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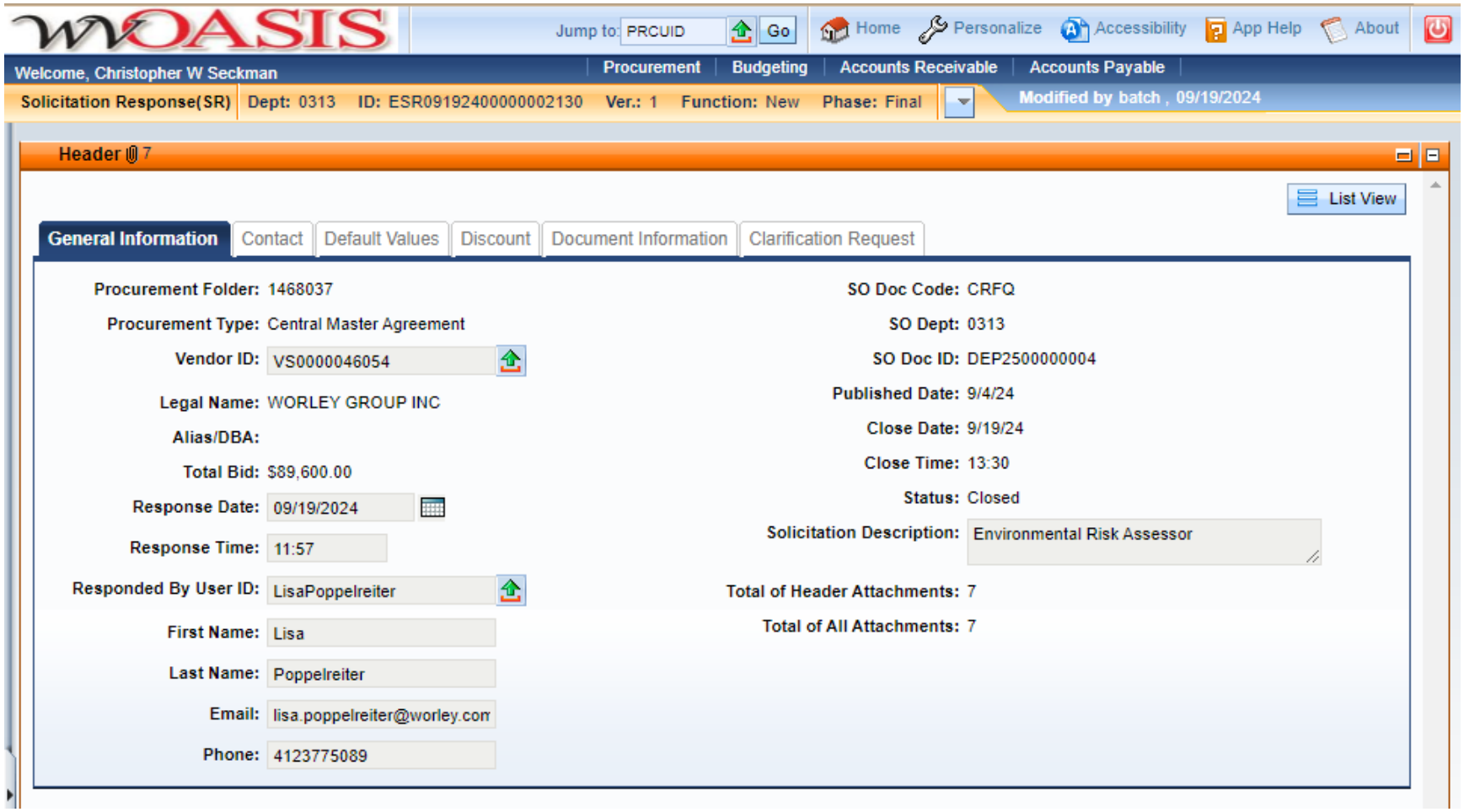
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Solicitation Response(SR) Dept: 0313 ID: ESR09192400000002130 Ver.: 1 Function: New Phase: Final
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General Information
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Document Information
Clarification Request
Procurement Folder: 1468037
Procurement Type: Central Master Agreement
Vendor ID: VS0000046054
Legal Name: WORLEY GROUP INC
Alias/DBA:
Total Bid: $89,600.00
Response Date: 09/19/2024
Response Time: 11:57
Responded By User ID: LisaPoppelreiter
First Name: Lisa
Last Name: Poppelreiter
Email: lisa.poppelreiter@worley.com
Phone: 4123775089
SO Doc Code: CRFQ
SO Dept: 0313
SO Doc ID: DEP2500000004
Published Date: 9/4/24
Close Date: 9/19/24
Close Time: 13:30
Status: Closed
Solicitation Description: Environmental Risk Assessor
Total of Header Attachments: 7
Total of All Attachments: 7

Department of Administration
Purchasing Division
2019 Washington Street East
Post Office Box 50130
Charleston, WV 25305-0130

State of West Virginia
Solicitation Response

Proc Folder:	1468037
Solicitation Description:	Environmental Risk Assessor
Proc Type:	Central Master Agreement

Solicitation Closes	Solicitation Response	Version
2024-09-19 13:30	SR 0313 ESR09192400000002130	1

VENDOR

VS0000046054
WORLEY GROUP INC

Solicitation Number: CRFQ 0313 DEP2500000004

Total Bid: 89600 **Response Date:** 2024-09-19 **Response Time:** 11:57:09

Comments:

FOR INFORMATION CONTACT THE BUYER
Joseph E Hager III
(304) 558-2306
joseph.e.hageriii@wv.gov

Vendor
Signature X **FEIN#** **DATE**

All offers subject to all terms and conditions contained in this solicitation

Line	Comm Ln Desc	Qty	Unit Issue	Unit Price	Ln Total Or Contract Amount
1	Risk or hazard assessment	700.00000	HOUR	128.000000	89600.00

Comm Code	Manufacturer	Specification	Model #
77101501			

Commodity Line Comments: 700 hours x $128/hr = $89,600

Extended Description:

Environmental Risk Assessor Open end contract for service, bid sheet represents an estimated number of hours for bidding purposes to establish a contracted set price per hour.

Worley Group, Inc.
One Meridian Boulevard, Suite 2C02
Wyomissing PA 19610
USA

Telephone: +1 610 855 2000

worley.com

19 September 2024

Ref: 418160-56526

Joseph E. Hager III
West Virginia Department of Environmental Protection
2019 Washington Street, East
Charleston, WV 25305

Attention: Joseph Hager

Dear Mr. Hager,

SOLICITATION NO. CRFQ 0313 DEP2500000004 – ENVIRONMENTAL RISK ASSESSOR

Worley Group, Inc. (Worley) is proud to respond to the above referenced centralized request for quote (CRFQ) and to present our qualifications to the State of West Virginia, West Virginia Department of Environmental Protection (WVDEP).

Our distinguished track record in executing more than 1,000 human health and ecological risk assessment (HHERA) reports, and third-party reviews of risk assessment reports, uniquely qualify our company to provide risk assessment services to the WVDEP. Worley employee, Ms. Lisa Poppelreiter, has assisted the WVDEP in previous years completing reviews of HHERA reports submitted to WVDEP and provided technical comments regarding adherence to WVDEP regulations and guidance. Lisa has also assisted WVDEP with updating technical spreadsheets that were utilized to derive the WVDEP *De Minimis* standards. Furthermore, she has routinely attended the annual West Virginia Brownfields Conference and has conducted several presentations on technical topics as part of the Licensed Remediation Specialist (LRS) training seminar at the conference.

Another key employee at Worley is Dr. Tiona Todoruk. Tiona has more than 20 years in the execution, oversight, and review of risk assessment reports in the U.S., Canada, and internationally. She has provided third party review of HHERA reports in support of cost recovery, gap analysis, and regulatory compliance across a range of U.S. jurisdictions. She has participated in the development of several regulatory guidance documents pertaining to HHERA and is the technical director of Worley's risk assessment practice.

The attached bid contains the following items per the instructions provided by the State of West Virginia Solicitation No. CRFQ 0313 DEP2500000004:

- Signed CRFQ including proposed unit rate and acknowledgement of applicable addenda;
- Curriculum vitae (CV) for key Worley employees, including Lisa Poppelreiter and Tiona Todoruk, as well as CV for other supporting Worley employees; and,
- Example HHERA report prepared by Worley.

Worley looks forward to serving the WVDEP on this important opportunity. Please don't hesitate to contact me at 412-377-5089 if you have any questions or concerns regarding this bid or any other information contained herein.

Sincerely,

Lisa Poppelreiter
Associate Technical Consultant/Environmental Scientist

Decommissioning & Restoration
Worley Consulting

Human Health and Ecological Risk Assessment Report – Revised June 2024

Former Hinton Ice House

508 Commercial Avenue
Hinton, Summers County, West Virginia
Voluntary Remediation Project #21037

PREPARED FOR GREENBRIER ENVIRONEMNTAL GROUP, INC.

Document no. Rev 1: 218160-53377

August 9 2024

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Disclaimer

The information presented in this document was compiled and interpreted exclusively for the purposes stated in this document. Worley Group, Inc. (Worley) provided this report for Greenbrier Environmental Group, Inc. solely for the purpose noted above.

Worley has exercised reasonable skill, care, and diligence to assess the information acquired during the preparation of this report, but makes no guarantees or warranties as to the accuracy or completeness of this information. The information contained in this report is based upon, and limited by, the circumstances and conditions acknowledged herein, and upon information available at the time of its preparation. The information provided by others is believed to be accurate but cannot be guaranteed.

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Any questions concerning the information or its interpretation should be directed to L. Poppelreiter or T. Todoruk.

August 9 2024

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PROJECT 218160-53377 - 00: REP-0001 – Human Health and Ecological Risk Assessment					
Rev	**Description**	**Originator**	**Reviewer**	**Worley Approver**	**Revision Date**
Rev 0	Issued as Final	G. Marquez	L. Poppelreiter	T. Todoruk	01-May-24
Rev 1	Revised Final	G. Marquez	L. Poppelreiter	T. Todoruk	09-Aug-24

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Table of Contents

List of Tables

List of Figures

List of Appendices

Executive Summary

This document presents the human health and ecological risk assessment for the Former Hinton Ice House (Site) in Hinton, Summers County, West Virginia. The risk assessment was completed following the West Virginia Department of Environmental Protection (WVDEP) rules, regulations, and guidelines outlined in the Title 60 Code of State Regulations, Series 3 Voluntary Remediation and Redevelopment Rule (referred to as the "Rule" in this report) (WVDEP 2021) and the West Virginia Voluntary Remediation Program (WV VRP) Guidance Manual (WVDEP 2023a).

Currently the Site is unoccupied but was previously used for industrial and commercial purposes as a cold storage location and grocery and ice plant. In the future, the planned land use for the Site will be part commercial and part recreational. One future proposed use of the Site is as an amphitheatre.

Soil analytical data were screened against the WVDEP industrial soil and residential soil *de minimis* standards. Analytical results for metals were also compared to WVDEP background soil standards. Synthetic precipitation leaching procedure (SPLP) analytical data collected from surface and subsurface soil samples were screened against the WVDEP groundwater *de minimis* standards. In accordance with WVDEP guidance, at least ten percent of the analytical data utilized in the risk assessment has been validated in accordance with standard EPA protocols.

Based on the screened analytical data, constituents of concern (COCs) were selected. There were 11 direct contact COCs retained in surface and/or subsurface soil that exceeded residential standards. These included polycyclic aromatic hydrocarbons (PAHs), metals, and aroclor-1254. Three direct contact COCs were retained in surface soil that exceeded industrial standards (i.e. benzo[a]pyrene, arsenic, and lead). There were no direct contact COCs retained from SPLP samples.

Migration routes were retained based on the detection of constituents in a specific environmental medium and the potential for those constituents to migrate within the medium or to other environmental media. The retained migration routes for on-Site surface and subsurface soil included volatilization of constituents to outdoor/trench air and indoor air, particulate emission of constituents to outdoor/trench air, and leaching from surface/subsurface soil to groundwater.

Based on the current use and anticipated future use of the Site, expected receptors were evaluated. Potential exposure pathways were evaluated for each expected receptor. Those exposure pathways that were determined to be a complete exposure pathway were retained for the quantitative risk assessment, except for those exposure pathways that will be made incomplete by means of an institutional/engineering control in a land use covenant (LUC). The receptors and exposure pathways retained for the quantitative risk assessment are:

- On-Site Maintenance Worker - Incidental ingestion of soil, dermal contact with soil, and inhalation of particulates from soil (without intrusive activities).
- On-Site Outdoor Worker – Incidental ingestion of soil, dermal contact with soil, and inhalation of particulates from soil (without intrusive activities).

- On-Site Construction/Utility Worker – Incidental ingestion of soil, dermal contact with soil, and inhalation of particulates from soil (during intrusive activities).
- On-Site Recreational User – Incidental ingestion of soil, dermal contact with soil, and inhalation of volatiles and particulates from soil (without intrusive activities).
- Trespasser – Incidental ingestion of soil, dermal contact with soil, and inhalation of particulates from soil (without intrusive activities).

The Site will be restricted to commercial/industrial use and recreational use; therefore, residential receptors were not evaluated in this risk assessment.

An ecological screening was completed for the Site. The "Checklist to Determine the Applicable Remediation Standards, Part 1: Ecological Standards", provided in the WV VRP Guidance Manual (WVDEP 2023a), was used in the ecological screening process. The checklist follows the ecological *de minimis* screening evaluation outlined in Section 60-3-9.5 of the Rule (WVDEP 2021). The ecological checklist indicated "no further ecological evaluation is required" for the Site. An evaluation of Site conditions concluded that it is unlikely that the Site would serve as a suitable habitat for terrestrial species.

Exposure point concentrations (EPCs) were derived for the applicable retained COCs in soil. The source concentrations for soil were 95% upper confidence limits (UCLs) of the mean concentrations derived using data from on-Site surface soil samples collected 0-2 feet below ground surface (ft bgs). For COCs with an insufficient number of detections to calculate a UCL, maximum concentrations were utilized as the source concentrations (i.e. aroclor 1254). The arithmetic mean of surface soil concentrations was derived for lead.

In accordance with the WVDEP VRP Guidance Manual (WVDEP 2023a), the Risk Assessment Information System (RAIS) website (http://rais.ornl.gov) was generally utilized to obtain chemical properties where available. Where RAIS did not contain chemical properties for COCs, alternative sources such as USEPA were consulted. Toxicity reference values were compiled following the hierarchy of sources presented in Section 60-3-8.1.c.1 in the Rule (WVDEP 2021).

Receptor-specific exposure assumptions were selected using WVDEP recommended values, when available. Otherwise, alternative sources were used, such as recommended values from other state program guidance or USEPA guidance; or professional judgment based on Site-specific information. The estimated total carcinogenic risks and noncarcinogenic hazard indices (HI) for the on-Site construction worker (total risk of 1E-6 and total HI of 0.2) are below the WVDEP industrial benchmark values of 1E-5 and 1, respectively. The total risk of 2E-5 for the on-Site maintenance worker exceeds the industrial risk benchmark of 1E-5; however, the total HI (0.2) is below the benchmark of 1. The total risk of 8E-5 for the on-Site outdoor worker exceeds the industrial risk benchmark of 1E-5; however, the total HI (0.5) is below the benchmark of 1. The total risk (1E-4) and total HI (2) for the on-Site recreational user are above the WVDEP residential benchmark values of 1E-6 and 1, respectively. For the trespasser, the total risk (9E-6) exceeds the residential risk benchmark of 1E-6; however, the total HI (0.1) is below the benchmark of 1.

A cleanup level for lead was also derived for the on-Site recreational user based on USEPA guidance. The calculated cleanup level was 255 mg/kg. The arithmetic mean for lead using surface soil samples is 650.8 mg/kg, which exceeds the cleanup level. This arithmetic mean also exceeds the industrial soil standard for lead utilized in this HHERA (247 mg/kg).

The source concentrations derived for COCs in surface soil were skewed high due to observed concentrations in surface soil sample SS-04 (0-0.5'), which had concentrations at least an order of magnitude greater than other surface soil samples collected. An alternative risk analysis was completed to determine if further mitigation measures would still be required after SS-04 (0-0.5') was mitigated. Based on this alternative risk analysis, the risk for the on-Site recreational user (total risk of 1E-5) will still require abatement via remedial measures or pathway elimination after surface soil sample SS-04 (0-0.5') has been mitigated. In addition, the alternative arithmetic mean concentration for lead (391.8 mg/kg) exceeds the calculated cleanup level for the recreational user and the industrial soil standard utilized in this report. A cap will be placed on the property and a Land Use Covenant (LUC) restriction will be established requiring excavation workers to follow a Health and Safety Plan (HASP) during intrusive activities beneath the cap.

During the risk assessment process, uncertainty and variability are inherent in the estimation of risks based on specific variables, such as screening of analytical data, selection of COCs, receptors and exposure pathways analysis, derivation of EPCs, selection of exposure parameters, and selection of toxicological values. This risk assessment employed multiple conservative assumptions, which, when combined, produce an additive conservative effect throughout the process, resulting in an overestimation of the potential risk.

1. Introduction

At the request of Greenbrier Environmental Group (GEG), Worley Group Inc. operating as Worley Consulting (Worley) has prepared the human health and ecological risk assessment report (HHERA) for the Former Hinton Ice House (the Site). The Site is owned by New River Gorge Regional Development Authority (NRGDA) and is currently under the West Virginia Voluntary Remediation and Redevelopment Program (VRP #21037) to address environmental conditions resulting from the previous operations at the Site. Currently the Site is unoccupied but was previously used for industrial and commercial purposes as a cold storage location and grocery and ice plant. In the future, the planned land use for the Site will be part commercial and part recreational. One future proposed use of the Site is as an amphitheatre.

The risk assessment was completed following the West Virginia Department of Environmental Protection (WVDEP) rules, regulations, and guidelines outlined in the Title 60 Code of State Regulations (CSR), Series 3 Voluntary Remediation and Redevelopment Rule (i.e. the Rule) (WVDEP 2021) and the West Virginia Voluntary Remediation Program (VRP) Guidance Manual (WVDEP 2023a).

The purpose of this HHERA is to evaluate the potential risks to human health and the environmental from exposure to Site-related constituents. The HHERA was prepared based on the characterization results presented in the January 2024 Site Assessment Report (SAR; GEG 2024).

1.1 Site History and Current Site Conditions

Information regarding the Site history and current Site conditions was obtained from the SAR (GEG 2024). The Site is located at 508 Commercial Avenue in Hinton, Summers County, West Virginia. The Site is located on four parcels, encompassing approximately 0.437 acres of land (Parcel ID #45-04-003A-0017-0000, 45-04-003A-0018-0000, 45-04-003A-0019-0000, and 45-04-003A-0020-0000). The approximate Global Positioning System (GPS) coordinates for the center of the Site are 37.676911° North Latitude and -80.887903° West Longitude. The Site location is shown on **Figure 1** (GEG 2024).

The Site was formerly developed with several dwellings, until circa 1905 when a wholesale hardware store was developed on the southeastern corner of the property. A coal shed was also erected on the southwestern corner of the property in approximately 1910.

Previous assessments identified the following recognized environmental conditions (RECs) in connection with the property:

- Piles at the Site were thought to be road cinders for weather control; however, this had not been confirmed.
- While the areas around or near the fence line were covered in vegetation, the central portion of the Site showed little to no signs of vegetation growth. It was unknown if the vegetation was missing due to frequent traffic at the Site, herbicide use or some other unknown cause.

- Dark soil staining was present near a pile of crushed/damaged drums along the northern wall of the building.
- Discarded upright beverage coolers (labeled "Snapple®") and propane-like tanks were present during the Site visit.
- The property operated as a cold storage location and grocery, as well as an ice plant. It was unknown if any leaks of any coolant have occurred from these activities. It was also unknown what type of coolant was used by these businesses for the coolers, ice makers, and refrigeration units.
- The retaining wall along the north and east of the Site was built with old railroad ties, which may have been treated with creosote. Some of these ties have broken or deteriorated.

The Site is currently developed with a three-story commercial structure formerly operated as the Hinton Ice House. The existing building is slab-on-grade. The Site is currently unpaved, covered by grass and gravel. The Site had been used for equipment storage by the City of Hinton but is currently unused and unoccupied. A Site map is shown on **Figure 2** (GEG 2024).

1.2 Surrounding Land Use and Utilities

The Site is bounded by various commercial structures/properties as described below.

- To the north the Site is bounded by Front Street with a CSX Transportation owned and operated railyard beyond Front Street.
- To the south, the Site is bounded by Commercial Avenue followed by a converted railroad depot and vacant commercial structure known as the Hinton Hardwoods Building.
- To the east, the Site is bounded by 6th Avenue followed by undeveloped/wooded property owned by CSX Transportation which previously served as a portion of the railyard.
- To the west, the Site is bounded by vacant commercial structures followed by 5th Avenue. Additionally, a basketball court and water park owned and operated by the City of Hinton is located west of the Site beyond 5th Avenue.

There are residential properties located further south, southeast, and southwest of the Site.

As shown on **Figure 2** (GEG 2024), there are underground utility lines surrounding the Site. These include water, gas, and sanitary sewer lines. A drain line extends from the existing building to the northwest across Front Street. The utility lines are approximately 3 ft bgs.

2. Analytical Results and Screening

This section presents the screened analytical results for surface soil and subsurface soil (**Tables 2-1A through 2-1L**) and SPLP results (**Tables 2-2A through 2-2E**). **Table 2-3** presents a summary of the analytical sample locations and identifies which samples were retained for use in the risk assessment.

2.1 Analytical Data

2.1.1 Soil

The locations of the surface soil and subsurface soil samples are presented on **Figures 3 and 4** (GEG 2024), respectively. **Tables 2-1A through 2-1L** present surface and subsurface soil analytical results for polychlorinated biphenyls (PCBs), metals, herbicides, volatile organic compounds (VOCs), PAHs, and semi-volatile organic compounds (SVOCs), respectively. The analytical data presented in these tables are compared to the West Virginia *de minimis* standards for residential and industrial soil (WVDEP 2023b) with the exception of the lead screening values.

The United States Environmental Protection Agency (USEPA) recently updated the residential soil regional screening levels (RSLs) for lead in May 2024 (USEPA 2024a). The USEPA recommends a residential soil RSL of 200 mg/kg for Sites with one source of lead and a residential soil RSL of 100 mg/kg for Sites with multiple sources of lead (e.g. lead-based paint, lead water pipes, etc.). The WVDEP is proposing to adopt these USEPA residential lead soil screening values in the next update to the *de minimis* standards (WVDEP 2024). In accordance with USEPA, three secondary sources of lead were considered: ambient air, lead in drinking water, and lead-based paint. According to the National Ambient Air Quality Standards (NAAQS), the Site is located in a region that is in attainment for lead air quality. It is unknown if lead pipes are used in the public water distribution system or in residential homes that utilize the public water supply. According to the USEPA lead paint index search tool (EJScreen Tool), the Site is located in an area that is in the 80-90th percentile category. Based on this analysis, the USEPA residential soil screening level of 100 mg/kg was used for comparison to lead analytical results in soil.

The WVDEP is proposing to update the industrial soil *de minimis* standard from 800 mg/kg to 426 mg/kg (WVDEP 2024). The value of 426 mg/kg is based on using WVDEP default exposure assumptions for an outdoor worker in the USEPA Adult Lead Model (ALM). This value is based on a target blood lead level of 5 µg/dL, which assumes a single source of lead. However, in this risk assessment, the ALM was used to derive a preliminary remediation goal (PRG) that is protective of an outdoor worker exposed to multiple sources of lead. This model is included in **Appendix A**. Default WVDEP assumptions for an outdoor worker were used in the ALM. The

target blood lead level was changed from 5 µg/dL to 3.5 µg/dL to be protective of multiple sources of lead. The resulting PRG is 247 mg/kg. This value was selected to screen lead soil analytical results to evaluate nonresidential receptors.

In addition, metals were compared to West Virginia background concentrations for soil. In accordance with the VRP Guidance Manual, a comparison to West Virginia migration to groundwater standards was not made as SPLP analytical results from select soil samples were used to evaluate migration to groundwater.

In accordance with Section 4.4.1 of the WV VRP Guidance Manual (WVDEP 2023a), although the Site is currently commercial/industrial land use and future residential land use will be restricted, the soil data were screened against WVDEP residential soil *de minimis* standards to support the need for a land use covenant.

In general, soil samples were collected from surface soil (0-2 ft bgs) and subsurface soil (2-15 ft bgs) from the unsaturated zone. No saturated samples were collected as a saturated zone (groundwater) was not encountered. **Table 2-3** presents a summary of the soil sample locations and indicates if the sample is retained or not retained for use in the risk assessment. In general, soil samples collected (including the field duplicates) were utilized in the risk assessment. In accordance with West Virginia guidance (WVDEP 2023a), the analytical results of the original and duplicate soil samples were compared, and the more conservative analytical results per constituent was utilized for risk assessment purposes.

