Note:

1. Estimated theoretical Cancer risk is calculated with cancer slope factor of 7.3 $(mg/kg/day)^{-1}$ for B(a)P

2. The exposure dose of the Pica Kids was estimated with one "pica" episode per week for 40 seasonal outdoor play weeks

3. The exposure dose of the lifetime residences was estimated with cumulative doses from child to adult

Table 13. Estimated Exposure Doses from All Sources – Arsenic

Contaminant	Exposure Medium	Exposure Concentration (mg/kg)	Estimated Exposure Dose(mg/kg/day)					MRL (mg/kg/day)	NOAEL (mg/kg/day)	LOAEL (mg/kg/day)
			Pica Child (1- 3 yrs)	Non-pica Child (1-6 yrs)	Teenagers/ Adolescents (7 -17 yrs)	Adult (18 and older)	Lifetime Residents (cumulative)			
Acute Exposure										
Arsenic	Residential Surface Soil	68.8	0.03	0.00086	0.00019	0.000098	NA	0.005	NA	0.05
	Non-Residential Surface Soil	486	NA	0.0061	0.00133	0.00069	NA	0.005	NA	0.05
	Potable Water	0.0035	0.00035	0.00002	0.00010	0.00010	NA	0.005	NA	0.05
	Soil + Water	NA	0.034	0.0061	0.0014	0.00079	NA	0.005	NA	0.05
Chronic Exposure										
Arsenic	Residential Surface Soil	21.7	NA	0.00019	0.000018	0.000005	0.00022	0.0003	0.0008	0.014
	Non-Residential Surface Soil	103.2	NA	0.00007	0.000032	0.000037	0.00014			
	Potable Water	0.0035	NA	0.00022	0.00010	0.00010	0.00041			
	Combination of three sources	NA	NA	0.00048	0.00014	0.00014	0.00077			

Notes:

NA - *Not Applicable or not available*

MRL - *Minimal Risk Level, Developed by ATSDR*

NOAEL - *No Observed Adverse Effect Level*

LOAEL - *Lowest Observed Adverse Effect Level*

Table 14. Estimated Theoretical Cancer Risk – Arsenic

Contaminant	Lifetime Exposure /Media	Arithmetic Mean Concentration (mg/kg)	Estimated Exposure Dose for Carcinogenic Effects (mg/kg/day)				Cancer Effect Level (CEL) (mg/kg/day)	
			Non-Pica Child (1-6 yrs)	Teenagers/ Adolescents (7-17 yrs)	Adult (18 and Older)	Lifetime Residents (cumulative)	Bladder, Lung and Liver Cancer	Skin Cancer
Arsenic	Residential soil	21.7	0.000017	0.000004	0.000002	0.000023	0.064 (chen et al. 1986)[11]	0.014 (Tseng et al. 1968)[11]
	Non-Residential	103.2	0.000006	0.000007	0.000010	0.000023		
	Drinking Water	0.0035	0.000019	0.000020	0.000043	0.000082		
	Total Lifetime Exposure Doses	NA	0.000041	0.000031	0.000055	0.00013		
Estimated Theoretical Cancer Risk[a]			0.00006	0.00005	0.00008	0.00019	NA	

Note:
a - Estimated Theoretical Cancer Risk is calculated using Arsenic cancer slope factor of 1.5/(mg/kg/day)

Table 15. Estimated Exposure Doses from All Sources – Cadmium

Contaminant	Exposure Medium	Exposure Concentration (mg/kg)	Estimated Exposure Dose (mg/kg/day)					MRL	NOAEL	LOAEL
			Pica Child (1-3 yrs)	Non-Pica Child (1-6 yrs)	Teenagers /Adolescents (7-17 yrs)	Adult	Lifetime Residents (cumulative)	mg/kg/day		
Acute Exposure										
Cadmium	Residential Surface Soil	32.3	0.0162	0.00040	0.000088	0.000046	NA	NA	NA	0.07[a]
	Non-Residential Surface Soil	709	NA	0.0089	0.0019	0.0010	NA			
Chronic Exposure										
Cadmium	Residential Surface Soil	10.9	NA	0.00010	0.0000089	0.0000026	0.00011	0.0002	0.0021	NA
	Non-Residential Surface Soil	103.9	NA	0.000071	0.000032	0.000037	0.00014	0.0002	0.0021	
	Total Chronic Exposure	NA	NA	0.00017	0.000041	0.000040	0.00025	0.0002	0.0021	