2.1.2 Synthetic Precipitation Leaching Procedure (SPLP)

Groundwater was not encountered during Site investigation activities. Therefore, no groundwater monitoring wells were installed and no groundwater samples were collected. However, surface and subsurface soil samples were retained for SPLP analysis.

Tables 2-2A through 2-2E present the SPLP analytical results for VOCs, PAHs, dissolved metals, herbicides and PCBs, respectively. The SPLP analytical data were screened against the WVDEP *de minimis* groundwater standards (WVDEP 2023b).

Table 2-3 presents a summary of the SPLP sample locations and indicates if the samples are retained or not retained for this risk assessment. As indicated in **Table 2-3**, all SPLP samples were retained for use in this risk assessment (including the field duplicates). In accordance with West Virginia guidance (WVDEP 2023a), the analytical results of the original and duplicate SPLP samples were compared, and the more conservative analytical result per constituent was utilized for risk assessment purposes.

2.2 Data Validation

Analytical data generated during assessment activities at the Site were validated to Stage IV requirements by Environmental Data Validation, Inc. The data validation entailed a general review for completeness of analytical data deliverables and a detailed review of at least 10% of the

analytical data per medium collected during Site assessment activities. Copies of the Data Validation Reports are included in the SAR (GEG 2024). It was determined that, in general, the data could be used for the risk assessment with minor exceptions that would not affect the results of the risk assessment, as rejections were not for Site-related constituents of concern (COCs) and/or were related to waste characterization purposes.

3. Selection of Constituents of Concern

COCs were selected for the direct contact exposure pathways for Site receptors. Direct contact exposure pathways include ingestion, dermal contact, and inhalation of volatiles/particulates in outdoor air. The selection process was done using the analytical data and comparisons presented above in Section 2.1. There were little to no detections of volatile constituents in surface and subsurface soil, and no soil gas samples were collected. Therefore, a comparison to vapor intrusion screening criteria was not completed.

3.1 Direct Contact COC

A detailed discussion of direct contact COC selection is presented below for surface soil (**Table 3-1**), subsurface soil (**Table 3-2**), and SPLP results (**Table 3-3**). A summary of direct contact COCs retained in each medium is shown in **Table 3-4**.

3.1.1 Surface and Subsurface Soil

Constituents that exceeded a residential or industrial soil *de minimis* standard in surface soil samples collected between 0-2 ft bgs or subsurface soil samples collected greater than 2 ft bgs was retained as a residential or industrial direct contact COC in surface and/or subsurface soil, respectively. In addition, metals were compared to WV background standards (90th percentile) from the VRP Guidance Manual (WVDEP 2023a). Metals that were detected in concentrations above the WV *De Minimis* standards, but below the WV background standards were not retained as direct contact COCs. Metals that were detected above WV background standards, but below risk-based WV *de minimis* standards were also not retained as direct contact COCs.

Table 3-1 presents the COC selection process for surface soil and **Table 3-2** presents the COC selection process for subsurface soil. These tables include frequency of detection, minimum and maximum concentrations, and a comparison of maximum concentrations to applicable screening criteria.

As shown in **Table 3-1**, the COCs retained in surface soil include the following:

PAHs

- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(k)fluoranthene
- Dibenzo(a,h)anthracene
- Indeno(1,2,3-cd)pyrene

Metals

- Antimony
- Arsenic
- Iron

- Lead

PCBs

- Aroclor-1254

As shown in **Table 3-2**, the COC retained in subsurface soil include the following:

PAHs

- Benzo(a)pyrene

Metals

- Arsenic
- Lead

A summary of the retained direct contact COC in surface and subsurface soil is presented in **Table 3-4**.

3.1.2 Soil to Groundwater Evaluation

Constituents that exceeded a groundwater *de minimis* standard in SPLP samples collected from surface and subsurface soil was retained as a direct contact COCs in soil. As shown in **Table 3-3** and summarized in **Table 3-4**, there were no COCs retained in SPLP samples and no further evaluation of contaminant transport to groundwater will be necessary.

4. Conceptual Site Model

This section presents the conceptual Site model (CSM) developed for the Site and includes a geologic CSM, human health CSM, and an ecological screening assessment.

4.1 Geological Conceptual Site Model and Physical Characteristics

4.1.1 Geology

The Site is located in the Appalachian Plateau physiographic province, a subdivision of the Appalachian Mountains. The province includes the western two thirds of the state of West Virginia and is characterized by relatively flat-bedded sedimentary rock formations. The Site is located in a relatively mountainous area, approximately 1,400 feet above sea level. According to the geologic map of West Virginia, the geology beneath the Site consists of the Kanawha Formation of the Pennsylvanian System.

The geology underlying the Site consists of Pennsylvanian age rocks of the Kanawha Formation, primarily characterized by sandstone with minor constituents of shale, siltstone, and coals with thin marine zones (Cardwell 1968). A single type of soil was mapped at the Site. The Site is composed of Urban land-Ernest complex soil, which is predominantly silty loamy soil.

The Site is not paved and is overlain with a thin layer (less than two feet) of topsoil and/or crushed gravel/limestone. Below topsoil, there is a layer of sandy silt and gravel fill. Silty sand with sandstone fragments were encountered from 5-14 ft bgs and bedrock was encountered from 5-20 ft bgs. Some locations showed evidence of coal fines. Gravel was also present throughout the cores. Groundwater has not been encountered at the Site to the depth of investigation (20 ft bgs).

4.1.2 Hydrogeology

Groundwater in the Appalachian Plateau physiographic province occurs in two hydrogeologic units comprising the surficial aquifer (unconsolidated sand, gravels, silts, and clays) and the underlying bedrock aquifer. Occasionally, groundwater may be encountered in perched zones due to the presence of higher, shallow permeable units confined by lower impermeable units. Groundwater was not encountered during Site investigations to the depth of investigation (20 ft bgs) and additional details on groundwater beneath the Site is not available.

4.1.3 Surface Water Bodies and Water Resources

No perennial surface water bodies are present on the Site. The New River is located approximately 475 feet to the northwest of the Site beyond Front Street and the CSX railyard.

According to the West Virginia Water Resources Management Plan, the Site is not located within a WVDEP recognized Source Water Zone of Critical Concern (ZCC). Additionally, the Site is not located within a WVDEP recognized Wellhead Protection Area.

Residential structures in the area are provided public water by West Virginia American Water. Sanitary sewer services are provided by the Hinton Sanitary Board.

4.2 Human Health Conceptual Site Model

Potential constituent migration routes and potential receptors are assessed in this section to determine whether potentially complete exposure pathways exist at the Site. As stated in Section 4.1 in the WV VRP Guidance Manual (WVDEP 2023a), an exposure pathway is considered complete if the following four elements exist: 1) a source and mechanism of a chemical release to the environment; 2) an environmental receiving or transport mechanism (i.e. soil or groundwater) or pathway (i.e. air vapor and/or particulates, surface water, and sediment) for the released chemical; 3) a point of potential contact with the environmental medium/pathway of concern; and, 4) an exposure route (i.e. ingestion, dermal contact, inhalation) at the receptor contact point.

4.2.1 Potential Constituent Migration Routes

Likely constituent migration routes were evaluated for soil based on the detection of constituents in the medium and the potential for those detected constituents to migrate within the medium or to other media. The evaluation of migration routes is based on the detection of constituents and is independent of whether those constituents exceed applicable screening criteria.

The potential constituent migration routes retained for receptor-specific evaluation are presented in **Table 4-1** and are summarized as follows:

On-Site Surface and Subsurface Soil

- Volatilization of constituents from on-Site surface and subsurface soil to soil gas and subsequent seepage of soil gas into a building (indoor air);
- Volatilization of constituents from on-Site surface and subsurface soil to ambient/trench air;
- Particulate emission of constituents from on-Site surface soil to ambient air;
- Particulate emission of constituents from on-Site surface and subsurface soil to trench air; and,
- Leaching of constituents from on-Site surface soil to subsurface soil and then to groundwater.

4.2.2 Potential Receptors and Exposure Pathways

This section identifies potential receptors and their associated exposure pathways. Potential receptors were selected to represent individuals who are likely to come into contact with COCs in soil at the Site now or in the future. As part of the exposure pathway analysis, reasonable potential exposure pathways were assessed. This exposure pathway analysis accounts for pre-emptive restrictions at the Site (i.e. land use restriction), which are presented in more detail in Section 4.2.3.

The following likely receptors were evaluated:

Current Receptors:

- On-Site Outdoor Worker
- Trespasser

Future Receptors:

- On-Site Maintenance Worker
- On-Site Outdoor Worker
- On-Site Construction/Utility Worker
- On-Site Indoor Worker
- On-Site Recreational User

The Site is currently not occupied but redevelopment for commercial and recreational land use is anticipated. Recreational use of the property may include uses such as a park or amphitheater. Current receptors are limited to workers who may occasionally access the Site (property had been used recently for equipment storage) and trespassers that may occasionally access the Site. Future receptors could include workers and recreational users.

Based on the potential receptors listed above and the planned future land use, descriptions of the retained receptors are provided below. Exposure pathways were retained based on the potential sources of COCs, migration potential of COCs, and the activities of the receptor. **Table 4-1** presents a summary of the exposure pathways considered for each receptor and identifies whether exposure pathways were retained.

4.2.2.1 Trespasser

The trespasser is a receptor who may infrequently visit the Site without permission. This trespasser is likely to be a resident from a nearby property. There is the potential for a trespasser to access the Site and be exposed to soil.

A realistic age range for the trespasser is a teenager/young adult. This receptor is not expected to perform intrusive activities while at the Site. As a result, the trespasser could be directly exposed to surface soil, but not subsurface soil. Due to the limited exposure scenario for this receptor (e.g. infrequent visits to the Site), it was determined that the industrial soil *de minimis* standards were considered appropriate to evaluate this receptor. See Section 7.1.4 for further discussion on the assumed exposure parameters for a trespasser. There were COCs retained in soil based on measured constituent concentrations above industrial soil *de minimis* standards. As a result, incidental ingestion, dermal contact, and inhalation of particulates soil exposure pathways were retained for this receptor. There were no volatile constituents retained as industrial direct contact COC in surface soil or subsurface soil. Therefore, the inhalation of volatiles from surface soil and subsurface soil pathways were not retained.

A summary of the exposure pathways considered and retained for the on-Site trespasser is provided in **Table 4-1**.

4.2.2.2 On-Site Outdoor Worker and Maintenance Worker

The on-Site outdoor worker is an individual who is an employee for the City of Hinton and primarily performs work activities outdoors. Currently, the Site is unoccupied but has had occasional use for equipment storage and laydown area. Current outdoor workers may have minimal exposure to soil during equipment pick up and drop off. In the future, it was assumed an on-Site maintenance worker would likely work at the Site. The on-Site maintenance worker is an individual who will perform general work at the Site including groundskeeping, landscaping, and maintenance of the facility for a limited time and frequency during the year as the property is small in size (0.437 acres) and would require limited maintenance. However, as a conservative analysis, it was also assumed a full-time outdoor worker may potentially work at the Site in the future.

These receptors may be directly exposed to constituents in surface soil or indirectly exposed to volatile constituents that volatilize from subsurface soil to ambient air. There were COCs retained in on-Site surface soil that exceeded industrial soil *de minims* standards. Therefore, incidental ingestion, dermal contact, and inhalation of particulates exposure pathways for surface soil were retained for these receptors. There were no volatile constituents retained as industrial direct contact COCs in surface soil or subsurface soil. Therefore, the inhalation of volatiles from surface soil and subsurface soil pathways were not retained.

A summary of the exposure pathways considered for the current and future on-Site outdoor worker and future on-Site maintenance worker, and whether or not those pathways were retained is shown in **Table 4-1**. Based on the more frequent exposure expected for the future on-Site outdoor worker, a future on-Site outdoor worker was quantitatively evaluated, which is a more conservative assessment that is protective of the current outdoor worker. The future on-Site maintenance worker was also quantitatively evaluated.

4.2.2.3 On-Site Construction/Utility Workers

The on-Site construction worker is an individual who would be involved in future construction and/or excavation activities on-Site. This may include installation of new utility lines, major repairs to existing utility lines, installation of building footings or other similar activities, which may result in exposure lasting more than one day. The on-Site utility worker is an individual who would be involved with repairing and maintaining utility lines on-Site. The utility worker is not expected to be involved in the installation of new lines as this is assumed to be performed by a construction worker.

Note that consideration was made to evaluate off-Site construction and utility workers in the right-of-way of the adjacent roads; however, the off-Site construction and utility workers are expected to have less exposure compared to the on-Site construction and utility workers since impacts are primarily on-Site. As a result, the highest potential exposure to COCs is expected to occur on-Site.

The typical maximum excavation depths that WVDEP considers for a construction worker and utility worker are 10 ft bgs and 4 ft bgs, respectively. Although the typical excavation depth provided by

WVDEP for a construction worker is significantly deeper than the current depths of utilities at the Site (i.e. approximately 3 ft bgs), these were the excavation depths assumed for the on-Site construction and utility workers to evaluate potential exposure due to the potential for utilities to be installed at deeper depths in the future and the potential for future building construction. Based on the maximum excavation depth for the on-Site construction and utility workers, these receptors may come into direct contact with surface and subsurface soil. There were no constituents measured at concentrations above the WVDEP industrial soil *de minimis* standards in subsurface soil. As a result, no exposure pathways were retained for subsurface soil.

These receptors may be directly exposed to constituents in surface soil. There were COCs retained in on-Site surface soil that exceeded industrial soil *de minimis* standards. Therefore, incidental ingestion, dermal contact, and inhalation of particulates exposure pathways for surface soil were retained for these receptors. There were no volatile constituents retained as industrial direct contact COC in surface soil. Therefore, the inhalation of volatiles from surface soil was not retained.

A summary of the potential and retained exposure pathways considered for the on-Site construction worker and on-Site utility worker is provided in **Table 4-1**. Since exposure scenarios for both of these receptors are the same (exposure is to COC in surface soil only), one quantitative assessment (labeled as a "construction worker") was completed that is considered representative of both receptors.

4.2.2.4 On-Site Indoor Worker

The on-Site indoor worker is an individual who performs work activities indoors. Currently the Site is unoccupied; therefore, there is no current on-Site indoor worker. Future plans for the Site are to refurbish the existing on-Site building. The primary activity conducted by a future on-Site indoor worker is likely office work.

An on-Site inside worker is expected to spend the majority of their time indoors. Therefore, the outdoor direct contact soil exposure pathways (i.e. incidental ingestion, dermal contact, and the inhalation of particulates and volatiles to outdoor air from soil) were not considered applicable for this receptor as exposure is considered to be negligible from these pathways. However, there is the potential for this receptor to be exposed to Site-related constituents that volatilize to indoor air (via vapor intrusion) from soil.

Volatile constituents in soil were generally below detection limits; the few detections of volatile constituents are orders of magnitude below the industrial soil *de minimis* standards. As a result, the inhalation of volatiles from soil to indoor air via vapor intrusion was not retained for a future on-Site indoor worker.

A summary of the exposure pathways considered for the on-Site indoor worker and whether or not those pathways were retained is shown in **Table 4-1**.

4.2.2.5 On-Site Recreational User

The anticipated future use of the Site may include recreational use. This may include uses such as a park or amphitheater. The on-Site recreational user is an individual who performs recreational activities outdoors. The recreational activities performed by this receptor may include activities such as playground use, attending concerts, picnics, etc. Child and adult on-Site recreational users were evaluated. It was conservatively assumed that the child recreational user and the adult recreational user may be the same individual; therefore, the child and adult recreational user exposures were summed together.

Based on the expected activities of the on-Site recreational user, this receptor is not expected to perform intrusive activities. However, the on-Site recreational user may be exposed to the existing surface soil. This receptor was assumed to be in direct contact with surface soil (0-2 ft bgs). There were COCs retained in on-Site surface soil that exceeded residential soil *de minimis* standards. Therefore, incidental ingestion, dermal contact, and inhalation of particulates exposure pathways for surface soil were retained for this receptor. There were also two potentially volatile constituents (benzo[a]anthracene and aroclor-1254) retained as residential direct contact COCs in surface soil. Therefore, the inhalation of volatiles from surface soil was also retained. There were no volatile constituents retained as residential direct contact COC in subsurface soil. Therefore, the inhalation of volatiles from subsurface soil was not retained.

A summary of the potential and retained exposure pathways considered for the on-Site recreational user is shown in **Table 4-1**.

4.2.3 Summary of Incomplete Pathways Via Institutional Controls

Based on the receptor and exposure pathway analysis above, a number of exposure pathways will be considered incomplete by means of implementing an institutional control. The following is a summary of the receptor(s) and pathways that will be considered incomplete via implementation of the forthcoming proposed institutional control:

- Restricted residential use of the on-Site property, which will eliminate direct contact exposures to soil for future on-Site residents.

The institutional control shall be constituted via a land use covenant, which will be documented in the Final Report.

4.3 Ecological Assessment Summary

To comply with Section 60-3-8.5 of the Rule (WVDEP 2021), potential impacts to ecological receptors were evaluated. The "Checklist to Determine the Applicable Remediation Standards, Part 1: Ecological Standards", provided in the WV VRP Guidance Manual (WVDEP 2023a), was used in the ecological screening process. The checklist follows the ecological *De Minimis* screening evaluation outlined in Section 60-3-9.5 of the Rule (WVDEP 2021).

The first step in determining whether a complete exposure pathway exists was performed using the "Checklist to Determine the Applicable Remediation Standards, Part 1: Ecological Standards", which

is presented in **Appendix B**. As shown in the ecological checklist, "no further ecological evaluation is required" for the Site. A description of the local conditions is presented below.

Local conditions:

- The Site is currently developed with a three-story commercial structure formerly operated as the Hinton Ice House. The Site is currently unoccupied but land use was historically commercial/industrial and the Site is generally developed. The property is approximately 0.437 acres in size. The Site is unpaved and is overlain with a thin layer (<2 ft bgs) of top soil or gravel. While the areas around or near the fence line were covered in vegetation, the central portion of the Site showed little to no signs of vegetation growth. It was unknown if the vegetation was missing due to frequent traffic at the Site or herbicide use or some other unknown cause. There were no herbicides detected in soil samples collected across the Site. The developed area would not be considered suitable habitat for terrestrial ecological receptors due to a lack of vegetation and the presence of buildings. In addition, surface water (the New River) is located approximately 475 feet to the northwest of the Site beyond Front Street and the CSX railyard. Based on the distance to the river, and the presence of the railroad between the Site and the river, it is unlikely that Site-related constituents in surface runoff would reach the river.

Given the absence of vegetation and development status of the Site, it is unlikely that the Site would serve as a suitable habitat for terrestrial species. Additionally, Site-related constituents are unlikely to reach the nearby surface water feature. As such, it can be concluded that there is no complete exposure pathway for ecological receptors, and the initial screening was adequate to determine that no substantial ecological risk exists.

5. Exposure Point Concentrations

This section presents the procedures that were used to develop source concentrations and exposure point concentrations (EPCs) for the COCs identified at the Site. For each COC in surface soil, a source concentration representative of Site conditions was estimated using statistical analysis. These source concentrations were subsequently used in the exposure modeling to estimate EPCs (Section 7).

5.1 Source Concentrations for the Direct Contact Exposure Pathways

The source concentration is defined as a measured concentration within a specific medium (e.g. soil). The EPC is derived by multiplying the source concentration by a transfer factor (also called a volatilization factor for the inhalation pathway). For exposure scenarios where the receptor is directly exposed to the medium where the concentration was measured (e.g. soil), the transfer factor is equal to 1. For exposure scenarios where the receptor is exposed to a medium different than where the concentration was measured (e.g. concentration is measured in soil and exposure is to air), the transfer factor is estimated through modeling. This modeled transfer factor is chemical-specific and medium-specific.

5.1.1 Media-Specific and Receptor-Specific Source Concentrations

The selection of source concentrations for each receptor is based on the potentially complete exposure pathways for that receptor. The following describes the selected source concentrations in soil for receptors based on the retained exposure pathways.

Based on the initial screening, only constituents in surface soil were retained for further assessment. Source concentrations were derived using statistical analysis and analytical data from on-Site surface soil samples (located at depths between 0-2 ft bgs), where possible. ProUCL version 5.1 was used to derive 95% upper confidence levels (UCLs) of the mean concentrations. Due to the limited number of detections of aroclor-1254, the maximum concentration was conservatively used to evaluate direct contact exposure to this constituent in soil. In accordance with WVDEP VRP guidance (WVDEP 2023a), the arithmetic mean was estimated for lead using on-Site surface soil samples.

Appendix C presents the soil datasets and statistical analysis for development of the source concentrations for on-Site surface soil. **Table 5-1** presents a summary of the source concentrations in on-Site surface soil.

5.2 Calculation of Exposure Point Concentrations for the Direct Contact Exposure Pathways

EPCs are calculated for each direct contact COC by multiplying the selected source concentrations by a transfer factor. For the incidental ingestion and dermal contact pathways, which involve actual contact with soil, the transfer factor is 1.0 (USEPA 2004). For inhalation of particulates emitted from

soil to outdoor air, the transfer factor was the USEPA default value of 7.4E-10 kg/m^3 (1/1.36E+9 m^3/kg) (USEPA 2024a).

For the exposure pathways involving inhalation of volatile constituents emitted from soil to outdoor air (either ambient or trench air), the transfer factor (analogous to a volatilization factor) relates measured concentrations in soil to estimated concentrations in outdoor air. For volatilization of constituents from soil to outdoor air, transfer factors are calculated following USEPA's soil screening guidance (USEPA 1996) and are presented in **Appendix D** of this document.

5.3 Site-specific Cleanup Level for Lead

Lead is typically regulated based on blood lead concentration (PbB). In lieu of evaluating risk using typical intake calculations and toxicity criteria, USEPA (2003) recommends the use of the ALM for adults or Integrated Exposure Uptake Biokinetic (IEUBK) model for children. In accordance with WVDEP VRP guidance (WVDEP 2023a), the arithmetic mean is used as the source concentration in soil rather than a UCL. The estimated arithmetic mean using on-Site surface soil samples analyzed for lead was 650.8 mg/kg. This mean concentration is above the selected industrial soil standard of 247 mg/kg assuming exposure to multiple sources of lead. In addition, the mean concentration exceeds the USEPA residential soil screening level of 100 mg/kg for Sites with multiple sources of lead (USEPA 2024a). A Site-specific cleanup level for lead was calculated for the on-Site recreational user, which is the more sensitive receptor as compared to the nonresidential receptors.

Both a child and adult on-Site recreational user are potential receptors that may be exposed to surface soil at the Site. Due to the child exposure being the more conservative exposure scenario, the IEUBK model was considered for use to assess lead exposure for the on-Site recreational user. However, one of the limitations of the IEUBK model is that it was developed to assess risk at residential Sites and assumes that 100% of the receptor's time is spent at the residence, leading to a continuous exposure (Syracuse Research Corporation [SRC] 2021). This is not the case for the on-Site recreational user as this receptor is assumed to spend a portion of time exposed to surface soil at the Site and a portion of time exposed to surface soil at their residence. Thus, a time-weighted exposure approach was used in accordance with USEPA guidance document "Assessing Intermittent or Variable Exposures at Lead Sites" (USEPA 2003).

This time-weighted exposure approach requires a minimum exposure of one day per week and minimum exposure duration of three months, both of which are exceeded with the exposure parameters selected for the recreational user in Section 7.1.3. The time-weighted exposure approach to calculating cleanup levels for soil requires a weighted soil lead concentration and a home soil lead concentration. The weighted soil lead concentration was set to 100 mg/kg based on the USEPA residential soil regional screening level for Sites with multiple sources of lead (USEPA 2024a) to verify that total lead exposure across soils from the Site and the home remain under the threshold. A value of 38 mg/kg was used as the home soil lead concentration, which was the 90th percentile background soil lead concentration in West Virginia (WVDEP 2023a). IEUBK defaults were used for the total time spent outdoors for each age range (SRC 2021), and the exposure parameters to the Site were the same as in Section 7.1.3. Threshold values were calculated for each age range recommended by the IEUBK model, and the conservative value of the age ranges was selected as

the final lead cleanup level. The calculation is presented in **Table 5-2**. This Site-specific cleanup level for lead was directly compared to the source concentration to determine risks from lead at the Site, which is discussed in Section 8.2.

6. Constituent-Specific Parameters

This section presents constituent-specific parameters used in the quantitative risk assessment including chemical properties, toxicological values, and absorption adjustment factors. Note that lead was not included in the tables presented in this section as there are no toxicity values available for lead, and lead is evaluated separately.

6.1 Chemical Properties

Table 6-1 presents the chemical properties required to complete the Site-specific risk calculations. This table also references the source for each chemical property. In accordance with WVDEP Guidance (WVDEP 2023a), the Risk Assessment Information System (RAIS) website (http://rais.ornl.gov) was utilized to obtain the majority of chemical properties. If a value was not available through the RAIS database, the USEPA RSL Chemical Specific Parameters table (dated May 2024) was utilized to obtain the chemical-specific property (USEPA 2024b).

6.2 Toxicological Values

COCs are quantitatively evaluated on the basis of their cancer and/or noncancer potential. Cancer slope factors (CSFs) and inhalation unit risks (IURs) are the toxicity values used to evaluate cancer health effects in humans. The reference doses (RfDs) and reference concentrations (RfCs) are the toxicity values used to evaluate noncancer (e.g. systemic) health hazards in humans.

CSFs and IURs are presented in **Table 6-2** for direct contact COCs. **Table 6-2** also indicates if the retained COCs have a mutagenic mode of action or not. As shown in **Table 6-2**, six of the retained COCs are mutagenic and include benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene. RfDs and RfCs for chronic effects associated with long-term exposures are provided in **Table 6-3** for the direct contact COCs.

Toxicity values were obtained from the following the hierarchy presented in Section 8.1.c.1 of the Rule (WVDEP 2021):

- Tier 1: Integrated Risk Information System (IRIS)
- Tier 2: Provisional Peer Reviewed Toxicity Values (PPRTVs)
- Tier 3: Other Toxicity Values

Tier 3 of the hierarchy includes several sources of toxicity values that are commonly consulted by the USEPA when a relevant toxicity value is not available from either IRIS or the PPRTV database. They may include:

- The Agency for Toxic Substances and Disease Registry (ATSDR) Minimal Risk Levels (MRLs);
- The California Environmental Protection Agency toxicity values;

- PPRTV screening values from certain PPRTV assessment appendices; and
- The EPA Superfund Health Effects Assessment Summary Tables (HEAST).

RfDs and RfCs for subchronic effects associated with short-term exposures are provided in **Table 6-4** for the direct contact COC. These values were obtained from the PPRTVs, the ATSDR MRLs, or HEAST tables. If values were not available from these sources, then the RfDs or RfCs for chronic effects were used. In this risk assessment report, the construction worker is evaluated assuming a subchronic exposure.

In accordance with USEPA Risk Assessment Guidance for Superfund (RAGS) Part E (USEPA 2004), values representing the fraction of constituent absorbed in gastrointestinal tract (GIABS) were used to convert oral slope factors and reference doses to dermal slope factors and reference doses. The conversion factors used are presented in **Tables 6-2, 6-3, and 6-4**.

Tumor type/critical effect and target organ information (when available) for the COCs are presented in **Table 6-5** (CSFs and IURs), **Table 6-6** (chronic RfDs and RfCs), and **Table 6-7** (subchronic RfDs and RfCs).

6.3 Absorption Adjustment Factors

Absorption adjustment factors (*AAF*s) are needed for the various direct contact soil exposure pathways (i.e. oral and dermal exposure). **Table 6-8** presents the *AAFs* for the various direct contact soil exposure pathways used in the risk assessment.

Oral *AAF*s consider absorption and bioavailability. The oral *AAF*s were generally set to 1 mg/mg, which is a conservative assumption and implies that 100% of the constituent is absorbed into the blood stream as a result of ingestion. The only exception was for arsenic which has a USEPA-recommended oral *AAF* of 0.6 (USEPA 2024a).

Dermal *AAF*s reflect desorption of a constituent from soil and subsequent absorption across the skin and into the blood stream (USEPA 1989). The absorption adjustment factors for dermal contact with soil are constituent dependent. The dermal *AAF*s are 0.13 for PAHs, 0.03 for arsenic, and 0.14 for PCBs. For the other metals (i.e. antimony and iron), the *AAF* values for dermal contact with soil are not available because in accordance with RAGS-E, for inorganics, the speciation of the compound is critical to the dermal absorption and there are too little data to extrapolate a reasonable default value (USEPA 2004).

7. Intake and Exposure Concentration Equations and Assumptions

This section presents the intake or absorbed dose equations and assumptions used to calculate constituent intakes for the ingestion and dermal contact exposure pathways as well as the equations and assumptions used to calculate exposure concentrations for the inhalation exposure pathways for applicable receptors. These equations were obtained from USEPA guidance (USEPA 1989) (USEPA 2009). The equations are presented in **Tables 7-1 through 7-5** for the on-Site maintenance worker, on-Site outdoor worker, on-Site construction worker, on-Site recreational user, and trespasser, respectively.

For constituents with a mutagenic mode of action for carcinogenicity, a separate set of mutagenic equations was utilized where appropriate. The intake for the mutagenic equation is adjusted based on age-dependent adjustment factors (*ADAFs*). The *ADAFs* for mutagenic COC is receptor-specific (based on their age). In this risk assessment, the mutagenic equations were utilized for the on-Site recreational user and trespasser, which are presented in **Table 7-4 and Table 7-5**.

7.1 Receptor-Specific Exposure Assumptions

This section presents receptor-specific exposure assumptions for each receptor. The receptor-specific exposure assumptions were selected using WVDEP recommended values, when available, selected from Appendix C (Section C.3.1 – Exposure Parameters) of the VRP Guidance Manual (WVDEP 2023a). Otherwise, alternative sources were used, such as recommended values from other state program guidance or USEPA guidance, or professional judgment (based on Site-specific information) to select appropriate receptor-specific exposure assumptions.

7.1.1 On-Site Maintenance Worker and On-Site Outdoor Worker

Table 7-1 presents the exposure parameters for the on-Site maintenance worker, and **Table 7-2** presents the exposure parameters for the on-Site outdoor worker. In general, the WVDEP (2023a) defaults for commercial/industrial receptors were utilized. For the maintenance worker, several exposure parameters were selected using professional judgement.

The difference between the maintenance worker and outdoor worker was the exposure frequency (*EF*) and exposure time (*ET*). For the maintenance worker, the *EF* was selected to be 72 days/year based on the professional judgment of 3 days per week for 6 months, which is assuming exposure during warm months of the year (May through October). An *ET* of 4 hours/day was selected for the time spent outdoors for the maintenance worker based on professional judgment. These *EF* and *ET* values assume the maintenance worker would a limited portion of their time in direct contact with surface soil performing activities such as landscaping. For the future outdoor worker, the WVDEP default commercial/industrial *EF* of 250 days/year and WVDEP default commercial/industrial *ET* of 8 hours/day were used, assuming a full-time outdoor worker scenario.

The remaining parameters are the same for both the maintenance worker and outdoor worker. The WVDEP default commercial/industrial exposure duration (*ED*) of 25 years was used. The soil

ingestion rate (*IR*) was set to the WVDEP default of 100 mg-soil/day for an outdoor worker. The total daily soil ingestion fraction (*FI*) was conservatively set at 1, which assumes that 100% of the receptor's daily soil intake occurs at the Site. The body weight (*BW*) for the worker was set at 80 kg and is based on the WVDEP default value for an adult. The exposed surface area (*SA*) for dermal contact with soil was 3,527 cm^2/day based on the WVDEP default exposure assumption for a commercial/industrial receptor. The soil adherence factor (*AF*) of 0.12 mg-soil/cm^2 is also a WVDEP default exposure assumption for a commercial/industrial receptor. The fraction of the day in contact with soil (*FC*) was conservatively set at 1, which assumes that 100% of the receptor's daily soil contact occurs from soil at the Site.

Following WVDEP (2023a) guidance, the averaging time for carcinogenic effects (AT_c) was set at 25,550 days (USEPA 1989) for the ingestion and dermal exposure pathways and 613,200 hours for the inhalation pathway (based on a lifetime of 70 years) (USEPA 2009). The averaging time for noncarcinogenic effects (AT_{nc}) was set at 9,125 days for the ingestion and dermal exposure pathways and 219,000 hours for the inhalation exposure pathway.

7.1.2 On-Site Construction Worker

Table 7-3 presents the exposure parameters for the on-Site construction worker. The WVDEP (2023a) defaults for a construction/utility worker were utilized where available.

Based on the acreage of the Site (<0.5 acres), the WVDEP default construction/utility worker *EF* of 30 days/year was utilized. An *ET* of 8 hours/day was selected, which is also the WVDEP default value for a construction/utility worker. The USEPA (2023a) default *ED* of 1 year for a construction worker was used.

The soil *IR* was set to 330 mg-soil/day, which is the WVDEP default exposure assumption for a construction/utility worker. The total daily soil *FI* was conservatively set at 1, which assumes that 100% of the receptor's daily soil intake occurs at the Site. The *BW* for the construction/utility worker was set at 80 kg and is based on the WVDEP default value for an adult.

The exposed *SA* for dermal contact with soil was 3,527 cm^2/day based on the WVDEP default exposure assumption for a construction/utility worker. The soil *AF* of 0.3 mg-soil/cm^2 is also a WVDEP default exposure assumption for a construction/utility worker. The *FC* was conservatively set at 1, which assumes that 100% of the receptor's daily soil contact occurs from soil at the Site.

Following WVDEP (2023a) guidance, the AT_c was set at 25,550 days (USEPA 1989) for the ingestion and dermal exposure pathways and 613,200 hours for the inhalation pathway (based on a lifetime of 70 years) (USEPA 2009). The averaging time for AT_{nc} was set at 350 days (WVDEP 2023a) for the ingestion and dermal exposure pathways and 8,400 hours (WVDEP 2023a) for the inhalation exposure pathway.

7.1.3 On-Site Recreational User

Table 7-4 presents the exposure parameters for the on-Site recreational user. In general, the WVDEP (2023a) defaults for residential adults/children and for a recreational user at a community park were utilized.

The WVDEP default *ED* of 26 years was used (default of 20 years for adults and 6 years for children). Note that for the mutagenic COC, the *ED* is segregated into age groups associated with the age-dependent adjustment factor (*ADAF*). An *ADAF* of 10 is applied to ages 0-2 years, an *ADAF* of 3 is applied to ages 2-6 years and 6-16 years, and an *ADAF* of 1 is applied to ages greater than 16 years.

The WVDEP default *EF* of 52 days/year was utilized based on recreational activity at a community park. The WVDEP default *ET* of 3 hours/day was also selected based on recreational activity at a community park. The soil *IR* was set to the WVDEP default of 100 mg-soil/day for adults and 200 mg-soil/day for children. The total daily soil *FI* was conservatively set at 1, which assumes that 100% of the receptor's daily soil intake occurs at the Site. The *BW* for the recreational user was set at the WVDEP default values of 80 kg for an adult and 15 kg for a child. The exposed *SA* for dermal contact with soil was 3,450 cm^2/day for a child and 8,890 cm^2/day for adults based on the WVDEP defaults for a recreational user at a community park. The WVDEP default recreational user *AFs* of 0.2 mg-soil/cm^2 for adults and 0.4 mg-soil/cm^2 for children were used. The *FC* was conservatively set at 1, which assumes that 100% of the receptor's daily soil contact occurs from soil at the Site.

Following WVDEP (2023a) guidance, the AT_c was set at 25,550 days (USEPA 1989) for the ingestion and dermal exposure pathways and 613,200 hours for the inhalation pathways (based on a lifetime of 70 years) (USEPA 2009). The averaging time for AT_{nc} was set at 9,490 days for the ingestion and dermal exposure pathways (2,190 days for a child 0 to 6 years old and 7,300 days for an adult greater than 6 to 26 years old) and 227,760 hours for the inhalation exposure pathways.

7.1.4 Trespasser

Table 7-5 presents the exposure parameters for the trespasser. In general, exposure parameters were selecting using either the WVDEP (2023a) defaults for residential adults or based on professional judgement.

The trespasser is assumed to be a teenager/young adult. Therefore, this receptor was assumed to be between the ages of 13 and 26 years old. As a result, the *ED* was set to 13 years. For the mutagenic COC, the *ADAF* values that apply to this receptor are the *ADAF* of 3 (which applies to the age range of 13-16 years for this receptor) and the *ADAF* of 1 (which applies to the age range of 16-26 years for this receptor).

The *EF* was set to 52 days/year. This was based on professional judgement assuming exposure to soil may occur 2 days per week during the warmer months of May through October. The *ET* was set to 2 hours/day, which was also based on professional judgement.

Since this receptor is assumed to be older than 6 years old, the default exposure parameters for a child resident were not utilized in the risk calculation for the trespasser. The soil *IR* was set to the

WVDEP default of 100 mg-soil/day for adults. The total daily soil *FI* was conservatively set at 1, which assumes that 100% of the receptor's daily soil intake occurs at the Site. The *BW* for the trespasser was set at the WVDEP default value of 80 kg for an adult. The exposed *SA* for dermal contact with soil was 6,032 cm^2/day based on the WVDEP default for adults. The WVDEP default *AF* of 0.07 mg-soil/cm^2 for adults was used. The *FC* was conservatively set at 1, which assumes that 100% of the receptor's daily soil contact occurs from soil at the Site.

Following WVDEP (2023a) guidance, the AT_c was set at 25,550 days (USEPA 1989) for the ingestion and dermal exposure pathways and 613,200 hours for the inhalation pathway (based on a lifetime of 70 years) (USEPA 2009). The averaging time for AT_{nc} was set at 4,745 days for the ingestion and dermal exposure pathways and 113,880 hours for the inhalation exposure pathway.

8. Risk Characterization

In this section of the risk assessment, the potential human health risks for complete exposure pathways are assessed. Potential risks due to exposures to COCs in soil from the Site are evaluated by integrating exposure assessments and toxicity data into quantitative expressions of cancer risk and noncancer health hazards. The equations to calculate risks and hazard indices (HIs) are included in **Tables 7-1 through 7-5**. These equations were obtained from USEPA guidance (USEPA 1989 and 2009).

8.1 Risk Results

Calculations of cancer risks and noncancer HIs for the on-Site maintenance worker, on-Site outdoor worker, on-Site construction worker, on-Site recreational user, and trespasser are presented in **Tables 8-1 through 8-5**, respectively. In accordance with Section 60-3-9.4.a and 60-3-9.4.b in the Rule (WVDEP 2021) and Section 4.6.2 in the WV VRP Guidance Manual (WVDEP 2023a), the risk benchmark value for industrial receptors is 1E-5, and the risk benchmark value for residential receptors (including recreational users) is 1E-6. The residential risk benchmark of 1E-6 was also used for the trespasser. The HI benchmark value is 1 irrespective of land use.

As presented in **Table 8-6**, the estimated total risk (1E-6) and total HI (0.2) for the on-Site construction worker are below the applicable WVDEP risk and HI benchmark values. For the on-Site maintenance worker, the total HI of 0.2 was below the benchmark of 1, but the total risk of 2E-5 exceeds the risk benchmark of 1E-5 for industrial receptors. For the on-Site outdoor worker, the total risk of 8E-5 exceeds the industrial risk benchmark of 1E-5; however, the total HI (0.5) is below the benchmark of 1. For the on-Site recreational user, the total HI of 2 exceeds the benchmark of 1, and the total risk of 1E-4 exceeds the risk benchmark of 1E-6 for residential receptors. For the trespasser, the total HI of 0.1 was below the benchmark of 1, but the total risk of 9E-6 exceeds the risk benchmark of 1E-6 for residential receptors.

Although the total risks for the on-Site maintenance worker, on-Site outdoor worker, trespasser, and recreational user are within the programmatically acceptable range of 1E-4 and 1E-6 that would require a public notification, the total HI benchmark exceedance for the recreational user will need to be addressed.

8.2 Calculation of Lead Cleanup Level

For lead, a Site-specific cleanup level was calculated for the on-Site recreational user. The calculation was presented in **Table 5-2**. The Site-specific cleanup level was estimated to be 255 mg/kg. Several surface soil samples had concentrations that exceeded this value. There were no subsurface soil samples with concentrations that exceeded the Site-specific cleanup level. The estimated source concentration for lead (arithmetic mean of 650.8 mg/kg) based on surface soil samples collected from the Site exceeds the Site-specific cleanup level of 255 mg/kg and the industrial soil standard of 247 mg/kg utilized in this report. As a result, exposure to lead in soil for

the on-Site recreational user as well as the nonresidential receptors evaluated for this Site will need to be addressed.

8.3 Alternative Risk Analysis

The total risks for the on-Site maintenance worker, on-Site outdoor worker, and trespasser, and the total risk and HI for the on-Site recreational user, exceed the applicable WVDEP benchmarks and are driven by the incidental ingestion of soil exposure pathway. Arsenic and benzo(a)pyrene are the primary parameters that drive risk. In addition, the arithmetic mean concentration of lead in surface soil also exceeded the Site-specific cleanup level for the on-Site recreational user. The UCLs and arithmetic mean derived for the COCs in surface soil were skewed high due to observed concentrations in surface soil sample SS-04 (0-0.5'), which had concentrations at least an order of magnitude greater than other surface soil sample collected.

An alternative risk analysis was performed to determine if further mitigation measures would still be required after SS-04 (0-0.5') was mitigated. This analysis was completed by removing SS-04 (0-0.5') from the surface soil dataset used to derive UCLs and the arithmetic mean. The alternative UCLs (i.e. excluding SS-04) were used to ratio alternative risk and HI results for the maintenance worker, outdoor worker, trespasser, and recreational user. In addition, the alternative arithmetic mean was compared to the Site-specific cleanup level. The ratioed risk results are presented in **Table 8-7**. The supporting ProUCL input datasets and outputs are provided in **Appendix C**.

As shown in **Table 8-7**, the ratioed total risk of 3E-6 for the on-Site maintenance worker and ratioed total risk of 9E-6 for the on-Site outdoor worker are below the WVDEP risk benchmark of 1E-5 for industrial receptors. For the trespasser, the ratioed risk of 1E-6 is at the WVDEP risk benchmark of 1E-6 for residential receptors. For the on-Site recreational user, the ratioed total HI of 0.4 is below the benchmark of 1. However, the ratioed total risk of 1E-5 remains above the residential risk benchmark of 1E-6. For lead, as shown in the table below, the alternative arithmetic mean is above the Site-specific cleanup level for the on-Site recreational user.

Alternative Arithmetic Mean for Lead	Site-Specific Cleanup Level
391.8 mg/kg	255 mg/kg

Based on this alternative risk analysis, the risk for the on-Site recreational user will still require abatement via remedial measures or pathway elimination after surface soil sample SS-04 (0-0.5') has been mitigated. Although the ratioed total risk of 1E-5 for the recreational user is within the programmatically acceptable range of 1E-4 and 1E-6 that would require a public notification, the exposure to lead in soil for the recreational user will need to be addressed. In addition, the exposure to lead in soil for nonresidential receptors will also need to be addressed. A cap will be placed on the property and an LUC restriction will be established requiring excavation workers to follow a HASP during intrusive activities beneath the cap.

9. Uncertainty Analysis

The risk assessment process presented in this document uses a considerable number of assumptions to provide a conservative estimate of risks. During the risk assessment process, uncertainty and variability are inherent in the estimation of risks based on specific variables such as:

- Identification of COCs;
- Receptors and exposure pathways;
- Source concentrations;
- Exposure parameters;
- Toxicological values; and,
- Risk characterization.

A qualitative review is presented in this section describing some of the variables as applicable to the risk analysis and their potential effect on the final risk estimates, which overall result in a high degree of confidence that potential risks are not underestimated.

9.1 Identification of COCs

Identification of COCs relies, in part, on the information provided by the sampling and analytical program. Uncertainty in this regard is reduced as much as possible by following appropriate sample collection, handling, and analytical procedures and implementing quality assurance / quality control measures as part of the field and analytical programs. Additionally, sampling typically occurs with more emphasis on areas expected to have higher concentrations. Collectively, these measures are considered to reduce uncertainty and provide data such that Site-related risk estimates are not underestimated. Additionally, quality assurance sampling and analysis protocols are followed to obtain characterization data that is as representative, precise, and accurate as possible to be used for risk assessment purposes.

As discussed in Section 2.2 (Data Validation), it was determined that, in general, data were acceptable for use within the risk assessment with minor exceptions that would not affect the results of the assessment as rejections were not for Site-related COCs and/or were related to waste characterization purposes. As a result, the COC selection process utilized in the risk assessment is considered conservative with low uncertainty and would be expected to overestimate potential risks.

9.2 Exposure Assessment

There are three major areas of uncertainty associated with exposure assessment, including: 1) receptors and exposure pathways; 2) calculation of source concentrations; and 3) exposure parameter values used to estimate chemical intake. A discussion on each of these elements is presented below.

9.2.1 Receptors and Exposure Pathways

Defining the probable current and future land use of the Site carries with it some degree of uncertainty. Evaluating and understanding this uncertainty is important during the selection of potential receptors and exposure pathways. For this evaluation, the potential receptors and exposure pathways were based on current Site conditions (non-residential) and the assumption that the Site will potentially be used for non-residential use and recreational use in the future, limiting the uncertainty associated with these parameters. This is line with the proposed future use of the Site, which is commercial use and potential recreational use, such as an amphitheatre.

9.2.2 Source Concentrations

Risk assessments typically evaluate concentrations over an exposure area using statistical analysis. This approach treats exposures within the exposure area as equally possible. Risks associated with exposures are then assessed by evaluating those concentrations with exposure factors and the appropriate exposure/toxicity values. Typically, the source concentration for a specific chemical in a particular medium is based on the 95% UCL of the mean concentrations.

In the dataset, aroclor-1254 was only detected in two samples. As a result, there was not a sufficient number of detections to derive a UCL, and the maximum concentration was conservatively utilized as the source concentration for aroclor-1254. Using the maximum concentration for this constituent is conservative because it assumes that the receptor would spend the entire time at the Site in contact with this sample location. Although it is likely that receptors would be in contact with the sample location with the maximum concentration at some point at the Site; exposure with one sample location is more likely to occur during a small portion of the total time spent at the Site. Therefore, the use of the maximum concentration for this constituent may overestimate total calculated risks/hazards for receptors. However, this is also based on the assumption that the measured maximum concentration from the sample is representative of the maximum concentration for the population. In cases where the maximum sample concentration is not representative of the maximum concentration for the population, the calculated risks/hazards may not be overestimated.

For the evaluation of exposure to lead in surface soil, the arithmetic mean of surface soil samples was used in accordance with WVDEP VRP guidance (WVDEP 2023a). Typically a 95% UCL is used in estimation of risks, which is an upper bound estimate of the mean concentration. Use of a 95% UCL is health protective because there is a 5% chance that the mean is underestimated, assuming that appropriate statistical and sampling methods are used such that the coverage is not less than a 95% probability of encompassing the true mean (Interstate Technology & Regulatory Council; ITRC 2020). The use of an arithmetic mean as the source concentration introduces uncertainty in the estimation of risks because environmental samples are subject to variability in the data distribution, and the arithmetic mean may be biased. However, according to USEPA guidance (SRC 2021), the soil lead concentration should be the arithmetic mean of the concentration of lead in the soil that a child is likely to be exposed to, assuming the child has an equal chance of contacting soil throughout the decision unit. This provides a central point estimate for risk of an elevated blood lead level.

An updated version of the software, ProUCL 5.2, was released in June 2022. ProUCL 5.2 includes a change in the Decision Tree used to choose the Suggested UCL, which eliminates the use of the

Chebyshev and Bootstrap methods, while ProUCL 5.1 uses the Chebyshev or Bootstrap methods as the "Suggested UCL" when the data are non-parametric (e.g. did not adhere to normal, lognormal, or gamma distributions; Stuchal 2023). This change in the Decision Tree algorithm can reduce the coverage from 95% to 80%, effectively producing an 80% UCL instead of a 95% UCL (Stuchal 2023). Several states have not recommended the use of ProUCL 5.2 in calculating 95% UCLs, including West Virginia and Florida. Thus, ProUCL 5.1 was chosen to calculate 95% UCLs for this Site as it is more conservative and is less likely to underestimate potential risks in situations where the data does not follow a discernable distribution.

9.2.3 Exposure Parameters

Uncertainty is associated with the exposure parameter values used; however, assumptions are chosen to be conservative so as not to underestimate risk. For example, assumptions are made for the exposure time, frequency, and duration of potential chemical exposures, as well as for the quantity of material ingested, inhaled, or absorbed. In addition, assumptions are made for lithologic conditions at the Site for volatilization models to estimate transfer factors for the inhalation of volatiles exposure pathway. In general, assumptions are made based on reasonable maximum exposures and values are often specified by WVDEP, USEPA or other state guidance documents, or Site-specific information. Using default exposure parameters that are representative of upper bound estimates of exposure is conservative and may potentially overestimates risks and hazard indices.

9.3 Toxicity Values

A potentially large source of uncertainty is inherent in the derivation of the toxicity values (e.g. RfDs, RfCs, CSFs, and IURs). In many cases, data are extrapolated from animals to sensitive human subpopulations by the application of uncertainty factors to an estimated no-observed-adverse-effect-level (NOAEL) or lowest-observed-adverse-effect-level (LOAEL) for noncancer health effects. While designed to be protective, in many cases uncertainty factors are applied that likely overestimate the magnitude of differences that may exist between humans and animals, and among humans.