Notes:

NA - *Not Applicable or Not Available*

MRL - *Minimal Risk Level, Developed by ATSDR*

NOAEL - *No Observed Adverse Effect Level*

LOAEL - *Lowest Observed Adverse Effect Level*

a - *Nordberg et al. (1973) estimated that the dose to cause nausea and vomiting in people exposed to cadmium in food was 0.07 mg/kg*

Table 16. Estimated Exposure Doses from All Sources – Antimony

Contaminant	Exposure Medium	Exposure Concentrations (mg/kg) or (mg/L)	Estimated Exposure Doses (mg/kg/day)					RfD (mg/kg/day)	NOAEL (mg/kg/day)	LOAEL (mg/kg/day)
			Pica Child (1-3 yrs)	Non-Pica Child (1-6 yrs)	Teen/Adolescent (7-17 yrs)	Adult (18 and older)	Lifetime Residents (cumulative)			
Acute Exposure										
Antimony	Residential Surface Soil	8.3	0.00415	0.00010	0.000023	0.000012	NA	NA	NA	0.529 [a]
	Non-Residential Surface Soil	11,100	NA	NA	0.0303	0.0159	NA			
	Potable Water	0.0049	0.00049	0.0003	0.00013	0.0001	NA			
	Soil + Water	NA	0.0046	0.0004	0.030	0.016	NA			
Chronic Exposure										
Antimony	Residential Surface Soil	3.6	NA	0.00003	0.0000029	0.0000008	0.00004	0.0004	NA	0.35
	Non-Residential Surface Soil	913.5	NA	0.00063	0.00028	0.00033	0.0012	0.0004	NA	0.35
	Potable Water	0.00049	NA	0.000031	0.000013	0.000014	0.00006	0.0004	NA	0.35
	Combination of Three Sources	NA	NA	0.00069	0.00030	0.00034	0.0013	0.0004	NA	0.35

Notes:
RfD - *Reference Doses*
NA - *Not Applicable or Not Available*
MRL - *Minimal Risk Level, Developed by ATSDR*
NOAEL - *No Observed Adverse Effect Level*
LOAEL - *Lowest Observed Adverse Effect Level*
a - 0.529 mg/kg/day is the Lowest Observed Adverse Health Effect dose for Human Gastro system. The symptom is vomiting. The Reference is Dunn 1928

Table 17. Estimated Exposure Doses from All Sources - Iron

Contaminant	Exposure Medium	Exposure Concentration (mg/kg)	Exposure Dose (mg/kg/day) Teen/Adolescent (7-17 yrs)	RfD	NOAEL	LOAEL
				mg/kg/day		
Acute Exposure						
Iron	Residential Surface Soil	41,700	0.11	0.7	NA	1
	Non-Residential Surface Soil	64,200	0.18	0.7		
	Combined Acute	NA	0.29	0.7		
Chronic Exposure						
Iron	Residential Surface Soil	25,800	0.021	0.7	NA	1
	Non-Residential Surface Soil	29038.1	0.009	0.7		
	Combined Chronic	NA	0.030	0.7		

Notes:

RfD - *Reference Doses*

NA - *Not Applicable or Not Available*

NOAEL - *No Observed Adverse Effect Level*

LOAEL - *Lowest Observed Adverse Effect Level*

Table 18. Estimated Exposure Doses - Site Surface Soil Data (12/28/1999 and 2/23/2000)