As discussed in the Guidelines for Carcinogen Risk Assessment (USEPA 2005), derivation of CSFs and IURs often involves linear extrapolation of effects at high doses to potential effects at lower doses commonly seen in environmental exposure settings. It is probable that the shape of the dose response curve for carcinogenicity varies with different chemicals and mechanisms of action. Toxicity values are established based on a point of departure value that is used in determining the shape of the linear response. Dependent upon whether or not concentrations in environmental media are above the point of departure may potentially underestimate calculated risks.

9.4 Risk Characterization

There is also uncertainty in assessing risks associated with a mixture of chemicals. In this assessment, the effects of exposure to each contaminant present have initially been considered separately. However, these substances occur together at the Site, and individuals may be exposed to mixtures of the chemicals. Predictions of how these mixtures of chemicals will interact must be

based on an understanding of the mechanisms of such interactions. Individual chemicals may interact in the body, yielding a new toxic component or causing different effects at different target organs.

Suitable data are not currently available to rigorously characterize the effects of chemical mixtures. Consequently, as recommended by USEPA, chemicals present at the Site are assumed to act additively, and potential health risks are evaluated by summing excess lifetime cancer risks and calculating HIs for noncancer health effects (USEPA 1989). This approach to assessing risk associated with mixtures of chemicals assumes that there are no synergistic or antagonistic interactions among the chemicals and that all chemicals have the same toxic endpoint and mechanisms of action. To the extent that these assumptions are correct, the actual risks could be underestimated or overestimated.

Current methodologies to evaluate exposure to lead cannot be integrated into the assessment of cumulative risks and hazard indices for other COCs in environmental media at the Site. As a result, at Sites where lead is retained as a COC along with other constituents, the cumulative impacts of exposures to lead and other constituents that act on the same target organs/systems may potentially be underestimated.

9.5 Conclusion of Uncertainty Analysis

Based on the above uncertainty analysis, the risk assessment employed multiple conservative assumptions, which, when combined, produce an additive conservative effect throughout the process, resulting in an overestimation of the potential risk. As a result of the uncertainties described above, this risk assessment should not be construed as presenting absolute risks or hazards. Rather, it is a conservative analysis intended to indicate the potential for adverse impacts to occur based on reasonable upper bound exposure that is well above the average but still within the range of possible exposures. The estimated cancer risks in this report are excess cancer risks that do not represent estimated levels for the population as a whole, but simply represent excess cancer risks above baseline levels associated with the Site.

9.6 Statement of Limitations

This document is prepared solely for the Site in Hinton, Summers County, West Virginia. This report was prepared based on the information supplied by GEG. The results of the risk assessment presented in this report apply to the existing and reasonably foreseeable Site conditions at the time of this assessment. This risk assessment is based only on the current Site conditions from the historic on-Site release(s) defined by the analytical data and does not assess potential future releases. Changes in the conditions of the property may occur with time due to natural processes or works of man at the Site or on adjacent properties. Changes in applicable standards and toxicity criteria may also occur as a result of legislation or the broadening of knowledge. As a result, if the exposure assumptions and/or assessment change in the future for this Site, the results of this risk assessment analysis may not apply and will require revalidation. Based on the evolving nature of risk assessments, this risk assessment shall be submitted to the appropriate regulatory agency within a reasonable timeframe (e.g. approximately three months from the completion date of this

document) such that it aligns with recent risk assessment methodologies and guidelines have been used at the time this risk assessment was completed. Worley Consulting is not responsible for the misinterpretation or misuse of this risk assessment analysis.

10. References

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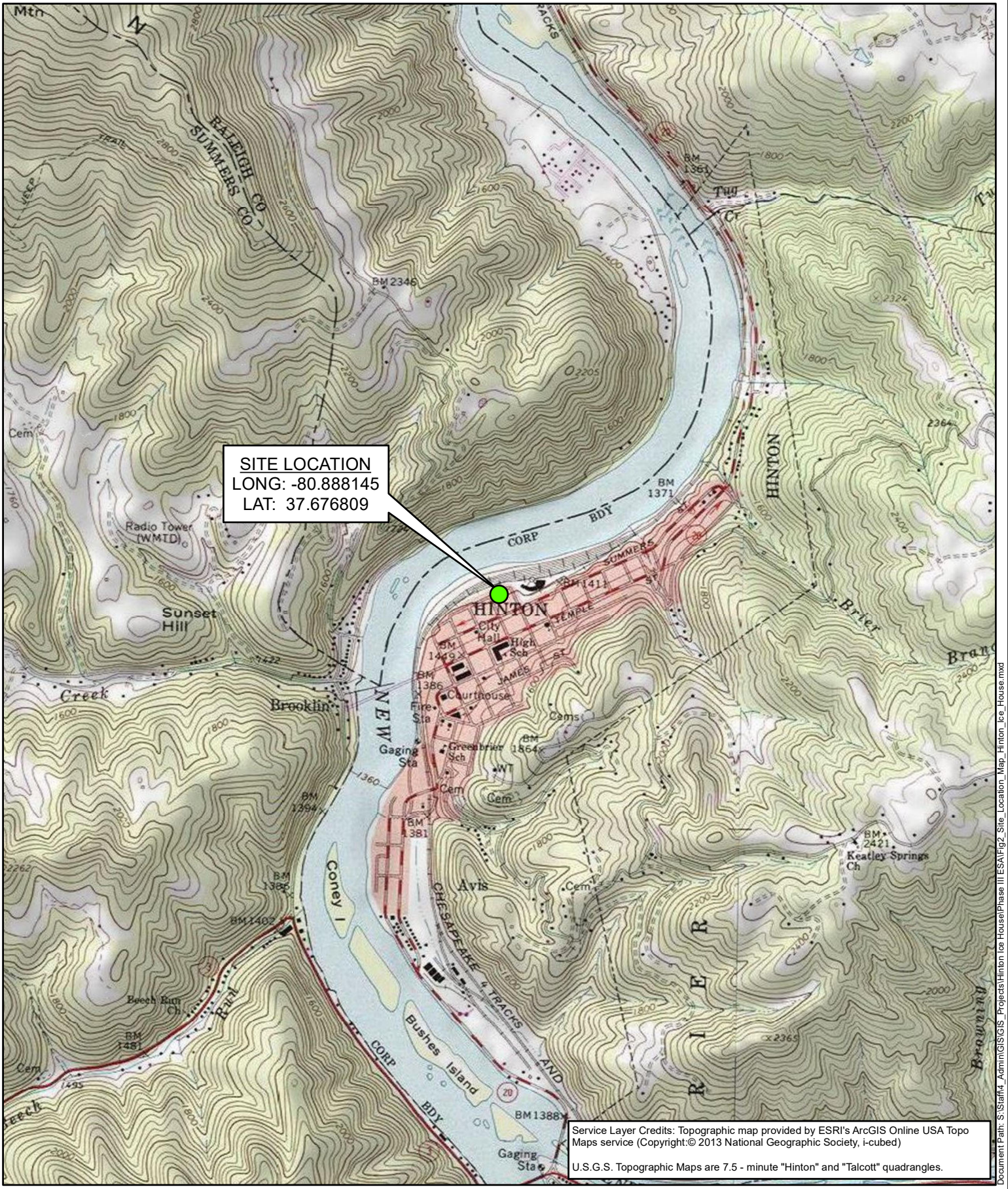

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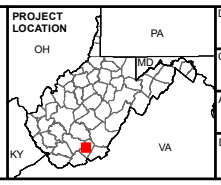
Greenbrier Environmental Group, Inc.

N

1 inch = 2,000 feet

0 500 1,000 2,000 Feet

PROJECT LOCATION

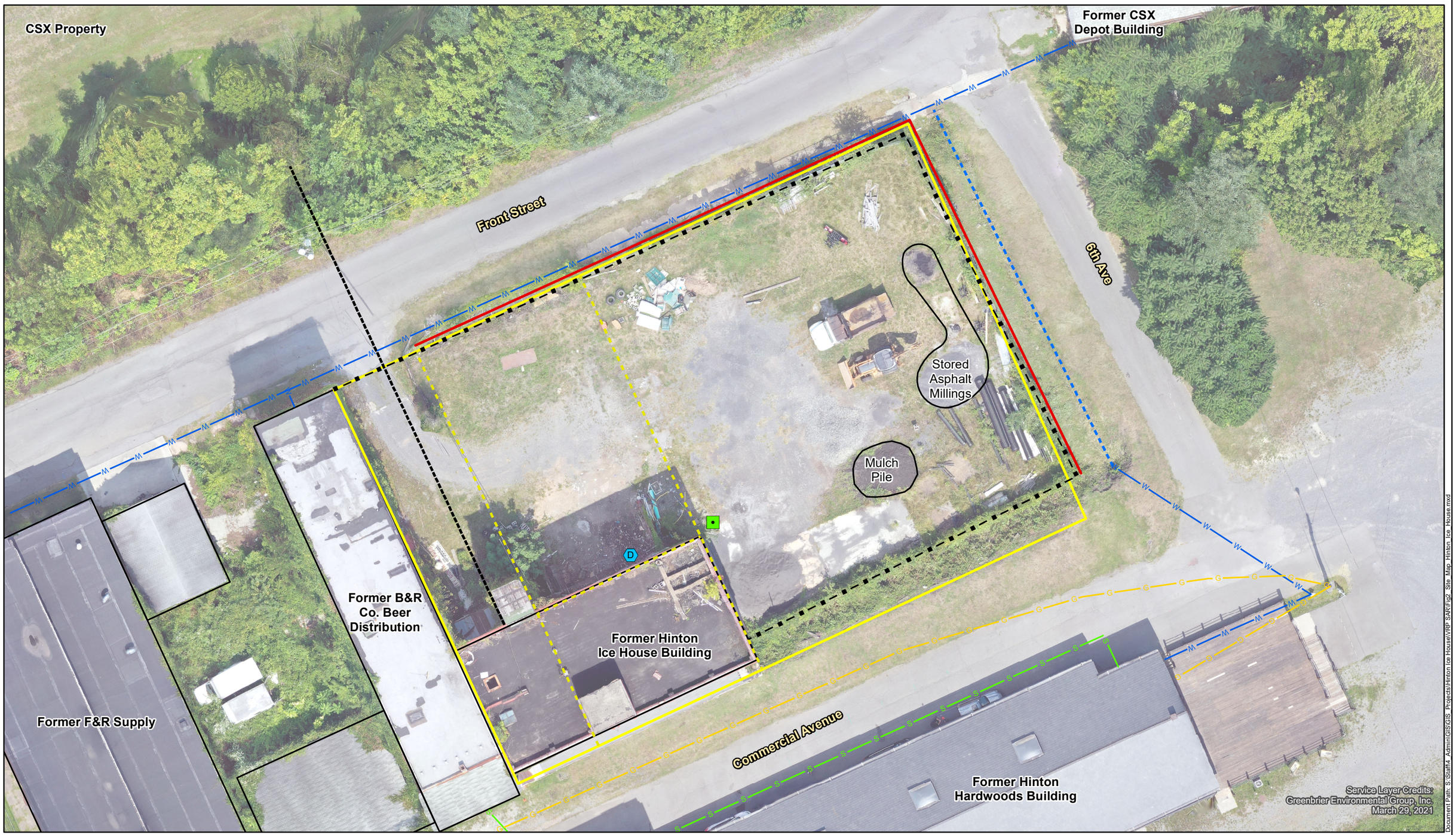


DRAWN BY: JB	PROJECT NUMBER: NRG-2021-004
CHECKED BY: MF	DATE: 11/30/2023
APPROVED:	REVISED:
DES:	FIGURE NUMBER 1

TITLE:

SITE LOCATION MAP

Former Hinton Ice House
508 Commercial Avenue
Hinton, Summers County, West Virginia



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Greenbrier Environmental Group, Inc.

Legend

- Drum
- Poly Tote (Empty)
- Ditch
- Drain Line
- Fence
- Retaining Wall
- Approximate Property Boundary
- Approximate Location of Sanitary Sewer Line
- Approximate Location of Natural Gas Line
- Approximate Location of Water Line

N

ABSOLUTE SCALE: 1:300

Summers County, WV

0 6.25 12.5 25 Feet

DRAWN BY: DJ	PROJECT NUMBER: NRG-2021-004
CHECKED BY: MF	DATE: 2/16/2024
APPROVED:	REVISED: JB
SCALE: 1 " = 25 '	FIGURE NUMBER: 2

NOTES:

TITLE:

SITE MAP

Former Hinton Ice House Property
508 Commercial Avenue
Hinton, Summers County, West Virginia

Greenbrier Environmental Group, Inc.

Legend

- Surface Soil Sample Location (October 2017)
- Surface Soil Sample Location (July 2022)
- Drum
- Poly Tote (Empty)
- Ditch
- Drain Line
- Fence
- Retaining Wall
- Approximate Property Boundary

N

ABSOLUTE SCALE: 1:300

Summers County, WV

0 6.25 12.5 25 Feet

DRAWN BY: SD	PROJECT NUMBER: NRG-2021-004
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APPROVED:	REVISED: JB
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NOTES:

TITLE:

SURFACE SOIL SAMPLE LOCATION MAP

Former Hinton Ice House
508 Commercial Avenue
Hinton, Summers County, West Virginia

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Greenbrier Environmental Group, Inc.

Legend

- Subsurface Soil Sample Location (October 2017)
- Subsurface Soil Sample Location (July 2022)
- D — Drum
- Poly Tote (Empty)
- Ditch
- Drain Line
- Fence
- Retaining Wall
- Approximate Property Boundary

N

ABSOLUTE SCALE: 1:300

Summers County, WV

0 6.25 12.5 25 Feet

DRAWN BY: DJ	PROJECT NUMBER: NRG-2021-004
CHECKED BY: MF	DATE: 11/30/2023
APPROVED:	REVISED: JB
SCALE: 1 " = 25 '	FIGURE NUMBER: 4

NOTES:

TITLE:

SUBSURFACE SOIL SAMPLE LOCATION MAP

Former Hinton Ice House
508 Commercial Avenue
Hinton, Summers County, West Virginia

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Table 2-1A
Surface Soil Analytical Data and Comparison to De Minimis Screening Values - PCBs
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

Sample Name				SS-01	SS-02	SS-03	SS-04	SS-05	SS-06	SS-07	SS-08	SS-09	SS-10	SS-11	SS-12	SS-13	SS-14	SS-15	FD-1
Sample Location				SS01	SS02	SS03	SS04	SS05	SS06	SS07	SS08	SS09	SS10	SS11	SS12	SS07	SS01	SS15	SS15
Sample Depth				0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-2'	0-2'
Sample Date				10/17/2017	10/17/2017	10/17/2017	10/16/2017	10/16/2017	10/16/2017	10/16/2017	10/16/2017	10/16/2017	10/16/2017	10/16/2017	10/17/2017	10/16/2017	10/17/2017	7/14/2022	7/14/2022
Sample Type				Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Duplicate	Duplicate	Field Sample	Duplicate
Surface/Subsurface				Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface
Saturated/Unsaturated				Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated
On-Site/Off-Site				Off-Site	Off-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site
CAS No.		WVDEP Residential Soil De Minimis Standard (µg/kg) Res	WVDEP Industrial Soil De Minimis Standard (µg/kg) Ind																
Polychlorinated Biphenyls (µg/kg)																			
Aroclor-1016	12674-11-2	5,500	82,000	< 75	< 73	< 72	< 86	< 81 UJ	< 76	< 74	< 71	< 77	NA	< 73	< 74	< 71	< 75	< 230	< 77
Aroclor-1221	11104-28-2	260	12,000	< 75	< 73	< 72	< 86	< 81 UJ	< 76	< 74	< 71	< 77	NA	< 73	< 74	< 71	< 75	< 230	< 77
Aroclor-1232	11141-16-5	220	10,000	< 75	< 73	< 72	< 86	< 81 UJ	< 76	< 74	< 71	< 77	NA	< 73	< 74	< 71	< 75	< 230	< 77
Aroclor-1242	53469-21-9	310	15,000	< 75	< 73	< 72	< 86	< 81 UJ	< 76	< 74	< 71	< 77	NA	< 73	< 74	< 71	< 75	< 230	< 77
Aroclor-1248	12672-29-6	310	15,000	< 75	< 73	< 72	< 86	< 81 UJ	< 76	< 74	< 71	< 77	NA	< 73	< 74	< 71	< 75	< 230	< 77
Aroclor-1254	11097-69-1	320	15,000	< 75	< 73	< 72	< 86	< 81 UJ	< 76	**350 /Res**	< 71	< 77	NA	< 73	**180**	**270**	< 75	< 230	< 77
Aroclor-1260	11096-82-5	330	16,000	< 75	< 73	**45 J**	< 86	< 81 UJ	< 76	**140**	< 71	< 77	NA	< 73	**110**	**130**	< 75	< 230	< 77
Aroclor-1262	37324-23-5	Nav	Nav	< 75	< 73	< 72	< 86	< 81 UJ	< 76	< 74	< 71	< 77	NA	< 73	< 74	< 71	< 75	NA	NA
Aroclor-1268	11100-14-4	Nav	Nav	< 75	< 73	< 72	< 86	< 81 UJ	< 76	< 74	< 71	< 77	NA	< 73	< 74	< 71	< 75	NA	NA
Criteria Exceeded in Sample										/Res									

Notes:

J - analyte is present at an estimated concentration between the MDL and Report Limit

UJ - Undetected at an estimated quantitation limit because of a quality control outlier.

NA - not analyzed

Nav - not available

Abbreviations used in comparisons:

/Res - Indicates exceedance of the WVDEP residential soil de minimis standard, December 2022

/Ind - Indicates exceedance of the WVDEP industrial soil de minimis standard, December 2022

Sample Name Sample Location Sample Depth Sample Date Sample Type Surface/Subsurface Saturated/Unsaturated On-Site/Off-Site CAS No.		WVDEP Residential Soil De Minimis Standard (µg/kg) Res	WVDEP Industrial Soil De Minimis Standard (µg/kg) Ind	SB-01 SS01A 7.0-9.3' 10/17/2017 Field Sample Subsurface Unsaturated Off-Site	SB-03 SS03 13.5-15.0' 10/17/2017 Field Sample Subsurface Unsaturated On-Site	SB-04 SS04A 1.9-3.8' 10/16/2017 Field Sample Subsurface Unsaturated On-Site	SB-05 SS05 5.3-7.0' 10/16/2017 Field Sample Subsurface Unsaturated On-Site	SB-06 SS06 6.0-7.0' 10/16/2017 Field Sample Subsurface Unsaturated On-Site	SB-07 SS07 11.5-13.0' 10/16/2017 Field Sample Subsurface Unsaturated On-Site	SB-08 SS08 4.0-6.0' 10/17/2017 Field Sample Subsurface Unsaturated On-Site	SB-09 SS09C 9.2-10.0' 10/17/2017 Field Sample Subsurface Unsaturated On-Site	SB-10 SS10C 2.0-7.1' 10/16/2017 Field Sample Subsurface Unsaturated On-Site	SB-12 SS12 4.5-6.1' 10/17/2017 Field Sample Subsurface Unsaturated On-Site	SB-13 SS13 9.3-11.1' 10/17/2017 Field Sample Subsurface Unsaturated On-Site	SB-15 SS15 6-8' 7/14/2022 Field Sample Subsurface Unsaturated On-Site	FD-2 SS15 6-8' 7/14/2022 Duplicate Subsurface Unsaturated On-Site
Polychlorinated Biphenyls (µg/kg)																
Aroclor-1016	12674-11-2	5,500	82,000	< 74	< 77	< 77	< 75	< 75	< 75	< 75	< 78	< 76	< 77	< 78	< 74	< 74
Aroclor-1221	11104-28-2	260	12,000	< 74	< 77	< 77	< 75	< 75	< 75	< 75	< 78	< 76	< 77	< 78	< 74	< 74
Aroclor-1232	11141-16-5	220	10,000	< 74	< 77	< 77	< 75	< 75	< 75	< 75	< 78	< 76	< 77	< 78	< 74	< 74
Aroclor-1242	53469-21-9	310	15,000	< 74	< 77	< 77	< 75	< 75	< 75	< 75	< 78	< 76	< 77	< 78	< 74	< 74
Aroclor-1248	12672-29-6	310	15,000	< 74	< 77	< 77	< 75	< 75	< 75	< 75	< 78	< 76	< 77	< 78	< 74	< 74
Aroclor-1254	11097-69-1	320	15,000	< 74	< 77	< 77	< 75	< 75	< 75	< 75	< 78	< 76	< 77	< 78	< 74	< 74
Aroclor-1260	11096-82-5	330	16,000	< 74	< 77	< 77	< 75	< 75	< 75	< 75	< 78	< 76	< 77	< 78	< 74	< 74
Aroclor-1262	37324-23-5	Nav	Nav	< 74	< 77	< 77	< 75	< 75	< 75	< 75	< 78	< 76	< 77	< 78	NA	NA
Aroclor-1268	11100-14-4	Nav	Nav	< 74	< 77	< 77	< 75	< 75	< 75	< 75	< 78	< 76	< 77	< 78	NA	NA
Criteria Exceeded in Sample																

Notes:

Abbreviations used in comparisons:

NA - not analyzed

Nav - not available

/Res - Indicates exceedance of the WVDEP residential soil de minimis standard, December 2022

/Ind - Indicates exceedance of the WVDEP industrial soil de minimis standard, December 2022

Table 2-1C
Surface Soil Analytical Data and Comparison to De Minimis Screening Values - Metals
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

Sample Name		WVDEP Residential Soil De Minimis Standard (mg/kg)	WVDEP Industrial Soil De Minimis Standard (mg/kg)	WVDEP Default Standard Background Value (mg/kg)	SS-01	SS-02	SS-03	SS-04	SS-05	SS-06	SS-07	SS-08	SS-09	SS-10	SS-11	SS-12	SS-13	SS-14	SS-15	FD-1
Sample Location					SS01	SS02	SS03	SS04	SS05	SS06	SS07	SS08	SS09	SS10	SS11	SS12	SS07	SS01	SS15	SS15
Sample Depth					0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-0.5'	0.2'	0.2'
Sample Date					10/17/2017	10/17/2017	10/17/2017	10/16/2017	10/16/2017	10/16/2017	10/16/2017	10/16/2017	10/16/2017	10/16/2017	10/16/2017	10/17/2017	10/16/2017	10/17/2017	7/14/2022	7/14/2022
Sample Type					Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Duplicate	Duplicate	Field Sample	Duplicate
Surface/Subsurface					Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface
Saturated/Unsaturated					Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated
On-Site/Off-Site					Off-Site	Off-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site
CAS No.																				
Metals (mg/kg)																				
Mercury	7439-97-6	3.1	3.1	0.09	**0.11**	**0.23**	**0.076**	**0.98**	**0.54** J+	**0.25**	**0.15**	**0.15**	**0.41**	NA	**0.015** J	**0.14**	**0.17**	**0.13**	**0.25** J-	**0.45** J*
Aluminium	7429-90-5	77,000	1,000,000	77,120	**5600**	**7700**	**4600**	**7100**	**9200**	**6100**	**5900**	**5200**	**8500**	NA	**3500**	**6200**	**5600**	**6500**	NA	NA
Antimony	7440-36-0	31	470	0.89	< 4.3 U	**2.8**	< 4.5 U	**49** /Res	**24**	**10**	< 4.1	**3.3**	**1.4**	NA	< 3.7	**2.7** J+	**1.8**	**2.8** J	NA	NA
Arsenic	7440-38-2	0.68	30	13.1	**7.3** /Res	**13** J+/Res	**5.8** /Res	**400** J+/Ind	**52** J+/Ind	**33** J+/Ind	**4.4** /Res	**20** J+/Res	**10** /Res	NA	**4.4** /Res	**7.6** /Res	**6.1** /Res	**7.6** /Res	**9.7** /Res	**16** /Res
Barium	7440-39-3	15,000	220,000	565	**280**	**86**	**170**	**1200**	**630**	**240**	**370**	**230**	**170**	NA	**36**	**190**	**470**	**300**	**170**	**240**
Beryllium	7440-41-7	160	2,300	2.8	**0.28**	**0.44**	**0.43**	**0.91**	**1.0**	**0.64**	< 0.17 U	**0.35**	**0.85**	NA	**0.11** J	**0.44**	**0.22**	**0.32**	NA	NA
Cadmium	7440-43-9	37	530	0.5	< 8.6 U	< 0.80 U	< 9.1 U	< 8.5 U	**2.5** J+	**1.4** J+	< 8.3 U	**1.1** J+	< 0.77 U	NA	< 7.4 U	**1.9**	**2.6**	< 8.9 U	**0.60** J	**0.72** J
Calcium	7440-70-2	Nav	Nav	3,300	**160000**	**2900**	**130000**	**7100**	**22000**	**10000**	**190000**	**39000**	**65000**	NA	**260000**	**58000**	**270000**	**150000**	NA	NA
Chromium*	7440-47-3	120,000	1,000,000	57.4	**29**	**17** J+	**48**	**26** J+	**32** J+	**20** J+	**19**	**22** J+	**13**	NA	**8.7**	**24** J-	**16**	**26**	**10** J+	**17** J*
Cobalt	7440-48-4	23	350	23.8	**6.5**	**9.3**	**6.6**	**15**	**12**	**8.3**	**5.8**	**5.6**	**10**	NA	**4.2**	**7.1**	**5.1**	**5.8**	NA	NA
Copper	7440-50-8	3,100	47,000	27.5	**110**	**70**	**40**	**1100**	**210**	**210**	**68**	**63**	**33**	NA	**12**	**91**	**51**	**94**	NA	NA
Iron	7439-89-6	55,000	820,000	39,380	**28000**	**23000**	**27000**	**120000** /Res	**61000** J/Res	**33000**	**19000**	**29000**	**13000**	NA	**8000**	**19000**	**18000**	**32000**	NA	NA
Lead	7439-92-1	100**	247***	38	**350** /Ind	**240** /Res	**170** /Res	**3500** /Ind	**1400** /Ind	**610** /Ind	**100**	**740** /Ind	**120** /Res	NA	**9.3**	**180** /Res	**110** /Res	**310** /Ind	**260** J*/Ind	**370** /Ind
Magnesium	7439-95-4	Nav	Nav	5,640	**7900**	**600** J+	**6300**	**620**	**1600**	**1300**	**9300**	**2700**	**2100**	NA	**12000**	**3900**	**11000**	**7000**	NA	NA
Manganese	7439-96-5	1,800	26,000	1,998	**320**	**280**	**360**	**630**	**700**	**550**	**230**	**380**	**1100**	NA	**160**	**310**	**310**	**300**	NA	NA
Nickel	7440-02-0	1,500	22,000	34.4	**17**	**7.3** J+	**19**	**30**	**20**	**12**	**16**	**6.8**	**8.2**	NA	**10**	**14** J+	**15**	**13**	NA	NA
Potassium	7440-09-7	Nav	Nav	19,880	**640** J+	**620** J+	**580** J+	**330** J+	**680** J+	**530** J+	**540** J+	**690** J+	**430**	NA	**750**	**560** J+	**590**	**660**	NA	NA
Selenium	7782-49-2	390	5,800	0.8	**1.5**	**1.7**	**1.7**	**3.2**	**3.9**	**2.1**	**1.4** J*	**1.7**	**2.0**	NA	**1.7**	**2.0**	**4.3** J	**2.5**	**1.5**	**1.3**
Silver	7440-22-4	390	5,800	1	< 0.43	< 0.40	< 0.45	**0.16** J,J+	< 0.43	< 0.43	**0.18** J,J+	< 0.44	< 0.38	NA	< 0.37	< 0.42	< 0.35	< 0.44	**0.28** J	**0.44** J
Sodium	7440-23-5	Nav	Nav	3,600	**140** J+	**25**	**110** J+	**210** J+	**4100** J+	**74** J+	**160** J+	**290** J+	**1200**	NA	**180**	**67**	**280** B,J*	**120**	NA	NA
Thallium	7440-28-0	0.78	12	0.8	< 8.6	< 0.80	< 9.1	< 8.5	< 0.86	< 0.86	< 8.3	< 0.87	< 0.77	NA	< 7.4	< 0.85	< 0.71	< 8.9	NA	NA
Vanadium	7440-62-2	460	8,400	98.8	**13** J+	**24** J+	**21** J+	**19** J+	**29** J+	**20** J+	**12** J+	**15** J+	**20**	NA	**7.4**	**24** J+	**11**	**18**	NA	NA
Zinc	7440-66-6	23,000	350,000	103	**990** B	**150** B,J+	**200** B,J+	**3100** B	**1700** B	**660** B,J+	**970** B	**640** B,J+	**210**	NA	**110**	**860**	**1100**	**820**	NA	NA
Criteria Exceeded in Sample					/Res/Ind	/Res	/Res	/Res/Ind	/Res/Ind	/Res/Ind	/Res	/Res/Ind	/Res		/Res	/Res	/Res	/Res/Ind	/Res/Ind	/Res/Ind

Notes:

J - analyte is present at an estimated concentration between the MDL and Report Limit

B - Analyte detected in the associated Method Blank above the Reporting Limit

J* - Estimated value; one or more quality control parameters were outside control limits

J+ - estimated value with potential high bias

J- - estimated value with potential low bias

U - Undetected; the parameter was qualified as undetected during data validation

* = Data compared to de minimis standard for trivalent chromium (CAS #16065-83-1)

**= May 2024 USEPA Residential Regional Screening Level (RSL) based on multiple sources of lead

***=Industrial screening value of 247 mg/kg is based on proposed WVDEP industrial soil de minimis standard for lead (426 mg/kg) adjusted from a target blood lead level of 5 ug/dL to 3.5 ug/dL to account for multiple sources of lead

NA - not analyzed

Nav - Not available

Abbreviations used in comparisons:

/Res - Indicates exceedance of the WVDEP residential soil de minimis standard, December 2022

/Ind - Indicates exceedance of the WVDEP industrial soil de minimis standard, December 2022

Table 2-1D
Subsurface Soil Analytical Data and Comparison to De Minimis Screening Values - Metals
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

Sample Name					SB-01		SB-03		SB-04		SB-05		SB-06		SB-07		SB-08		SB-09		SB-10		SB-12		SB-13		SB-15		FD-2	
Sample Location					SS01A		SS03		SS04A		SS05		SS06		SS07		SS08		SS09C		SS10C		SS12		SS13		SS15		SS15	
Sample Depth					7.0-9.3'		13.5-15.0'		1.9-3.8'		5.3-7.0'		6.0-7.0'		11.5-13.0'		4.0-6.0'		9.2-10.0'		2.0-7.1'		4.5-6.1'		9.3-11.1'		6-8'		6-8'	
Sample Date					10/17/2017		10/17/2017		10/16/2017		10/16/2017		10/16/2017		10/16/2017		10/17/2017		10/17/2017		10/16/2017		10/17/2017		10/17/2017		7/14/2022		7/14/2022	
Sample Type					Field Sample		Field Sample		Field Sample		Field Sample		Field Sample		Field Sample		Field Sample		Field Sample		Field Sample		Field Sample		Field Sample		Field Sample		Duplicate	
Surface/Subsurface					Subsurface		Subsurface		Subsurface		Subsurface		Subsurface		Subsurface		Subsurface		Subsurface		Subsurface		Subsurface		Subsurface		Subsurface		Subsurface	
Saturated/Unsaturated					Unsaturated		Unsaturated		Unsaturated		Unsaturated		Unsaturated		Unsaturated		Unsaturated		Unsaturated		Unsaturated		Unsaturated		Unsaturated		Unsaturated		Unsaturated	
On-Site/Off-Site					Off-Site		On-Site		On-Site		On-Site		On-Site		On-Site		On-Site		On-Site		On-Site		On-Site		On-Site		On-Site		On-Site	
CAS No.		WVDEP Residential Soil De Minimis Standard (mg/kg)	WVDEP Industrial Soil De Minimis Standard (mg/kg)	WVDEP Default Standard Background Value (mg/kg)																										
		Res	Ind																											
Metals (mg/kg)																														
Mercury	7439-97-6	3.1	3.1	0.09	**0.040**		**0.037**		**0.048**		**0.064**		**0.12**		**0.022**		**0.052**		**0.025**		**0.038**		**0.059**		**0.045**		**0.024**		**0.037**	
Aluminum	7429-90-5	77,000	1,000,000	77,120	**9700**		**9500**		**9800**		**7800**		**6300**		**7800**		**6700**		**12000**		**9600**		**7600**		**11000**		NA		NA	
Antimony	7440-36-0	31	470	0.89	**1.8**		**1.4**		**1.6**		**1.7**		**5.7**		**1.1**		**1.1**		**2.0**		**1.4**		**1.1**		**1.1**		NA		NA	
Arsenic	7440-38-2	0.68	30	13.1	**13**	J+/Res	**7.7**	J+/Res	**9.2**	J+/Res	**10**	J+/Res	**17**	J+/Res	**8.0**	J+/Res	**5.7**	J+/Res	**17**	/Res	**7.5**	J+/Res	**8.4**	/Res	**6.8**	/Res	**6.7**	J-/Res	**4.0**	J*/Res
Barium	7440-39-3	15,000	220,000	565	**33**		**94**		**21**		**37**		**98**		**40**		**32**		**27**		**24**		**54**		**46**		**67**		**57**	
Beryllium	7440-41-7	160	2,300	2.8	**0.42**		< 0.18	U	< 0.19	U	**0.23**		**0.38**		**0.29**		< 0.15	U	**0.44**		< 0.18	U	**0.18**		**0.14**	J	NA		NA	
Cadmium	7440-43-9	37	530	0.5	< 0.83	U	< 0.89		< 0.94		< 0.89		< 0.92	U	< 0.82	U	< 0.73		< 0.75		< 0.89		< 0.84	U	< 0.83	U	< 0.75		< 0.74	
Calcium	7440-70-2	Nav	Nav	3,300	**860**		**780**		**1200**		**1200**		**4000**		**920**		**1200**		**630**		**480**		**1200**		**1000**		NA		NA	
Chromium*	7440-47-3	120,000	1,000,000	57.4	**22**	J+	**11**	J+	**12**	J+	**21**	J+	**16**	J+	**11**	J+	**14**		**11**		**15**	J+	**15**		**12**		**13**	J+	**12**	
Cobalt	7440-48-4	23	350	23.8	**8.1**		**3.8**		**5.5**		**8.2**		**6.1**		**4.1**		**10**		**15**		**5.8**		**14**		**4.1**		NA		NA	
Copper	7440-50-8	3,100	47,000	27.5	**12**		**9.2**		**8.5**		**8.1**		**41**		**8.0**		**4.3**		**13**		**7.9**		**6.1**		**9.1**		NA		NA	
Iron	7439-89-6	55,000	820,000	39,380	**31000**		**24000**		**24000**		**26000**		**35000**		**19000**		**17000**		**35000**		**24000**		**18000**		**17000**		NA		NA	
Lead	7439-92-1	100**	247***	38	**11**		**8.3**		**11**		**21**		**130**	/Res	**15**		**12**		**11**		**9.7**		**13**		**9.4**		**22**	J*	**8.7**	J*
Magnesium	7439-95-4	Nav	Nav	5,640	**1400**		**620**		**730**		**530**		**780**		**1200**		**450**		**1200**		**710**		**610**		**1200**		NA		NA	
Manganese	7439-96-5	1,800	26,000	1,998	**210**		**71**		**130**		**580**		**370**		**49**		**460**		**390**		**140**		**470**		**65**		NA		NA	
Nickel	7440-02-0	1,500	22,000	34.4	11		**5.1**		**4.4**		**3.0**		**10**		**7.9**		**2.7**		**9.0**		**4.7**		**3.5**		**6.7**		NA		NA	
Potassium	7440-09-7	Nav	Nav	19,880	**490**	J+	**450**	J+	**540**	J+	**380**	J+	**430**	J+	**450**	J+	**340**	J+	**550**		**530**	J+	**430**		**590**		NA		NA	
Selenium	7782-49-2	390	5,800	0.8	**1.2**		**1.3**		**1.1**		**1.7**		**1.8**		**1.2**		**0.96**		**2.2**		**1.3**		**1.9**		**2.0**		**0.53**	J	**0.38**	J
Silver	7440-22-4	390	5,800	1	< 0.41		< 0.45		< 0.47		< 0.44		< 0.46		< 0.41		< 0.36		< 0.38		< 0.45		< 0.42		< 0.42		**0.18**	J	**0.18**	J
Sodium	7440-23-5	Nav	Nav	3,600	**27**		**92**	J+	**31**		**340**	J+	**36**	J+	< 16	U	**26**	J+	**39**		< 18	U	**19**		**23**		NA		NA	
Thallium	7440-28-0	0.78	12	0.8	< 0.83		< 0.89		< 0.94		< 0.89		< 0.92		< 0.82		< 0.73		< 0.75		< 0.89		< 0.84		< 0.83		NA		NA	
Vanadium	7440-62-2	460	8,400	98.8	**22**	J+	**23**	J+	**24**	J+	**26**	J+	**20**	J+	**22**	J+	**23**	J+	**21**		**23**	J+	**25**		**27**		NA		NA	
Zinc	7440-66-6	23,000	350,000	103	**36**	B,J+	**23**	B,J+	**24**	B,J+	**26**	B,J+	**470**	B,J+	**27**	B,J+	**16**	B,J+	**39**		**24**	B,J+	**22**		**41**		NA		NA	
Criteria Exceeded in Sample					/Res		/Res		/Res		/Res		/Res		/Res		/Res		/Res		/Res		/Res		/Res		/Res		/Res	

Notes:

J - analyte is present at an estimated concentration between the MDL and Report Limit

B - Analyte detected in the associated Method Blank above the Reporting Limit

J* - Estimated value; one or more quality control parameters were outside control limits

J+ - estimated value with potential high bias

J- - estimated value with potential low bias

U - Undetected; the parameter was qualified as undetected during data validation

* = Data compared to de minimis standard for trivalent chromium (CAS #16065-83-1)

**= May 2024 USEPA Residential Regional Screening Level (RSL) based on multiple sources of lead

***=Industrial screening value of 247 mg/kg is based on proposed WVDEP industrial soil de minimis standard for lead (426 mg/kg) adjusted from a target blood lead level of 5 ug/dL to 3.5 ug/dL to account for multiple sources of lead

NA - not analyzed

Nav - not available

Abbreviations used in comparisons:

/Res - Indicates exceedance of the WVDEP residential soil de minimis standard, December 2022

/Ind - Indicates exceedance of the WVDEP industrial soil de minimis standard, December 2022

Sample Name				SS-01	SS-02	SS-03	SS-04	SS-05	SS-06	SS-07	SS-08	SS-09	SS-10	SS-11	SS-12	SS-13	SS-14	SS-15	FD-1
Sample Location				SS01	SS02	SS03	SS04	SS05	SS06	SS07	SS08	SS09	SS10	SS11	SS12	SS07	SS01	SS15	SS15
Sample Depth				0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-2'	0-2'
Sample Date				10/17/2017	10/17/2017	10/17/2017	10/16/2017	10/16/2017	10/16/2017	10/16/2017	10/16/2017	10/16/2017	10/16/2017	10/16/2017	10/17/2017	10/16/2017	10/17/2017	7/14/2022	7/14/2022
Sample Type				Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Duplicate	Duplicate	Field Sample	Duplicate
Surface/Subsurface				Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface
Saturated/Unsaturated				Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated
On-Site/Off-Site				Off-Site	Off-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site
CAS No.		WVDEP Residential Soil De Minimis Standard (ug/kg) Res	WVDEP Industrial Soil De Minimis Standard (ug/kg) Ind																
Herbicides (ug/kg)																			
2,4-DB	94-82-6	1,900,000	25,000,000	< 76.1 UJ	< 74.0 UJ	< 73.1 UJ	< 84.4 UJ	< 82.4 UJ	< 79.2 UJ	< 72.9 UJ	< 73.0 UJ	< 75.0 UJ	< 76.7 UJ	< 73.7 UJ	< 74.9 UJ	< 72.4	< 78.8	< 133	< 125
2,4,5-T (Trichlorophenoxyacetic acid)	93-76-5	630,000	8,200,000	< 76.1 UJ	< 74.0 UJ	< 73.1 UJ	< 84.4 UJ	< 82.4 UJ	< 79.2 UJ	< 72.9 UJ	< 73.0 UJ	< 75.0 UJ	< 76.7 UJ	< 73.7 UJ	< 74.9 UJ	< 72.4 UJ	< 78.8 UJ	< 226	< 213
2,4-D (Dichlorophenoxyacetic acid)	94-75-7	700,000	9,600,000	< 76.1 UJ	< 74.0 UJ	< 73.1 UJ	< 84.4 UJ	< 82.4 UJ	< 79.2 UJ	< 72.9 UJ	< 73.0 UJ	< 75.0 UJ	< 76.7 UJ	< 73.7 UJ	< 74.9 UJ	< 72.4 UJ	< 78.8 UJ	< 133	< 125
Silvex (2,4,5-TP)	93-72-1	510,000	6,600,000	< 76.1 UJ	< 74.0 UJ	< 73.1 UJ	< 84.4 UJ	< 82.4 UJ	< 79.2 UJ	< 72.9 UJ	< 73.0 UJ	< 75.0 UJ	< 76.7 UJ	< 73.7 UJ	< 74.9 UJ	< 72.4 UJ	< 78.8 UJ	< 133	< 125
Dalapon	75-99-0	1,900,000	25,000,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	< 133	< 125
Dicamba	1918-00-9	1,900,000	25,000,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	< 133	< 125
Dichloroprop	120-36-5	Nav	Nav	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	< 133	< 125
Dinoseb	88-85-7	63,000	820,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	< 226 UJ	< 213 UJ
MCPA	94-74-6	32,000	410,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	< 16000	< 15000
MCPP	7085-19-0	Nav	Nav	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	< 16000	< 15000
Pentachlorophenol	87-86-5	1,000	40,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	< 133	< 125
Criteria Exceeded in Sample																			

Notes:
UJ - per data validation report, data are to be used cautiously as they are estimated

NA - not analyzed

Nav - not available

Abbreviations used in comparisons:

/Res - Indicates exceedance of the WVDEP residential soil de minimis standard, December 2022

/Ind - Indicates exceedance of the WVDEP industrial soil de minimis standard, December 2022

Sample Name				SB-01	SB-03	SB-04	SB-05	SB-06	SB-07	SB-08	SB-09	SB-10	SB-12	SB-13	SB-15	FD-2
Sample Location				SS01A	SS03	SS04A	SS05	SS06	SS07	SS08	SS09C	SS10C	SS12	SS13	SS15	SS15
Sample Depth				7.0-9.3'	13.5-15.0'	1.9-3.8'	5.3-7.0'	6.0-7.0'	11.5-13.0'	4.0-6.0'	9.2-10.0'	2.0-7.1'	4.5-6.1'	9.3-11.1'	6-8'	6-8'
Sample Date				10/17/2017	10/17/2017	10/16/2017	10/16/2017	10/16/2017	10/16/2017	10/17/2017	10/17/2017	10/16/2017	10/17/2017	10/17/2017	7/14/2022	7/14/2022
Sample Type				Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Duplicate
Surface/Subsurface				Subsurface	Subsurface	Subsurface	Subsurface	Subsurface	Subsurface	Subsurface	Subsurface	Subsurface	Subsurface	Subsurface	Subsurface	Subsurface
Saturated/Unsaturated				Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated
On-Site/Off-Site				Off-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site
CAS No.		WVDEP Residential Soil De Minimis Standard (µg/kg) Res	WVDEP Industrial Soil De Minimis Standard (µg/kg) Ind													
Herbicides (µg/kg)																
2,4-DB	94-82-6	1,900,000	25,000,000	< 75.3 UJ	< 77.5 UJ	< 77.6 UJ	< 75.7 UJ	< 75.1 UJ	< 75.3 UJ	< 76.2 UJ	< 76.7 UJ	< 75.3 UJ	< 77.6 UJ	< 78.4	< 112	< 117
2,4,5-T (Trichlorophenoxyacetic acid)	93-76-5	630,000	8,200,000	< 75.3 UJ	< 77.5 UJ	< 77.6 UJ	< 75.7 UJ	< 75.1 UJ	< 75.3 UJ	< 76.2 UJ	< 76.7 UJ	< 75.3 UJ	< 77.6 UJ	< 78.4 UJ	< 191	< 199
2,4-D (Dichlorophenoxyacetic acid)	94-75-7	700,000	9,600,000	< 75.3 UJ	< 77.5 UJ	< 77.6 UJ	< 75.7 UJ	< 75.1 UJ	< 75.3 UJ	< 76.2 UJ	< 76.7 UJ	< 75.3 UJ	< 77.6 UJ	< 78.4 UJ	< 112	< 117
Silvex (2,4,5-TP)	93-72-1	510,000	6,600,000	< 75.3 UJ	< 77.5 UJ	< 77.6 UJ	< 75.7 UJ	< 75.1 UJ	< 75.3 UJ	< 76.2 UJ	< 76.7 UJ	< 75.3 UJ	< 77.6 UJ	< 78.4 UJ	< 112	< 117
Dalapon	75-99-0	1,900,000	25,000,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	< 112	< 117
Dicamba	1918-00-9	1,900,000	25,000,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	< 112	< 117
Dichloroprop	120-36-5	Nav	Nav	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	< 112	< 117
Dinoseb	88-85-7	63,000	820,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	< 161 UJ	< 199 UJ
MCPA	94-74-6	32,000	410,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	< 13500	< 14000
MCPP	7085-19-0	Nav	Nav	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	< 13500	< 14000
Pentachlorophenol	87-86-5	1,000	40,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	< 112	< 117
Criteria Exceeded in Sample																

Notes:

UJ - per data validation report, data are to be used cautiously as they are estimated

NA - not analyzed

Nav - not available

Abbreviations used in comparisons:

/Res - Indicates exceedance of the WVDEP residential soil de minimis standard, December 2022

/Ind - Indicates exceedance of the WVDEP industrial soil de minimis standard, December 2022