Contaminant	Exposure Media	Exposure Concentration (mg/kg)	Exposure Doses (mg/kg/day) Teen/Adolescent (7-17 yrs)	Acute MRL	RfD or Chronic MRL	NOAEL	LOAEL
				mg/kg/day			
Acute Exposure							
Antimony	Non-Residential soil	948	0.0026	NA			0.529 [a] (Acute)
Arsenic		1,970	0.0054	0.005			0.05 (Acute)
Cadmium		1,920	0.0052	NA			0.07 [b] (Acute)
Selenium		2,560	0.0070	NA			
Thallium		8.1	0.00002	NA			
Chronic Exposure							
Antimony	Non-Residential soil	67	0.00003		0.0004		0.35
Arsenic		320	0.00012		0.0003	0.0008	0.014
Cadmium		103	0.00004		0.0002	0.0021	
Selenium		295	0.00011		0.005	0.015	0.023
Thallium		2.6	0.000001		0.00007 (RfD)		

Notes:

Acute MRL - *Minimal Risk Level for Short-Term (less than 14 days) Exposure*

Chronic MRL - *Minimal Risk Level for Long-Term (longer than one year) Exposure*

RfD – USEPA *Reference Doses*

NOAEL - *No Observed Adverse Health Effect*

LOAEL - *Lowest Observed Adverse Health Effect*

a - *0.529 mg/kg/day is the acute Lowest Observed Adverse Health Effect dose for Human Gastro system. The symptom is vomiting. The Reference is Dunn 1928*

b - *Nordberg et al. (1973) estimated that the acute exposure dose to cause nausea and vomiting in people exposed to cadmium in food was 0.07 mg/kg*

Table 19. Census 2000 Summary Files					
	United States	**West Virginia**	**Wetzel County ***	**Zip Code 26155 ***	**New Martinsville ***
% Pre-1960 Structures	35.0	40.7	44.9	38.2	40.5
Median Year Structure Built	1971	1969	1964	1967	1966
% Children 5 Years of Age and Younger in Total Population	6.8	5.6	5.7	5.8	5.6
% Children 17 Years and Younger in Total Population	25.7	22.2	23.8	23.2	22.9
% Children 5 Years and Younger in Poverty	18.2	27.0	29.4	35.1	41.7
% Children 17 Years and Younger in Poverty	16.6	24.3	27.1	27.6	29.4
% Total Population in Poverty	12.4	17.9	19.8	19.1	20.6

*Approximate area in square miles: Wetzel County = 361; Zip Code 26155 = 108; New Martinsville = 2

Appendix B. Glossary of Terms

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)
ATSDR	Agency for Toxic Substances and Disease Registry
ASTs	Above Ground Storage Tanks
bgs	Below Ground Surface
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
Cancer risk	A theoretical risk for getting cancer if exposed to a substances every day for 70 years (a lifetime exposure).
CELs	Cancer Effects Levels
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
Chronic	Occurring over a long time
Chronic Exposure	Contact with a substance that occurs over a long time (more than 1 year)
COCs	Contaminants of Concern
CVs	Comparison Values
EBLL	Elevated Blood Lead level
ERRS	Emergency Rapid Response Services
EMEG	Environmental Media Evaluation Guide
EPA	U.S. Environmental Protection Agency
HAZCAT	Hazard Categorization
IDW	Investigative Derived Waste
IEUBK	Integrated Exposure Uptake Biokinetic Model
Intermediate Exposure	Exposure Duration of 14 – 365 days
LOAEL	Lowest Observed Adverse Effect Level
MCL	Maximum Contaminant Level
MWs	Monitoring Wells
MRL	Minimal Risk Level
NCR	Nuclear Regulatory Commission
NOAEL	No Observed Adverse Effect level
OSC	On-Scene-Coordinator
OWM	Office of Waste Management
PAHs	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyl
PHA	Public Health Assessment
PI	Pre-closure Inspection
Pica	A craving to eat nonfood items, such as dirt, paint chips, and clay. Some children exhibit pica-related behavior
ppb	Parts per billion, microgram/liter (µg/L) or microgram/kilogram (µg/kg)
ppm	Parts per million, milligram/liter (mg/L) or milligram/kilogram (mg/kg)
RBCs	Risk Based Concentrations
RfD	Reference Doses
SATA	Site Assessment and Technical Assistance

SVOC	Semi-Volatile Organic Compounds
START	Superfund Technical Assessment and Response Team
TAL	Target Analyte List
TCE	Trichloroethylene
TEF	Toxicity Equivalent Factor
USTs	Underground Storage Tanks
VOCs	Volatile Organic Compounds