Sample Name				SS-01	SS-02	SS-03	SS-04	SS-05	SS-06	SS-07	SS-08	SS-09	SS-10	SS-11	SS-12	SS-13	SS-14	SS-15	FD-1
Sample Location				SS01	SS02	SS03	SS04	SS05	SS06	SS07	SS08	SS09	SS10	SS11	SS12	SS07	SS01	SS15	SS15
Sample Depth				0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-2'	0-2'
Sample Date				10/17/2017	10/17/2017	10/17/2017	10/16/2017	10/16/2017	10/16/2017	10/16/2017	10/16/2017	10/16/2017	10/17/2017	10/16/2017	10/17/2017	10/16/2017	10/17/2017	7/14/2022	7/14/2022
Sample Type				Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Duplicate	Duplicate	Field Sample	Duplicate
Surface/Subsurface				Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface
Saturated/Unsaturated				Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated
On-Site/Off-Site				Off-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site
CAS No.		WVDEP Residential Soil De Minimis Standard (µg/kg) Res	WVDEP Industrial Soil De Minimis Standard (µg/kg) Ind																
Volatile Organic Compounds (µg/kg)																			
1,1,1-Trichloroethane	71-55-6	640,000	640,000	< 41	NA	NA	NA	NA	< 44	< 40	< 38	< 40	< 39	NA	NA	NA	NA	< 48	< 49
1,1,2,2-Tetrachloroethane	79-34-5	640	28,000	< 41	NA	NA	NA	NA	< 44	< 40	< 38	< 40	< 39	NA	NA	NA	NA	< 48 UJ	< 49
1,1,2-Trichloroethane	79-00-5	1,200	6,800	< 41	NA	NA	NA	NA	< 44	< 40	< 38	< 40	< 39	NA	NA	NA	NA	< 48	< 49
1,1,2-Trichlorotrifluoroethane	76-13-1	910,000	910,000	< 41	NA	NA	NA	NA	< 44	< 40	< 38	< 40	< 39	NA	NA	NA	NA	< 48	< 49
1,1-Dichloroethane	75-34-3	3,800	170,000	< 41	NA	NA	NA	NA	< 44	< 40	< 38	< 40	< 39	NA	NA	NA	NA	< 48	< 49
1,1-Dichloroethene	75-35-4	240,000	1,100,000	< 41	NA	NA	NA	NA	< 44	< 40	< 38	< 40	< 39	NA	NA	NA	NA	< 48	< 49
1,2,3-Trichlorobenzene	87-61-6	Nav	Nav	< 41	NA	NA	NA	NA	< 44	< 40	< 38	< 40	< 39	NA	NA	NA	NA	< 160	< 160
1,2,4-Trichlorobenzene	120-82-1	24,000	280,000	< 41	NA	NA	NA	NA	< 44	< 40	< 38	< 40	< 39	NA	NA	NA	NA	< 160	< 160
1,2-Dibromo-3-chloropropane	96-12-8	5.7	690	< 140	NA	NA	NA	NA	< 150	< 130	< 130	< 130	< 130	NA	NA	NA	NA	< 160	< 160
1,2-Dibromoethane	106-93-4	39	1,700	< 41	NA	NA	NA	NA	< 44	< 40	< 38	< 40	< 39	NA	NA	NA	NA	< 48	< 49
1,2-Dichlorobenzene	95-50-1	380,000	380,000	< 41	NA	NA	NA	NA	< 44	< 40	< 38	< 40	< 39	NA	NA	NA	NA	< 48	< 49
1,2-Dichloroethane	107-06-2	500	22,000	< 41	NA	NA	NA	NA	< 44	< 40	< 38	< 40	< 39	NA	NA	NA	NA	< 160	< 160
1,2-Dichloropropane	78-87-5	2,700	71,000	< 41	NA	NA	NA	NA	< 44	< 40	< 38	< 40	< 39	NA	NA	NA	NA	< 48	< 49
1,3-Dichlorobenzene	541-73-1	Nav	Nav	< 41	NA	NA	NA	NA	< 44	< 40	< 38	< 40	< 39	NA	NA	NA	NA	< 48	< 49
1,4-Dichlorobenzene	106-46-7	2,800	120,000	< 41	NA	NA	NA	NA	< 44	< 40	< 38	< 40	< 39	NA	NA	NA	NA	< 48	< 49
2-Butanone	78-93-3	28,000,000	28,000,000	< 270	NA	NA	NA	NA	< 290	< 270	< 250	< 270	**380**	NA	NA	NA	NA	< 320	**230** J
2-Hexanone	591-78-6	Nav	Nav	< 41	NA	NA	NA	NA	< 44	< 40	< 38	< 40	< 39	NA	NA	NA	NA	< 48	< 49
4-Methyl-2-pentanone	108-10-1	3,400,000	3,400,000	< 41	NA	NA	NA	NA	< 44	< 40	< 38	< 40	< 39	NA	NA	NA	NA	< 48	< 49
Acetone	67-64-1	61,000,000	110,000,000	< 140	NA	NA	NA	NA	< 150	< 130	< 130	< 130	< 130	NA	NA	NA	NA	< 220 U	< 210 U
Benzene	71-43-2	1,200	54,000	< 41	NA	NA	NA	NA	< 44	< 40	< 38	< 40	< 39	NA	NA	NA	NA	< 48	< 49
Bromochloromethane	74-97-5	Nav	Nav	< 41	NA	NA	NA	NA	< 44	< 40	< 38	< 40	< 39	NA	NA	NA	NA	< 48	< 49
Bromodichloromethane	75-27-4	310	14,000	< 41	NA	NA	NA	NA	< 44	< 40	< 38	< 40	< 39	NA	NA	NA	NA	< 48	< 49
Bromoform	75-25-2	20,000	910,000	< 41	NA	NA	NA	NA	< 44	< 40	< 38	< 40	< 39	NA	NA	NA	NA	< 48	< 49
Bromomethane	74-83-9	7,300	32,000	< 140	NA	NA	NA	NA	< 150	< 130	< 130	< 130	< 130	NA	NA	NA	NA	< 160	< 160
Carbon disulfide	75-15-0	740,000	740,000	< 41	NA	NA	NA	NA	< 44	< 40	< 38	< 40	< 39	NA	NA	NA	NA	< 48	< 49
Carbon tetrachloride	56-23-5	700	31,000	< 41	NA	NA	NA	NA	< 44	< 40	< 38	< 40	< 39	NA	NA	NA	NA	< 48	< 49
Chlorobenzene	108-90-7	290,000	760,000	< 41	NA	NA	NA	NA	< 44	< 40	< 38	< 40	< 39	NA	NA	NA	NA	< 48	< 49
Chloroethane	75-00-3	2,100,000	2,100,000	< 140	NA	NA	NA	NA	< 150	< 130	< 130	< 130	< 130	NA	NA	NA	NA	< 160	< 160
Chloroform	67-66-3	340	15,000	< 41	NA	NA	NA	NA	< 44	< 40	< 38	< 40	< 39	NA	NA	NA	NA	< 48	< 49
Chloromethane	74-87-3	120,000	500,000	< 140	NA	NA	NA	NA	< 150	< 130	< 130	< 130	< 130	NA	NA	NA	NA	< 160	< 160
cis-1,2-Dichloroethene	156-59-2	17,000	80,000	< 41	NA	NA	NA	NA	< 44	< 40	< 38	< 40	< 39	NA	NA	NA	NA	< 48	< 49
cis-1,3-Dichloropropene	10061-01-5	Nav	Nav	< 41	NA	NA	NA	NA	< 44	< 40	< 38	< 40	< 39	NA	NA	NA	NA	< 48	< 49
Cyclohexane	110-82-7	120,000	120,000	< 41	NA	NA	NA	NA	< 44	< 40	< 38	< 40	< 39	NA	NA	NA	NA	< 160	< 160
Cyclohexanone	108-94-1	5,100,000	5,100,000	< 41	NA	NA	NA	NA	< 44	< 40	< 38	< 40	< 39	NA	NA	NA	NA	NA	NA
Dibromochloromethane	124-48-1	8,300	390,000	< 41	NA	NA	NA	NA	< 44	< 40	< 38	< 40	< 39	NA	NA	NA	NA	< 48	< 49
Dichlorodifluoromethane	75-71-8	94,000	400,000	< 41	NA	NA	NA	NA	< 44	< 40	< 38	< 40	< 39	NA	NA	NA	NA	< 160 UJ	< 160 UJ
Ethylbenzene	100-41-4	6,200	270,000	< 41	NA	NA	NA	NA	< 44	< 40	< 38	< 40	< 39	NA	NA	NA	NA	< 48	< 49
Isopropylbenzene	98-82-8	270,000	270,000	< 41	NA	NA	NA	NA	< 44	< 40	< 38	< 40	< 39	NA	NA	NA	NA	< 48	< 49
m,p-Xylene	136777-61-2	Nav	Nav	**53** J	NA	NA	NA	NA	**36** J	**89**	**30** J	< 80	**71** J	NA	NA	NA	NA	< 97	< 98
Methyl acetate	79-20-9	23,000,000	29,000,000	**230** J	NA	NA	NA	NA	**160** J	< 270 UJ	< 250 UJ	< 270 UJ	**99** J	NA	NA	NA	NA	**150** J	**130** J
Methyl tert-butyl ether	1634-04-4	50,000	2,200,000	< 41	NA	NA	NA	NA	< 44	< 40	< 38	< 40	< 39	NA	NA	NA	NA	< 48	< 49
Methylcyclohexane	108-87-2	Nav	Nav	**140**	NA	NA	NA	NA	**140**	**190**	**73**	< 40	< 39	NA	NA	NA	NA	< 48	< 49
Methylene chloride	75-09-2	58,000	3,300,000	< 41	NA	NA	NA	NA	< 44	< 40	< 38	< 40	< 39	NA	NA	NA	NA	**240** J	**380** J
Naphthalene	91-20-3	2,400	110,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	< 160	< 160
o-Xylene	95-47-6	Nav	Nav	**33** J	NA	NA	NA	NA	< 44	**50**	**17** J	< 40	**53**	NA	NA	NA	NA	< 48	< 49
Styrene	100-42-5	870,000	870,000	< 41	NA	NA	NA	NA	< 44	< 40	< 38	< 40	< 39	NA	NA	NA	NA	< 48	< 49
Tetrachloroethene	127-18-4	25,000	170,000	< 41	NA	NA	NA	NA	< 44	< 40	< 38	< 40	< 39	NA	NA	NA	NA	< 48	< 49
Toluene	108-88-3	820,000	820,000	**33** J	NA	NA	NA	NA	< 44	**110**	**29** J	**25** J	< 39	NA	NA	NA	NA	< 48	< 49
trans-1,2-Dichloroethene	156-60-5	75,000	320,000	< 41	NA	NA	NA	NA	< 44	< 40	< 38	< 40	< 39	NA	NA	NA	NA	< 48	< 49
trans-1,3-Dichloropropene	10061-02-6	Nav	Nav	< 41	NA	NA	NA	NA	< 44	< 40	< 38	< 40	< 39	NA	NA	NA	NA	< 48	< 49
Trichloroethene	79-01-6	1,000	20,000	< 41	NA	NA	NA	NA	< 44	< 40	< 38	< 40	< 39	NA	NA	NA	NA	< 48	< 49
Trichlorofluoromethane	75-69-4	790,000	1,200,000	< 41	NA	NA	NA	NA	< 44	< 40	< 38	< 40	< 39	NA	NA	NA	NA	< 48	< 49
Vinyl chloride	75-01-4	61	18,000	< 41	NA	NA	NA	NA	< 44	< 40	< 38	< 40	< 39	NA	NA	NA	NA	< 48	< 49
Xylenes, Total	1330-20-7	260,000	260,000	**86** J	NA	NA	NA	NA	< 130	**140**	**47** J	< 120	**120**	NA	NA	NA	NA	< 150	< 150
Criteria Exceeded in Sample																			

Notes:

J - analyte is present at an estimated concentration between the MDL and Report Limit

U - Undetected; the parameter was qualified as undetected during data validation

UJ - per data validation report, data are to be used cautiously as they are estimated

NA - not analyzed

Nav - not available

Abbreviations used in comparisons:

Res - Indicates exceedance of the WVDEP residential soil de minimis standard, December 2022

/Ind - Indicates exceedance of the WVDEP industrial soil de minimis standard, December 2022

Table 2-1H
Subsurface Soil Analytical Data and Comparison to De Minimis Screening Values - VOCs
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

Sample Name Sample Location Sample Depth Sample Date Sample Type Surface/Subsurface Saturated/Unsaturated On-Site/Off-Site CAS No.		WVDEP Residential Soil De Minimis Standard (µg/kg) Res	WVDEP Industrial Soil De Minimis Standard (µg/kg) Ind	SB-01 SS01A 8.5-8.7' 10/17/2017 Field Sample Subsurface Unsaturated Off-Site	SB-03 SS03 14.4-14.6' 10/17/2017 Field Sample Subsurface Unsaturated On-Site	SB-04 SS04A 2.8-3.0' 10/16/2017 Field Sample Subsurface Unsaturated On-Site	SB-05 SS05 6.3-6.4' 10/16/2017 Field Sample Subsurface Unsaturated On-Site	SB-06 SS06 6.6-6.8' 10/16/2017 Field Sample Subsurface Unsaturated On-Site	SB-07 SS07 12.7-12.9' 10/16/2017 Field Sample Subsurface Unsaturated On-Site	SB-08 SS08 5.5-5.7' 10/17/2017 Field Sample Subsurface Unsaturated On-Site	SB-09 SS09C 9.5-9.7' 10/17/2017 Field Sample Subsurface Unsaturated On-Site	SB-10 SS10C 2.0-7.1' 10/16/2017 Field Sample Subsurface Unsaturated On-Site	SB-12 SS12 5.6-5.8' 10/17/2017 Field Sample Subsurface Unsaturated On-Site	SB-13 SS13 10.2-10.5' 10/17/2017 Field Sample Subsurface Unsaturated On-Site	SB-15 SS15 6-8' 7/14/2022 Field Sample Subsurface Unsaturated On-Site	FD-2 SS15 6-8' 7/14/2022 Duplicate Subsurface Unsaturated On-Site
Volatile Organic Compounds (µg/kg)																
1,1,1-Trichloroethane	71-55-6	640,000	640,000	< 37	< 41	< 40	< 39	< 38	< 36	< 38	< 38	NA	< 41	< 41	< 37	< 32
1,1,2,2-Tetrachloroethane	79-34-5	640	28,000	< 37	< 41	< 40	< 39	< 38	< 36	< 38	< 38	NA	< 41	< 41	< 37	< 32
1,1,2-Trichloroethane	79-00-5	1,200	6,800	< 37	< 41	< 40	< 39	< 38	< 36	< 38	< 38	NA	< 41	< 41	< 37	< 32
1,1,2-Trichlorotrifluoroethane	76-13-1	910,000	910,000	< 37	< 41	< 40	< 39	< 38	< 36	< 38	< 38	NA	< 41	< 41	< 37	< 32
1,1-Dichloroethane	75-34-3	3,800	170,000	< 37	< 41	< 40	< 39	< 38	< 36	< 38	< 38	NA	< 41	< 41	< 37	< 32
1,1-Dichloroethene	75-35-4	240,000	1,100,000	< 37	< 41	< 40	< 39	< 38	< 36	< 38	< 38	NA	< 41	< 41	< 37	< 32
1,2,3-Trichlorobenzene	87-61-6	Nav	Nav	< 37	< 41	< 40	< 39	< 38	< 36	< 38	< 38	NA	< 41	< 41	< 120	< 110
1,2,4-Trichlorobenzene	120-82-1	24,000	280,000	< 37	< 41	< 40	< 39	< 38	< 36	< 38	< 38	NA	< 41	< 41	< 120	< 110
1,2-Dibromo-3-chloropropane	96-12-8	5.7	690	< 120	< 140	< 130	< 130	< 130	< 120	< 130	< 130	NA	< 140	< 140	< 120	< 110
1,2-Dibromoethane	106-93-4	39	1,700	< 37	< 41	< 40	< 39	< 38	< 36	< 38	< 38	NA	< 41	< 41	< 37	< 32
1,2-Dichlorobenzene	95-50-1	380,000	380,000	< 37	< 41	< 40	< 39	< 38	< 36	< 38	< 38	NA	< 41	< 41	< 37	< 32
1,2-Dichloroethane	107-06-2	500	22,000	< 37	< 41	< 40	< 39	< 38	< 36	< 38	< 38	NA	< 41	< 41	< 120	< 110
1,2-Dichloropropane	78-87-5	2,700	71,000	< 37	< 41	< 40	< 39	< 38	< 36	< 38	< 38	NA	< 41	< 41	< 37	< 32
1,3-Dichlorobenzene	541-73-1	Nav	Nav	< 37	< 41	< 40	< 39	< 38	< 36	< 38	< 38	NA	< 41	< 41	< 37	< 32
1,4-Dichlorobenzene	106-46-7	2,800	120,000	< 37	< 41	< 40	< 39	< 38	< 36	< 38	< 38	NA	< 41	< 41	< 37	< 32
2-Butanone	78-93-3	28,000,000	28,000,000	< 250	< 280	< 270	< 260	< 250	< 240	< 250	< 250	NA	< 270	< 280	< 250 R	**130 J**
2-Hexanone	591-78-6	Nav	Nav	< 37	< 41	< 40	< 39	< 38	< 36	< 38	< 38	NA	< 41	< 41	< 37	< 32
4-Methyl-2-pentanone	108-10-1	3,400,000	3,400,000	< 37	< 41	< 40	< 39	< 38	< 36	< 38	< 38	NA	< 41	< 41	< 37	< 32
Acetone	67-64-1	61,000,000	110,000,000	< 120	< 140	< 130	< 130	< 130	< 120	< 130	< 130	NA	< 140	< 140	< 130 U,UJ	< 110
Benzene	71-43-2	1,200	54,000	< 37	< 41	< 40	< 39	< 38	< 36	< 38	< 38	NA	< 41	< 41	< 37	< 32
Bromochloromethane	74-97-5	Nav	Nav	< 37	< 41	< 40	< 39	< 38	< 36	< 38	< 38	NA	< 41	< 41	< 37	< 32
Bromodichloromethane	75-27-4	310	14,000	< 37	< 41	< 40	< 39	< 38	< 36	< 38	< 38	NA	< 41	< 41	< 37	< 32
Bromoform	75-25-2	20,000	910,000	< 37	< 41	< 40	< 39	< 38	< 36	< 38	< 38	NA	< 41	< 41	< 37	< 32
Bromomethane	74-83-9	7,300	32,000	< 120	< 140	< 130	< 130	< 130	< 120	< 130	< 130	NA	< 140	< 140	< 120	< 110
Carbon disulfide	75-15-0	740,000	740,000	< 37	< 41	< 40	< 39	< 38	< 36	< 38	< 38	NA	< 41	< 41	< 37	< 32
Carbon tetrachloride	56-23-5	700	31,000	< 37	< 41	< 40	< 39	< 38	< 36	< 38	< 38	NA	< 41	< 41	< 37	< 32
Chlorobenzene	108-90-7	290,000	760,000	< 37	< 41	< 40	< 39	< 38	< 36	< 38	< 38	NA	< 41	< 41	< 37	< 32
Chloroethane	75-00-3	2,100,000	2,100,000	< 120	< 140	< 130	< 130	< 130	< 120	< 130	< 130	NA	< 140	< 140	< 120	< 110
Chloroform	67-66-3	340	15,000	< 37	< 41	< 40	< 39	< 38	< 36	< 38	< 38	NA	< 41	< 41	< 37	< 32
Chloromethane	74-87-3	120,000	500,000	< 120	< 140	< 130	< 130	< 130	< 120	< 130	< 130	NA	< 140	< 140	< 120	< 110
cis-1,2-Dichloroethene	156-59-2	17,000	80,000	< 37	< 41	< 40	< 39	< 38	< 36	< 38	< 38	NA	< 41	< 41	< 37	< 32
cis-1,3-Dichloropropene	10061-01-5	Nav	Nav	< 37	< 41	< 40	< 39	< 38	< 36	< 38	< 38	NA	< 41	< 41	< 37	< 32
Cyclohexane	110-82-7	120,000	120,000	< 37	< 41	< 40	< 39	< 38	< 36	< 38	< 38	NA	< 41	< 41	< 120	< 110
Cyclohexanone	108-94-1	5,100,000	5,100,000	< 37	< 41	< 40	< 39	< 38	< 36	< 38	< 38	NA	< 41	< 41	NA	NA
Dibromochloromethane	124-48-1	8,300	390,000	< 37	< 41	< 40	< 39	< 38	< 36	< 38	< 38	NA	< 41	< 41	< 37	< 32
Dichlorodifluoromethane	75-71-8	94,000	400,000	< 37	< 41	< 40	< 39	< 38	< 36	< 38	< 38	NA	< 41	< 41	< 120 UJ	< 110 UJ
Ethylbenzene	100-41-4	6,200	270,000	< 37	< 41	< 40	< 39	< 38	< 36	< 38	< 38	NA	< 41	< 41	< 37	< 32
Isopropylbenzene	98-82-8	270,000	270,000	< 37	< 41	< 40	< 39	< 38	< 36	< 38	< 38	NA	< 41	< 41	< 37	< 32
m,p-Xylene	136777-61-2	Nav	Nav	< 75	< 83	< 80	< 78	< 76	< 72	< 76	< 76	NA	< 81	< 83	< 75	< 64
Methyl acetate	79-20-9	23,000,000	29,000,000	< 250 UJ	< 280 UJ	< 270 UJ	< 260 UJ	< 250 UJ	< 240 UJ	< 250 UJ	< 250 UJ	NA	< 270 UJ	< 280 UJ	**200 J**	**93 J**
Methyl tert-butyl ether	1634-04-4	50,000	2,200,000	< 37	< 41	< 40	< 39	< 38	< 36	< 38	< 38	NA	< 41	< 41	< 37	< 32
Methylcyclohexane	108-87-2	Nav	Nav	< 37	< 41	< 40	< 39	< 38	< 36	< 38	< 38	NA	< 41	< 41	< 37	< 32
Methylene chloride	75-09-2	58,000	3,300,000	< 37	< 41	< 40	< 39	< 38	< 36	< 38	< 38	NA	< 41	< 41	**230 J**	**150 J**
Naphthalene	91-20-3	2,400	110,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	< 120	< 110
o-Xylene	95-47-6	Nav	Nav	< 37	< 41	< 40	< 39	< 38	< 36	< 38	< 38	NA	< 41	< 41	< 37	< 32
Styrene	100-42-5	870,000	870,000	< 37	< 41	< 40	< 39	< 38	< 36	< 38	< 38	NA	< 41	< 41	< 37	< 32
Tetrachloroethene	127-18-4	25,000	170,000	< 37	< 41	< 40	< 39	< 38	< 36	< 38	< 38	NA	< 41	< 41	< 37	< 32
Toluene	108-88-3	820,000	820,000	< 37	< 41	< 40	< 39	< 38	< 36	< 38	< 38	NA	< 41	< 41	< 37	< 32
trans-1,2-Dichloroethene	156-60-5	75,000	320,000	< 37	< 41	< 40	< 39	< 38	< 36	< 38	< 38	NA	< 41	< 41	< 37	< 32
trans-1,3-Dichloropropene	10061-02-6	Nav	Nav	< 37	< 41	< 40	< 39	< 38	< 36	< 38	< 38	NA	< 41	< 41	< 37	< 32
Trichloroethene	79-01-6	1,000	20,000	< 37	< 41	< 40	< 39	< 38	< 36	< 38	< 38	NA	< 41	< 41	< 37	< 32
Trichlorofluoromethane	75-69-4	790,000	1,200,000	< 37	< 41	< 40	< 39	< 38	< 36	< 38	< 38	NA	< 41	< 41	< 37	< 32
Vinyl chloride	75-01-4	61	18,000	< 37	< 41	< 40	< 39	< 38	< 36	< 38	< 38	NA	< 41	< 41	< 37	< 32
Xylenes, Total	1330-20-7	260,000	260,000	< 110	< 120	< 120	< 120	< 110	< 110	< 110	< 110	NA	< 120	< 120	< 110	< 96
Criteria Exceeded in Sample																

Notes:

J - analyte is present at an estimated concentration between the MDL and Report Limit

UJ - per data validation report, data are to be used cautiously as they are estimated

R - the validator uses this qualifier to notate not to use this result

NA - not analyzed

Nav - not available

Abbreviations used in comparisons:

/Res - Indicates exceedance of the WVDEP residential soil de minimis standard, December 2022

/Ind - Indicates exceedance of the WVDEP industrial soil de minimis standard, December 2022

Table 2-1l
Surface Soil Analytical Data and Comparison to De Minimis Screening Values - PAHs
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

Sample Name				SS-01		SS-02		SS-03		SS-04 [1]		SS-05		SS-06		SS-07		SS-08		SS-09		SS-10		SS-11		SS-12		SS-13		SS-14		SS-15		FD-1	
Sample Location				SS01		SS02		SS03		SS04		SS05		SS06		SS07		SS08		SS09		SS10		SS11		SS12		SS07		SS01		SS15		SS15	
Sample Depth				0-0.5'		0-0.5'		0-0.5'		0-0.5'		0-0.5'		0-0.5'		0-0.5'		0-0.5'		0-0.5'		0-0.5'		0-0.5'		0-0.5'		0-0.5'		0-0.5'		0-2'		0-2'	
Sample Date				10/17/2017		10/17/2017		10/17/2017		10/16/2017		10/16/2017		10/16/2017		10/16/2017		10/16/2017		10/16/2017		10/17/2017		10/16/2017		10/17/2017		10/16/2017		10/17/2017		7/14/2022		7/14/2022	
Sample Type				Field Sample		Field Sample		Field Sample		Field Sample		Field Sample		Field Sample		Field Sample		Field Sample		Field Sample		Field Sample		Field Sample		Field Sample		Duplicate		Duplicate		Field Sample		Duplicate	
Surface/Subsurface				Surface		Surface		Surface		Surface		Surface		Surface		Surface		Surface		Surface		Surface		Surface		Surface		Surface		Surface		Surface	
Saturated/Unsaturated				Unsaturated		Unsaturated		Unsaturated		Unsaturated		Unsaturated		Unsaturated		Unsaturated		Unsaturated		Unsaturated		Unsaturated		Unsaturated		Unsaturated		Unsaturated		Unsaturated		Unsaturated	
On-Site/Off-Site				Off-Site		Off-Site		On-Site		On-Site		On-Site		On-Site		On-Site		On-Site		On-Site		On-Site		On-Site		On-Site		On-Site		On-Site		On-Site		On-Site	
CAS No.		WVDEP Residential Soil De Minimis Standard (µg/kg) Res	WVDEP Industrial Soil De Minimis Standard (µg/kg) Ind																																
Polycyclic Aromatic Hydrocarbons (µg/kg)																																			
2-Methylnaphthalene	91-57-6	310,000	4,700,000	39		27	J*	50		150		53		140		27		90		43		NA		1.9	J	71	J-	38		43		NA		NA	
Acenaphthene	83-32-9	4,100,000	47,000,000	22	J	8.9		11	J	420		66		170		48		180		170		NA		1.0	J	33	J-	77		13	J	< 23		51	J*
Acenaphthylene	208-96-8	4,200,000	51,000,000	590		37		510		10000		850		1400		370		720		990		NA		9.1		460	J-	350	J	550		130	J*	250	J*
Anthracene	120-12-7	23,000,000	350,000,000	210		41	J*	260		7700		530		1100		280		1100		690		NA		9.2		290	J,J-	260	J	180		260	J*	1100	J*
Benzo(a)anthracene	56-55-3	1,500	320,000	590		130	J*	640		42000	/Res	2000	/Res	3700	/Res	680		3400	/Res	2100	/Res	NA		19		1100	J-	760		730		1200	J*	3100	J*/Res
Benzo(a)pyrene	50-32-8	110	21,000	760	/Res	130	J*	800	/Res	36000	/Ind	2300	/Res	4000	/Res	700	/Res	3700	/Res	2400	/Res	NA		23		1200	J-/Res	870	/Res	890	/Res	1400	J*/Res	2100	J*/Res
Benzo(b)fluoranthene	205-99-2	1,100	210,000	1200	/Res	240	J*	1400	/Res	47000	/Res	3800	/Res	5600	/Res	1200	/Res	4900	/Res	3200	/Res	NA		51		2200	J-/Res	1500	/Res	1400	/Res	1700	J*/Res	3400	J*/Res
Benzo(g,h,i)perylene	191-24-2	1,800,000	23,000,000	580		100	J*	630		15000		1300		1900		530		1600		1400		NA		20		710	J-	530		600		710	J*	830	J*
Benzo(k)fluoranthene	207-08-9	11,000	2,100,000	410		66	J*	500		16000	/Res	920		2100		430		1400		1100		NA		16		790	J-	530		490		590	J*	830	J*
Chrysene	218-01-9	110,000	21,000,000	740		140	J*	740		39000		2000		3800		740		3200		2100		NA		28		1300	J-	850		890		1400	J*	3200	J*
Dibenzo(a,h)anthracene	53-70-3	110	21,000	140	/Res	29	J*	150	/Res	4100	/Res	370	/Res	610	/Res	110		520	/Res	320	/Res	NA		4.7		210	J,J-/Res	88		140	/Res	170	J*/Res	210	J*/Res
Fluoranthene	206-44-0	2,400,000	30,000,000	980		210	J*	880		70000		3300		6600		1200		6000		4000		NA		32		1800	J-	1600		1100		2200	J*	6200	J*
Fluorene	86-73-7	2,900,000	37,000,000	37	J	14	J*	28	J	1100		130		320		48		370		180		NA		2.1	J	92	J-	72		32	J	33	J*	430	J*
Indeno(1,2,3-cd)pyrene	193-39-5	1,100	210,000	700		120	J*	760		17000	/Res	1500	/Res	2500	/Res	650		2100	/Res	1500	/Res	NA		24		920	J-	650		720		950	J*	1100	J*
Naphthalene	91-20-3	2,400	110,000	26	J	17	J*	31	J	230		72		160		25	J*	100		75		NA		1.4	J	49	J-	50	J*	36	J	< 23		100	J*
Phenanthrene	85-01-8	23,000,000	350,000,000	330		170	J*	170		8500		1200		2700		540		3800		1800		NA		16		650	J-	860		340		860	J*	4000	J*
Pyrene	129-00-0	2,300,000	34,000,000	1100		220	J*	960		72000		3500		5900		1200		5600		3800		NA		44		2100	J-	1400		1400		1900	J*	6200	J*
Criteria Exceeded in Sample				/Res		/Res		/Res		/Res/Ind		/Res		/Res		/Res		/Res		/Res						/Res		/Res		/Res		/Res		/Res	

Notes:
[1] Multiple dilutions of several PAHs were analyzed. The result from the lowest dilution analyzed for each PAH was used
J - analyte is present at an estimated concentration between the MDL and Report Limit
J* - estimated value; one or more quality control parameters were outside control limits
J- - estimated value with potential low bias
NA - not analyzed
Abbreviations used in comparisons:
/Res - Indicates exceedance of the WVDEP residential soil de minimis standard, December 2022
/Ind - Indicates exceedance of the WVDEP industrial soil de minimis standard, December 2022

Sample Name			SB-01	SB-03	SB-04	SB-05	SB-06	SB-07	SB-08	SB-09	SB-10	SB-12	SB-13	SB-15	FD-2
Sample Location			SS01A	SS03	SS04A	SS05	SS06	SS07	SS08	SS09C	SS10C	SS12	SS13	SS15	SS15
Sample Depth			7.0-9.3'	13.5-15.0'	1.9-3.8'	5.3-7.0'	6.0-7.0'	11.5-13.0'	4.0-6.0'	9.2-10.0'	2.0-7.1'	4.5-6.1'	9.3-11.1'	6-8'	6-8'
Sample Date			10/17/2017	10/17/2017	10/16/2017	10/16/2017	10/16/2017	10/16/2017	10/17/2017	10/17/2017	10/16/2017	10/17/2017	10/17/2017	7/14/2022	7/14/2022
Sample Type			Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample	Duplicate
Surface/Subsurface			Subsurface	Subsurface	Subsurface	Subsurface	Subsurface	Subsurface	Subsurface	Subsurface	Subsurface	Subsurface	Subsurface	Subsurface	Subsurface
Saturated/Unsaturated			Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated	Unsaturated
On-Site/Off-Site			Off-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site	On-Site
CAS No.		WVDEP Residential Soil De Minimis Standard (µg/kg) Res	WVDEP Industrial Soil De Minimis Standard (µg/kg) Ind													
Polycyclic Aromatic Hydrocarbons (µg/kg)																
2-Methylnaphthalene	91-57-6	310,000	4,700,000	< 3.8	< 3.9	< 3.9	**0.47 J**	**27**	< 3.8	< 3.8	< 3.9	< 3.7	< 3.8	< 3.8	NA	NA
Acenaphthene	83-32-9	4,100,000	47,000,000	< 3.8	< 3.9	< 3.9	< 3.7	**16**	< 3.8	**0.29 J**	< 3.9	< 3.7	< 3.8	< 3.8	< 4.6	< 4.6
Acenaphthylene	208-96-8	4,200,000	51,000,000	**2.2 J**	< 3.9	**1.2 J**	**3.8**	**360**	< 3.8	**1.4 J**	**2.3 J**	**11**	**1.3 J**	< 3.8	< 4.6	< 4.6
Anthracene	120-12-7	23,000,000	350,000,000	**0.65 J**	< 3.9	**0.38 J**	**1.6 J**	**200**	**0.21 J**	**1.7 J**	< 3.9	**12**	< 3.8	< 3.8	< 4.6	< 4.6
Benzo(a)anthracene	56-55-3	1,500	320,000	**1.3 J**	< 3.9	**2.1 J**	**7.9**	**730**	< 3.8	**4.4**	< 3.9	**23**	< 3.8	**1.2 J**	< 4.6	< 4.6
Benzo(a)pyrene	50-32-8	110	21,000	**1.9 J**	< 3.9	**1.6 J**	**8.9**	**640 /Res**	< 3.8	**4.0**	< 3.9	**20**	< 3.8	**1.2 J**	< 4.6	< 4.6
Benzo(b)fluoranthene	205-99-2	1,100	210,000	**4.0**	< 3.9	**2.4 J**	**12**	**880**	< 3.8	**5.7**	< 3.9	**29**	< 3.8	**1.8 J**	< 4.6	< 4.6
Benzo(g,h,i)perylene	191-24-2	1,800,000	23,000,000	< 3.8	< 3.9	< 3.9	**4.9**	**390**	< 3.8	< 3.8	< 3.9	**10**	< 3.8	**1.1 J**	< 4.6	< 4.6
Benzo(k)fluoranthene	207-08-9	11,000	2,100,000	**1.5 J**	< 3.9	**1.0 J**	**5.0**	**290**	< 3.8	**2.3 J**	< 3.9	**9.7**	< 3.8	**0.88 J**	< 4.6	< 4.6
Chrysene	218-01-9	110,000	21,000,000	**1.5 J**	< 3.9	**1.3 J**	**8.0**	**680**	< 3.8	**4.0**	< 3.9	**21**	< 3.8	**0.84 J**	< 4.6	< 4.6
Dibenzo(a,h)anthracene	53-70-3	110	21,000	< 3.8	< 3.9	< 3.9	< 3.7	**96**	< 3.8	< 3.8	< 3.9	**3.3 J**	< 3.8	**0.76 J**	< 4.6	< 4.6
Fluoranthene	206-44-0	2,400,000	30,000,000	< 3.8 U	< 3.9	< 3.9 U	**13**	**1400**	< 3.8 U	**7.6**	< 3.9 U	**39**	< 3.8	< 3.8 U	< 4.6	**5.8**
Fluorene	86-73-7	2,900,000	37,000,000	< 3.8	< 3.9	< 3.9	**0.33 J**	**57**	< 3.8	**0.79 J**	< 3.9	**1.8 J**	< 3.8	< 3.8	< 4.6	< 4.6
Indeno(1,2,3-cd)pyrene	193-39-5	1,100	210,000	**0.24 J**	< 3.9	< 3.9	**6.5**	**490**	< 3.8	**0.64 J**	< 3.9	**13**	< 3.8	**1.4 J**	< 4.6	< 4.6
Naphthalene	91-20-3	2,400	110,000	< 3.8	< 3.9	< 3.9	**0.50 J**	**25**	< 3.8	< 3.8	< 3.9	< 3.7	< 3.8	< 3.8	< 4.6	< 4.6
Phenanthrene	85-01-8	23,000,000	350,000,000	**1.3 J**	< 3.9	**0.43 J**	**3.7 J**	**470**	**0.75 J**	**4.9**	< 3.9	**16**	< 3.8	< 3.8	< 4.6	< 4.6
Pyrene	129-00-0	2,300,000	34,000,000	< 3.8 U	< 3.9	< 3.9 U	**11**	**1200**	< 3.8	**9.2**	< 3.9 U	**41**	< 3.8	< 3.8 U	< 4.6	**6.6**
Criteria Exceeded in Sample							**/Res**									

Notes:

J - analyte is present at an estimated concentration between the MDL and Report Limit

U - Undetected; the parameter was qualified as undetected during data validation

NA - not analyzed

Abbreviations used in comparisons:

/Res - Indicates exceedance of the WVDEP residential soil de minimis standard, December 2022

/Ind - Indicates exceedance of the WVDEP industrial soil de minimis standard, December 2022

Sample Name				SS-01		SS-02		SS-03		SS-04		SS-05		SS-06		SS-07		SS-08		SS-09		SS-10		SS-11		SS-12		SS-13		SS-14		SS-15	FD-1
Sample Location				SS01		SS02		SS03		SS04		SS05		SS06		SS07		SS08		SS09		SS10		SS11		SS12		SS07		SS01		SS15	SS15
Sample Depth				0-0.5'		0-0.5'		0-0.5'		0-0.5'		0-0.5'		0-0.5'		0-0.5'		0-0.5'		0-0.5'		0-0.5'		0-0.5'		0-0.5'		0-0.5'		0-0.5'		0-2'	0-2'
Sample Date				10/17/2017		10/17/2017		10/17/2017		10/16/2017		10/16/2017		10/16/2017		10/16/2017		10/16/2017		10/16/2017		10/17/2017		10/16/2017		10/17/2017		10/16/2017		10/17/2017		7/14/2022	7/14/2022
Sample Type				Field Sample		Field Sample		Field Sample		Field Sample		Field Sample		Field Sample		Field Sample		Field Sample		Field Sample		Field Sample		Field Sample		Field Sample		Duplicate		Duplicate		Field Sample	Duplicate
Surface/Subsurface				Surface		Surface		Surface		Surface		Surface		Surface		Surface		Surface		Surface		Surface		Surface		Surface		Surface		Surface	Surface
Saturated/Unsaturated				Unsaturated		Unsaturated		Unsaturated		Unsaturated		Unsaturated		Unsaturated		Unsaturated		Unsaturated		Unsaturated		Unsaturated		Unsaturated		Unsaturated		Unsaturated		Unsaturated	Unsaturated
On-Site/Off-Site				Off-Site		Off-Site		On-Site		On-Site		On-Site		On-Site		On-Site		On-Site		On-Site		On-Site		On-Site		On-Site		On-Site		On-Site		On-Site	On-Site
CAS No.		WVDEP Residential Soil De Minimis Standard (µg/kg) Res	WVDEP Industrial Soil De Minimis Standard (µg/kg) Ind																														
Semivolatile Organic Compounds (ug/kg)																																	
1,1' -Biphenyl	92-52-4	51,000	210,000	< 390		**20**	J	**48**	J	< 210		**260**		**110**	J	< 180		**73**	J	< 380		NA		**6.4**	J	< 360		**40**	J	< 380		NA	NA
1,2,4,5-Tetrachlorobenzene	95-94-3	17,000	150,000	< 3900	UJ	< 360		< 1900		< 2100		< 2100		< 2000		< 1800		< 1800		< 3900		NA		< 360		< 3600		< 1800		< 3800		NA	NA
1,4-Dioxane	123-91-1	5,400	250,000	< 2000		< 180		< 930		< 1100		< 1000		< 990		< 920		< 920		< 1900		NA		< 180		< 1800		< 900		< 1900		NA	NA
2,2' -Oxybis(1-chloropropane)	108-60-1	5,100	230,000	< 390		< 36		< 180		< 210		< 210		< 200		< 180		< 180		< 380		NA		< 35		< 360		< 180		< 380		NA	NA
2,3,4,6-Tetrachlorophenol	58-90-2	1,900,000	25,000,000	< 790	UJ	< 73		< 370		< 430		< 420		< 400		< 370		< 370		< 780		NA		< 72		< 730		< 360		< 770		NA	NA
2,4,5-Trichlorophenol	95-95-4	6,300,000	82,000,000	< 390		< 36		< 180		< 210		< 210		< 200		< 180		< 180		< 380		NA		< 35		< 360		< 180		< 380		NA	NA
2,4,6-Trichlorophenol	88-06-2	49,000	820,000	< 390		< 36		< 180		< 210		< 210		< 200		< 180		< 180		< 380		NA		< 35		< 360		< 180		< 380		NA	NA
2,4-Dichlorophenol	120-83-2	190,000	2,500,000	< 390		< 36		< 180		< 210		< 210		< 200		< 180		< 180		< 380		NA		< 35		< 360		< 180		< 380		NA	NA
2,4-Dimethylphenol	105-67-9	1,300,000	16,000,000	< 390	UJ	< 36		< 180		< 210		< 210		< 200		< 180		< 180		< 380		NA		< 35		< 360	UJ	< 180		< 380		NA	NA
2,4-Dinitrophenol	51-28-5	130,000	1,600,000	< 390	R	< 36		< 180		< 210		< 210		< 200		< 180		< 180		< 380		NA		< 35		< 360	R	< 180		< 380		NA	NA
2,4-Dinitrotoluene	121-14-2	1,700	74,000	< 390		< 36		< 180		< 210		< 210		< 200		< 180		< 180		< 380		NA		< 35		< 360		< 180		< 380		NA	NA
2,6-Dinitrotoluene	606-20-2	360	15,000	< 390		< 36		< 180		< 210		< 210		< 200		< 180		< 180		< 380		NA		< 35		< 360		< 180		< 380		NA	NA
2-Chloronaphthalene	91-58-7	5,000,000	50,000,000	< 78	UJ	< 7.2		< 37		< 43		< 42		< 40		< 37		< 37		< 78		NA		< 7.1		< 73		< 36		< 76		NA	NA
2-Chlorophenol	95-57-8	340,000	3,900,000	< 390	UJ	< 36		< 180		< 210		< 210		< 200		< 180		< 180		< 380		NA		< 35		< 360		< 180		< 380		NA	NA
2-Methylphenol	95-48-7	3,200,000	41,000,000	< 390		< 36		< 180		< 210		< 210		< 200		< 180		< 180		< 380		NA		< 35		< 360	UJ	< 180		< 380		NA	NA
2-Nitroaniline	88-74-4	630,000	8,000,000	< 390		< 36		< 180		< 210		< 210		< 200		< 180		< 180		< 380		NA		< 35		< 360		< 180		< 380		NA	NA
2-Nitrophenol	88-75-5	Nav	Nav	< 390		< 36		< 180		< 210		< 210		< 200		< 180		< 180		< 380		NA		< 35		< 360		< 180		< 380		NA	NA
3&4-Methylphenol [1]	108-39-4/106-44-5	3,200,000	41,000,000	< 390		< 36		< 180		< 210		< 210		< 200		< 180		< 180		< 380		NA		< 35		< 360		< 180		< 380		NA	NA
3,3'-Dichlorobenzidine	91-94-1	1,200	51,000	< 2000		< 180		< 930		< 1100		< 1000		< 990		< 920		< 920		< 1900		NA		< 180		< 1800		< 900		< 1900		NA	NA
3-Nitroaniline	99-09-2	Nav	Nav	< 390		< 36		< 180		< 210		< 210		< 200		< 180		< 180		< 380		NA		< 35		< 360		< 180		< 380		NA	NA
4,6-Dinitro-2-methylphenol	534-52-1	Nav	Nav	< 390	R	< 36		< 180		< 210		< 210		< 200		< 180		< 180		< 380		NA		< 35		< 360		< 180		< 380		NA	NA
4-Bromophenyl phenyl ether	101-55-3	Nav	Nav	< 390		< 36		< 180		< 210		< 210		< 200		< 180		< 180		< 380		NA		< 35		< 360	UJ	< 180		< 380		NA	NA
4-Chloro-3-methylphenol	59-50-7	Nav	Nav	< 390		< 36		< 180		< 210		< 210		< 200		< 180		< 180		< 380		NA		< 35		< 360		< 180		< 380		NA	NA
4-Chloroaniline	106-47-8	2,700	110,000	< 790		< 73		< 370		< 430		< 420		< 400		< 370		< 370		< 780		NA		< 72		< 730		< 360		< 770		NA	NA
4-Chlorophenyl phenyl ether	7005-72-3	Nav	Nav	< 390	UJ	< 36		< 180		< 210		< 210		< 200		< 180		< 180		< 380		NA		< 35		< 360		< 180		< 380		NA	NA
4-Nitroaniline	100-01-6	Nav	Nav	< 2000		< 180		< 930		< 1100		< 1000		< 990		< 920		< 920		< 1900		NA		< 180		< 1800		< 900		< 1900		NA	NA
4-Nitrophenol	100-02-7	Nav	Nav	< 390	UJ	< 36		< 180		< 210		< 210		< 200		< 180		< 180		< 380		NA		< 35		< 360		< 180		< 380		NA	NA
Acetophenone	98-86-2	2,500,000	2,500,000	< 390		< 36		< 180		< 210		< 210		< 200		< 180		< 180		< 380		NA		< 35		< 360		< 180		< 380		NA	NA
Atrazine	1912-24-9	2,400	100,000	< 390		< 36		< 180		< 210		< 210		< 200		< 180		< 180		< 380		NA		< 35		< 360		< 180		< 380		NA	NA
Benzaldehyde	100-52-7	170,000	1,200,000	< 790		< 73		< 370		< 430		< 420		< 400		< 370		< 370		< 780		NA		< 72		< 730		< 360		< 770		NA	NA
Bis(2-chloroethoxy)methane	111-91-1	Nav	Nav	< 390	UJ	< 36		< 180		< 210		< 210		< 200		< 180		< 180		< 380		NA		< 35		< 360	UJ	< 180		< 380		NA	NA
Bis(2-chloroethyl)ether	111-44-4	240	11,000	< 390		< 36		< 180		< 210		< 210		< 200		< 180		< 180		< 380		NA		< 35		< 360	UJ	< 180		< 380		NA	NA
Bis(2-ethylhexyl)phthalate	117-81-7	39,000	1,600,000	< 390		**160**	J	< 210		< 210		< 210		< 200		**480**		< 180		< 380		NA		**35**	J	**420**	J*	**620**		**270**	J	NA	NA
Butyl benzyl phthalate	85-68-7	290,000	12,000,000	< 390		< 36		**360**		< 210		< 210		< 200		**240**	J*	< 180		< 380		NA		**49**		**500**	J*	< 180		< 380		NA	NA
Caprolactam	105-60-2	31,000,000	400,000,000	< 390	UJ	< 36		< 180		< 210		< 210		< 200		< 180		< 180		< 380		NA		< 35		< 360		< 180		< 380		NA	NA
Carbazole	86-74-8	Nav	Nav	< 390	UJ	< 36		< 180		**440**		**320**		**220**		**99**	J	**240**		**410**		NA		< 35		**190**	J	**190**	J*	< 380		NA	NA
Dibenzofuran	132-64-9	78,000	1,200,000	< 390	UJ	**30**	J	**52**	J	**720**		**590**		**290**		< 180		**240**		**100**	J	NA		< 35		< 360		**93**	J	< 380		NA	NA
Diethyl phthalate	84-66-2	51,000,000	660,000,000	< 390	UJ	< 36		< 180		< 210		< 210		< 200		< 180		< 180		< 380		NA		< 35		< 360	UJ	< 180		< 380		NA	NA
Dimethyl phthalate	131-11-3	Nav	Nav	< 390	R	< 36		< 180		< 210		< 210		< 200		< 180		< 180		< 380		NA		< 35		< 360	R	< 180		< 380		NA	NA
Di-n-butyl phthalate	84-74-2	6,300,000	82,000,000	< 390		< 36		< 180		< 210		< 210		< 200		< 180		< 180		< 380		NA		< 35		< 360	UJ	< 180		< 380		NA	NA
Di-n-octyl phthalate	117-84-0	Nav	Nav	< 390		< 36		< 180		< 210		< 210		< 200		< 180		< 180		< 380		NA		< 35		< 360		< 180		< 380		NA	NA
Hexachlorobenzene	118-74-1	220	10,000	< 390		< 36		< 180		< 210		< 210		< 200		< 180		< 180		< 380		NA		< 35		< 360		< 180		< 380		NA	NA
Hexachlorobutadiene	87-68-3	1,300	17,000	< 390	UJ	< 36		< 180		< 210		< 210		< 200		< 180		< 180		< 380		NA		< 35		< 360		< 180		< 380		NA	NA
Hexachlorocyclopentadiene	77-47-4	1,900	8,000	< 390	R	< 36		< 180		< 210		< 210		< 200		< 180		< 180		< 380		NA		< 35		< 360	R	< 180		< 380		NA	NA
Hexachloroethane	67-72-1	2,000	86,000	< 390	UJ	< 36		< 180		< 210		< 210		< 200		< 180		< 180		< 380		NA		< 35		< 360	UJ	< 180		< 380		NA	NA
Isophorone	78-59-1	570,000	24,000,000	< 2000		< 180		< 930		< 1100		< 1000		< 990		< 920		< 920		< 1900		NA		< 180		< 1800		< 900		< 1900		NA	NA
Nitrobenzene	98-95-3	5,500	240,000	< 2000		< 180		< 930		< 1100		< 1000		< 990		< 920		< 920		< 1900		NA		< 180		< 1800		< 900		< 1900		NA	NA
N-Nitrosodi-n-propylamine	621-64-7	78	3,300	< 390	UJ	< 36		< 180		< 210		< 210		< 200		< 180		< 180		< 380		NA		< 35		< 360	UJ	< 180		< 380		NA	NA
N-Nitrosodiphenylamine	86-30-6	110,000	7,200,000	< 390	UJ	< 36		< 180		< 210		< 210		< 200		< 180		< 180		< 380		NA		< 35		< 360	UJ	< 180		< 380		NA	NA
Pentachlorophenol	87-86-5	1,000	40,000	< 390		< 36		< 180		< 210		< 210		< 200		< 180		< 180		< 380		NA		< 35		< 360		< 180		< 380		NA	NA
Phenol	108-95-2	19,000,000	250,000,000	< 390		**47**		< 180		< 210		< 210		< 200		< 180		< 180		< 380		NA		< 35		< 360		< 180		< 380		NA	NA
Criteria Exceeded in Sample																																	

Notes:
NA - not analyzed
Nav - not available
J - analyte is present at an estimated concentration between the MDL and Report Limit
J* - Estimated value; one or more quality control parameters were outside control limits
UJ - per data validation report, data are to be used cautiously as they are estimated
R - the validator uses this qualifier to notate not to use this result

[1] There is no WVDEP residential and industrial soil de minimis standard for 3&4-methylphenol (i.e. m- and p-cresol). However, for purposes of screening, the lower of the m-cresol and p-cresol soil de minimis standards was used, which is conservative.

Abbreviations used in comparisons:
/Res - Indicates exceedance of the WVDEP residential soil de minimis standard, December 2022
/Ind - Indicates exceedance of the WVDEP industrial soil de minimis standard, December 2022

Sample Name Sample Location Sample Depth Sample Date Sample Type Surface/Subsurface Saturated/Unsaturated On-Site/Off-Site CAS No.	WVDEP Residential Soil De Minimis Standard (µg/kg) Res	WVDEP Industrial Soil De Minimis Standard (µg/kg) Ind	SB-01 SS01A 7.0-9.3' 10/17/2017 Field Sample Subsurface Unsaturated Off-Site	SB-03 SS03 13.5-15.0' 10/17/2017 Field Sample Subsurface Unsaturated On-Site	SB-04 SS04A 1.9-3.8' 10/16/2017 Field Sample Subsurface Unsaturated On-Site	SB-05 SS05 5.3-7.0' 10/16/2017 Field Sample Subsurface Unsaturated On-Site	SB-06 SS06 6.0-7.0' 10/16/2017 Field Sample Subsurface Unsaturated On-Site	SB-07 SS07 11.5-13.0' 10/16/2017 Field Sample Subsurface Unsaturated On-Site	SB-08 SS08 4.0-6.0' 10/17/2017 Field Sample Subsurface Unsaturated On-Site	SB-09 SS09C 9.2-10.0' 10/17/2017 Field Sample Subsurface Unsaturated On-Site	SB-10 SS10C 2.0-7.1' 10/16/2017 Field Sample Subsurface Unsaturated On-Site	SB-12 SS12 4.5-6.1' 10/17/2017 Field Sample Subsurface Unsaturated On-Site	SB-13 SS13 9.3-11.1' 10/17/2017 Field Sample Subsurface Unsaturated On-Site	SB-15 SS15 6-8' 7/14/2022 Field Sample Subsurface Unsaturated On-Site	FD-2 SS15 6-8' 7/14/2022 Duplicate Subsurface Unsaturated On-Site
Semivolatile Organic Compounds (ug/kg)																
1,1'-Biphenyl 92-52-4	51,000	210,000	< 38	< 39	< 37	< 36	< 190	< 38	< 36	< 38	< 38	< 37	< 38	NA	NA
1,2,4,5-Tetrachlorobenzene 95-94-3	17,000	150,000	< 380	< 390	< 380	< 370	< 1900	< 380	< 360	< 380	< 380	< 380	< 390	NA	NA
1,4-Dioxane 123-91-1	5,400	250,000	< 190	< 200	< 190	< 180	< 950	< 190	< 180	< 190	< 190	< 190	< 190	NA	NA
2,2'-Oxybis(1-chloropropane) 108-60-1	5,100	230,000	< 38	< 39	< 37	< 36	< 190	< 38	< 36	< 38	< 38	< 37	< 38	NA	NA
2,3,4,6-Tetrachlorophenol 58-90-2	1,900,000	25,000,000	< 77	< 79	< 76	< 74	< 380	< 76	< 73	< 77	< 76	< 76 UJ	< 78 UJ	NA	NA
2,4,5-Trichlorophenol 95-95-4	6,300,000	82,000,000	< 38	< 39	< 37	< 36	< 190	< 38	< 36	< 38	< 38	< 37 UJ	< 38 UJ	NA	NA
2,4,6-Trichlorophenol 88-06-2	49,000	820,000	< 38	< 39	< 37	< 36	< 190	< 38	< 36	< 38	< 38	< 37 UJ	< 38 UJ	NA	NA
2,4-Dichlorophenol 120-83-2	190,000	2,500,000	< 38	< 39	< 37	< 36	< 190	< 38	< 36	< 38	< 38	< 37 UJ	< 38 UJ	NA	NA
2,4-Dimethylphenol 105-67-9	1,300,000	16,000,000	< 38	< 39	< 37	< 36	< 190	< 38	< 36	< 38	< 38	< 37 UJ	< 38 UJ	NA	NA
2,4-Dinitrophenol 51-28-5	130,000	1,600,000	< 38	< 39	< 37	< 36	< 190	< 38	< 36	< 38	< 38	< 37 UJ	< 38 UJ	NA	NA
2,4-Dinitrotoluene 121-14-2	1,700	74,000	< 38	< 39	< 37	< 36	< 190	< 38	< 36	< 38	< 38	< 37	< 38	NA	NA
2,6-Dinitrotoluene 606-20-2	360	15,000	< 38	< 39	< 37	< 36	< 190	< 38	< 36	< 38	< 38	< 37	< 38	NA	NA
2-Chloronaphthalene 91-58-7	5,000,000	50,000,000	< 7.6	< 7.9	< 7.6	< 7.4	< 38	< 7.6	< 7.3	< 7.7	< 7.6	< 7.5	< 7.7	NA	NA
2-Chlorophenol 95-57-8	340,000	3,900,000	< 38	< 39	< 37	< 36	< 190	< 38	< 36	< 38	< 38	< 37 UJ	< 38 UJ	NA	NA
2-Methylphenol 95-48-7	3,200,000	41,000,000	< 38	< 39	< 37	< 36	< 190	< 38	< 36	< 38	< 38	< 37 UJ	< 38 UJ	NA	NA
2-Nitroaniline 88-74-4	630,000	8,000,000	< 38	< 39	< 37	< 36	< 190	< 38	< 36	< 38	< 38	< 37	< 38	NA	NA
2-Nitrophenol 88-75-5	Nav	Nav	< 38	< 39	< 37	< 36	< 190	< 38	< 36	< 38	< 38	< 37 UJ	< 38 UJ	NA	NA
3&4-Methylphenol [1] 108-39-4/106-44-5	3,200,000	41,000,000	< 38	< 39	< 37	< 36	< 190	< 38	< 36	< 38	< 38	< 37 UJ	< 38 UJ	NA	NA
3,3'-Dichlorobenzidine 91-94-1	1,200	51,000	< 190	< 200	< 190	< 180	< 950	< 190	< 180	< 190	< 190	< 190	< 190	NA	NA
3-Nitroaniline 99-09-2	Nav	Nav	< 38	< 39	< 37	< 36	< 190	< 38	< 36	< 38	< 38	< 37	< 38	NA	NA
4,6-Dinitro-2-methylphenol 534-52-1	Nav	Nav	< 38	< 39	< 37	< 36	< 190	< 38	< 36	< 38	< 38	< 37 UJ	< 38 UJ	NA	NA
4-Bromophenyl phenyl ether 101-55-3	Nav	Nav	< 38	< 39	< 37	< 36	< 190	< 38	< 36	< 38	< 38	< 37	< 38	NA	NA
4-Chloro-3-methylphenol 59-50-7	Nav	Nav	< 38	< 39	< 37	< 36	< 190	< 38	< 36	< 38	< 38	< 37 UJ	< 38 UJ	NA	NA
4-Chloroaniline 106-47-8	2,700	110,000	< 77	< 79	< 76	< 74	< 380	< 76	< 73	< 77	< 76	< 76	< 78	NA	NA
4-Chlorophenyl phenyl ether 7005-72-3	Nav	Nav	< 38	< 39	< 37	< 36	< 190	< 38	< 36	< 38	< 38	< 37	< 38	NA	NA
4-Nitroaniline 100-01-6	Nav	Nav	< 190	< 200	< 190	< 180	< 950	< 190	< 180	< 190	< 190	< 190	< 190	NA	NA
4-Nitrophenol 100-02-7	Nav	Nav	< 38	< 39	< 37	< 36	< 190	< 38	< 36	< 38	< 38	< 37 UJ	< 38 UJ	NA	NA
Acetophenone 98-86-2	2,500,000	2,500,000	< 38	< 39	< 37	< 36	< 190	< 38	< 36	< 38	< 38	< 37	< 38	NA	NA
Atrazine 1912-24-9	2,400	100,000	< 38	< 39	< 37	< 36	< 190	< 38	< 36	< 38	< 38	< 37	< 38	NA	NA
Benzaldehyde 100-52-7	170,000	1,200,000	< 77	< 79	< 76	< 74	< 380	< 76	< 73	< 77	< 76	< 76	< 78	NA	NA
Bis(2-chloroethoxy)methane 111-91-1	Nav	Nav	< 38	< 39	< 37	< 36	< 190	< 38	< 36	< 38	< 38	< 37	< 38	NA	NA
Bis(2-chloroethyl)ether 111-44-4	240	11,000	< 38	< 39	< 37	< 36	< 190	< 38	< 36	< 38	< 38	< 37	< 38	NA	NA
Bis(2-ethylhexyl)phthalate 117-81-7	39,000	1,600,000	< 38	< 39	< 37	< 36	< 190	< 38	< 36	< 38	< 38	< 37	< 38	NA	NA
Butyl benzyl phthalate 85-68-7	290,000	12,000,000	< 38	< 39	< 37	< 36	< 190	< 38	< 36	< 38	< 38	< 37	< 38	NA	NA
Caprolactam 105-60-2	31,000,000	400,000,000	< 38	< 39	< 37	< 36	< 190	< 38	< 36	< 38	< 38	< 37	< 38	NA	NA
Carbazole 86-74-8	Nav	Nav	< 38	< 39	< 37	< 36	< 190	< 38	< 36	< 38	< 38	< 37	< 38	NA	NA
Dibenzofuran 132-64-9	78,000	1,200,000	< 38	< 39	< 37	< 36	< 190	< 38	< 36	< 38	< 38	< 37	< 38	NA	NA
Diethyl phthalate 84-66-2	51,000,000	660,000,000	< 38	< 39	< 37	< 36	< 190	< 38	< 36	< 38	< 38	< 37	< 38	NA	NA
Dimethyl phthalate 131-11-3	Nav	Nav	< 38	< 39	< 37	< 36	< 190	< 38	< 36	< 38	< 38	< 37	< 38	NA	NA
Di-n-butyl phthalate 84-74-2	6,300,000	82,000,000	< 38	< 39	< 37	< 36	< 190	< 38	< 36	< 38	< 38	< 37	< 38	NA	NA
Di-n-octyl phthalate 117-84-0	Nav	Nav	< 38	< 39	< 37	< 36	< 190	< 38	< 36	< 38	< 38	< 37	< 38	NA	NA
Hexachlorobenzene 118-74-1	220	10,000	< 38	< 39	< 37	< 36	< 190	< 38	< 36	< 38	< 38	< 37	< 38	NA	NA
Hexachlorobutadiene 87-68-3	1,300	17,000	< 38	< 39	< 37	< 36	< 190	< 38	< 36	< 38	< 38	< 37	< 38	NA	NA
Hexachlorocyclopentadiene 77-47-4	1,900	8,000	< 38	< 39	< 37	< 36	< 190	< 38	< 36	< 38	< 38	< 37	< 38	NA	NA
Hexachloroethane 67-72-1	2,000	86,000	< 38	< 39	< 37	< 36	< 190	< 38	< 36	< 38	< 38	< 37	< 38	NA	NA
Isophorone 78-59-1	570,000	24,000,000	< 190	< 200	< 190	< 180	< 950	< 190	< 180	< 190	< 190	< 190	< 190	NA	NA
Nitrobenzene 98-95-3	5,500	240,000	< 190	< 200	< 190	< 180	< 950	< 190	< 180	< 190	< 190	< 190	< 190	NA	NA
N-Nitrosodi-n-propylamine 621-64-7	78	3,300	< 38	< 39	< 37	< 36	< 190	< 38	< 36	< 38	< 38	< 37	< 38	NA	NA
N-Nitrosodiphenylamine 86-30-6	110,000	7,200,000	< 38	< 39	< 37	< 36	< 190	< 38	< 36	< 38	< 38	< 37	< 38	NA	NA
Pentachlorophenol 87-86-5	1,000	40,000	< 38	< 39	< 37	< 36	< 190	< 38	< 36	< 38	< 38	< 37 UJ	< 38 UJ	NA	NA
Phenol 108-95-2	19,000,000	250,000,000	< 38	< 39	< 37	< 36	< 190	**51**	< 36	< 38	< 38	< 37 UJ	< 38 UJ	NA	NA
Criteria Exceeded in Sample															

Notes:
NA - not analyzed
Nav - not available
UJ - per data validation report, data are to be used cautiously as they are estimated

[1] There is no WVDEP residential and industrial soil de minimis standard for 3&4-methylphenol (i.e. m- and p-cresol). However, for purposes of screening, the lower of the m-cresol and p-cresol soil de minimis standards was used, which is conservative.

Abbreviations used in comparisons:
/Res - Indicates exceedance of the WVDEP residential soil de minimis standard, December 2022
/Ind - Indicates exceedance of the WVDEP industrial soil de minimis standard, December 2022

Table 2-2A
SPLP Data (VOCs) and Comparison to Direct Contact Screening Values
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

Chemical	CAS No.	WVDEP Groundwater De Minimis Standard (ug/L) GW	SS-15 0-2' SS15 07/14/22 Investigation On-Site		SB-15 6-8' SS15 07/14/22 Investigation On-Site		SS-16 2-4' SS16 07/14/22 Investigation On-Site		SB-16 8-10' SS16 07/14/22 Investigation On-Site		SS-17 2-4' SS17 07/14/22 Investigation On-Site		SB-17 4-5' SS17 07/14/22 Investigation On-Site		FD-1 0-2' SS15 07/14/22 Duplicate On-Site		FD-2 6-8' SS15 07/14/22 Duplicate On-Site	
Volatile Organic Compounds (ug/L)																		
1,1,1-Trichloroethane	71-55-6	200	< 20		< 20		< 20		< 20		< 20		< 20		< 20		< 20	
1,1,2,2-Tetrachloroethane	79-34-5	0.076	< 20		< 20		< 20		< 20		< 20		< 20		< 20		< 20	
1,1,2-Trichloroethane	79-00-5	5	< 20		< 20		< 20		< 20		< 20		< 20		< 20		< 20	
1,1,2-Trichlorotrifluoroethane	76-13-1	10000	< 20		< 20		< 20		< 20		< 20		< 20		< 20		< 20	
1,1-Dichloroethane	75-34-3	2.8	< 20		< 20		< 20		< 20		< 20		< 20		< 20		< 20	
1,1-Dichloroethene	75-35-4	7	< 20		< 20		< 20		< 20		< 20		< 20		< 20		< 20	
1,2,3-Trichlorobenzene	87-61-6	Nav	< 20		< 20		< 20		< 20		< 20		< 20		< 20		< 20	
1,2,4-Trichlorobenzene	120-82-1	70	< 20		< 20		< 20		< 20		< 20		< 20		< 20		< 20	
1,2-Dibromo-3-chloropropane (DBCP)	96-12-8	0.2	< 20		< 20		< 20		< 20		< 20		< 20		< 20		< 20	
1,2-Dibromoethane	106-93-4	0.05	< 20		< 20		< 20		< 20		< 20		< 20		< 20		< 20	
1,2-Dichlorobenzene	95-50-1	600	< 20		< 20		< 20		< 20		< 20		< 20		< 20		< 20	
1,2-Dichloroethane	107-06-2	5	< 20		< 20		< 20		< 20		< 20		< 20		< 20		< 20	
1,2-Dichloropropane	78-87-5	5	< 20		< 20		< 20		< 20		< 20		< 20		< 20		< 20	
1,3-Dichlorobenzene	541-73-1	Nav	< 20		< 20		< 20		< 20		< 20		< 20		< 20		< 20	
1,4-Dichlorobenzene	106-46-7	75	< 20		< 20		< 20		< 20		< 20		< 20		< 20		< 20	
2-Butanone (MEK)	78-93-3	5600	< 100		< 100		< 100		< 100		< 100		< 100		< 100		< 100	
2-Hexanone	591-78-6	Nav	< 100		< 100		< 100		< 100		< 100		< 100		< 100		< 100	
4-Methyl-2-pentanone	108-10-1	1200	< 20		< 20		< 20	UJ	< 20	UJ	< 20	U,U	< 20	UJ	< 20	UJ	< 20	UJ
Acetone	67-64-1	14000	< 200		< 200	U,U	< 200	UJ	< 200	UJ	< 280	UJ	< 200	UJ	< 200	UJ	< 200	UJ
Benzene	71-43-2	5	< 20		< 20		< 20		< 20		< 20		< 20		< 20		< 20	
Bromochloromethane	74-97-5	Nav	< 20		< 20		< 20		< 20		< 20		< 20		< 20		< 20	
Bromodichloromethane	75-27-4	80	< 20		< 20		< 20		< 20		< 20		< 20		< 20		< 20	
Bromoform	75-25-2	80	< 20		< 20		< 20		< 20		< 20		< 20		< 20		< 20	
Bromomethane	74-83-9	7.5	< 20		< 20		< 20	UJ	< 20	UJ	< 20	UJ	< 20	UJ	< 20	UJ	< 20	UJ
Carbon disulfide	75-15-0	810	< 20		< 20		< 20	UJ	< 20	UJ	< 20	UJ	< 20	UJ	< 20	UJ	< 20	UJ
Carbon tetrachloride	56-23-5	5	< 20		< 20		< 20		< 20		< 20		< 20		< 20		< 20	
Chlorobenzene	108-90-7	100	< 20		< 20		< 20		< 20		< 20		< 20		< 20		< 20	
Chloroethane	75-00-3	21000	< 20		< 20		< 20		< 20		< 20		< 20		< 20		< 20	
Chloroform	67-66-3	80	< 20		< 20		< 20		< 20		< 20		< 20		< 20		< 20	
Chloromethane	74-87-3	190	< 20		< 20		< 20		< 20		< 20		< 20		< 20		< 20	
cis-1,2-Dichloroethene	156-59-2	70	< 20		< 20		< 20		< 20		< 20		< 20		< 20		< 20	
cis-1,3-Dichloropropene	10061-01-5	Nav	< 20		< 20		< 20		< 20		< 20		< 20		< 20		< 20	
Cyclohexanone	108-94-1	1400	< 200		< 200		< 200		< 200		< 200		< 200		< 200		< 200	
Dibromochloromethane	124-48-1	80	< 20		< 20		< 20		< 20		< 20		< 20		< 20		< 20	
Dichlorodifluoromethane	75-71-8	200	< 20		< 20		< 20	UJ	< 20	UJ	< 20	UJ	< 20	UJ	< 20	UJ	< 20	UJ
Ethylbenzene	100-41-4	700	< 20		< 20		< 20		< 20		< 20		< 20		< 20		< 20	
Isopropylbenzene	98-82-8	450	< 20		< 20		< 20		< 20		< 20		< 20		< 20		< 20	
m,p-Xylene	136777-61-2	Nav	**18**	J	< 40		< 40		< 40		< 40		< 40		< 40		< 40	
Methyl acetate	79-20-9	5300	< 40		< 40		< 40		< 40		< 40		< 40		< 40		< 40	
Methyl tert-butyl ether (MTBE)	1634-04-4	14	< 20		< 20		< 20		< 20		< 20		< 20		< 20		< 20	
Methylcyclohexane	108-87-2	Nav	< 20		< 20		< 20		< 20		< 20		< 20		< 20		< 20	
Methylene chloride	75-09-2	5	< 100		< 100		< 100		< 100		< 100		< 100		< 100		< 100	
Naphthalene	91-20-3	0.12	< 100		< 100		< 100		< 100		< 100		< 100		< 100		< 100	
o-Xylene	95-47-6	Nav	**9.0**	J	< 20		< 20		< 20		< 20		< 20		< 20		< 20	
Styrene	100-42-5	100	< 20		< 20		< 20		< 20		< 20		< 20		< 20		< 20	
Tetrachloroethene	127-18-4	5	< 20		< 20		< 20		< 20		< 20		< 20		< 20		< 20	
Toluene	108-88-3	1000	**16**	J	< 20		< 20		< 20		< 20		< 20		< 20		< 20	
trans-1,2-Dichloroethene	156-60-5	100	< 20		< 20		< 20		< 20		< 20		< 20		< 20		< 20	
trans-1,3-Dichloropropene	10061-02-6	Nav	< 20		< 20		< 20		< 20		< 20		< 20		< 20		< 20	
Trichloroethene	79-01-6	5	< 20		< 20		< 20		< 20		< 20		< 20		< 20		< 20	
Trichlorofluoromethane	75-69-4	1100	< 20		< 20		< 20		< 20		< 20		< 20		< 20		< 20	
Vinyl chloride	75-01-4	2	< 20		< 20		< 20		< 20		< 20		< 20		< 20		< 20	
Xylenes, Total [1]	1330-20-7	10000	**27**	J	< 60		< 60		< 60		< 60		< 60		< 60		< 60	
Criteria Exceeded in Sample																		

Notes:
Nav - not available
J - analyte is present at an estimated concentration between the MDL and Report Limit
U - Undetected; the parameter was qualified as undetected during data validation
UJ - per data validation report, data are to be cautiously as they are estimated data with some quality control issues.
Abbreviations used in comparisons:
/GW - Indicates exceedance of the WVDEP groundwater de minimis standard (December 2022)

[1] Total xylenes concentrations for the analytical data were calculated by adding the laboratory reported results for the individual isomers.

Table 2-2B
SPLP Data (PAHs) and Comparison to Direct Contact Screening Values
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

Chemical	CAS No.	WVDEP Groundwater De Minimis Standard (µg/L) GW	SS-15 0-2' SS15 07/14/22 Investigation On-Site	SB-15 6-8' SS15 07/14/22 Investigation On-Site	SS-16 2-4' SS16 07/14/22 Investigation On-Site	SB-16 8-10' SS16 07/14/22 Investigation On-Site	SS-17 2-4' SS17 07/14/22 Investigation On-Site	SB-17 4-5' SS17 07/14/22 Investigation On-Site	FD-1 0-2' SS15 07/14/22 Duplicate On-Site	FD-2 6-8' SS15 07/14/22 Duplicate On-Site
Polynuclear Aromatic Hydrocarbons (PAHs) (µg/L)										
1-Methylnaphthalene	90-12-0	1.1	< 0.68	< 0.68	< 0.34	< 0.68	< 0.34	< 0.34	< 0.34	< 0.34
2-Chloronaphthalene	91-58-7	330	NA	NA	< 0.34	< 0.68	< 0.34	< 0.34	NA	NA
2-Methylnaphthalene	91-57-6	36	< 0.68	< 0.68	< 0.34	< 0.68	< 0.34	< 0.34	< 0.34	< 0.34
Acenaphthene	83-32-9	240	< 0.68	< 0.68	< 0.34	< 0.68	< 0.34	< 0.34	< 0.34	< 0.34
Acenaphthylene	208-96-8	240	< 0.68	< 0.68	< 0.34	< 0.68	< 0.34	< 0.34	< 0.34	< 0.34
Anthracene	120-12-7	1800	< 0.68	< 0.68	< 0.34	< 0.68	< 0.34	< 0.34	< 0.34	< 0.34
Benzo(a)anthracene	56-55-3	0.03	< 0.68	< 0.68	< 0.34	< 0.68	< 0.34	< 0.34	< 0.34	< 0.34
Benzo(a)pyrene	50-32-8	0.2	< 0.68	< 0.68	< 0.34	< 0.68	< 0.34	< 0.34	< 0.34	< 0.34
Benzo(b)fluoranthene	205-99-2	0.25	< 0.68	< 0.68	< 0.34	< 0.68	< 0.34	< 0.34	< 0.34	< 0.34
Benzo(g,h,i)perylene	191-24-2	600	< 0.68	< 0.68	< 0.34	< 0.68	< 0.34	< 0.34	< 0.34	< 0.34
Benzo(k)fluoranthene	207-08-9	2.5	< 0.68	< 0.68	< 0.34	< 0.68	< 0.34	< 0.34	< 0.34	< 0.34
Chrysene	218-01-9	25	< 0.68	< 0.68	< 0.34	< 0.68	< 0.34	< 0.34	< 0.34	< 0.34
Dibenzo(a,h)anthracene	53-70-3	0.025	< 0.68	< 0.68	< 0.34	< 0.68	< 0.34	< 0.34	< 0.34	< 0.34
Fluoranthene	206-44-0	800	< 0.68	< 0.68	< 0.34	< 0.68	**0.084 J**	< 0.34	< 0.34	< 0.34
Fluorene	86-73-7	150	< 0.68	< 0.68	< 0.34	< 0.68	< 0.34	< 0.34	< 0.34	< 0.34
Indeno(1,2,3-cd)pyrene	193-39-5	0.25	< 0.68	< 0.68	< 0.34	< 0.68	< 0.34	< 0.34	< 0.34	< 0.34
Naphthalene	91-20-3	0.12	< 0.68	< 0.68	< 0.34	< 0.68	< 0.34	< 0.34	< 0.34	< 0.34
Phenanthrene	85-01-8	1700	< 0.68	< 0.68	**0.080 J**	< 0.68	**0.29 J**	**0.16 J**	< 0.34	< 0.34
Pyrene	129-00-0	79	< 0.68	< 0.68	< 0.34	< 0.68	< 0.34	< 0.34	< 0.34	< 0.34
Criteria Exceeded in Sample										

Notes:
NA - not analyzed

J - analyte is present at an estimated concentration between the MDL and Report Limit
Abbreviations used in comparisons:

/GW - Indicates exceedance of the WVDEP groundwater de minimis standard (December 2022)

Table 2-2C
SPLP Data (Metals) and Comparison to Direct Contact Screening Values
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

Chemical	Sample Name Sample Location Date Collected Sample Type On-Site/Off-Site CAS No.	WVDEP Groundwater De Minimis Standard (mg/L) GW	SS-15 0-2' SS15 07/14/22 Investigation On-Site	SB-15 6-8' SS15 07/14/22 Investigation On-Site	SS-16 2-4' SS16 07/14/22 Investigation On-Site	SB-16 8-10' SS16 07/14/22 Investigation On-Site	SS-17 2-4' SS17 07/14/22 Investigation On-Site	SB-17 4-5' SS17 07/14/22 Investigation On-Site	FD-1 0-2' SS15 07/14/22 Duplicate On-Site	FD-2 6-8' SS15 07/14/22 Duplicate On-Site
Metals (mg/L)										
Arsenic	7440-38-2	0.01	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050
Barium	7440-39-3	2	**0.031**	< 0.0050	**0.0059**	< 0.0050	< 0.0050	< 0.0050	**0.036**	**0.0043** J
Cadmium	7440-43-9	0.005	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Chromium	7440-47-3	22 [1]	**0.0041** J	< 0.0050	**0.00098** J	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050
Lead	7439-92-1	0.015	< 0.0050	< 0.0050	**0.0014** J	< 0.0050	< 0.0050	< 0.0050	< 0.0050	**0.0019** J
Selenium	7782-49-2	0.05	< 0.010 U	< 0.010	< 0.010 U	< 0.010	< 0.010	< 0.010 U	< 0.010	< 0.010
Silver	7440-22-4	0.094	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050
Mercury	7439-97-6	0.002	< 0.00020	< 0.00020	< 0.00020	< 0.00020	< 0.00020	< 0.00020	< 0.00020	< 0.00020
Criteria Exceeded in Sample										

Notes:
NA - not analyzed
Nav - not available
J - analyte is present at an estimated concentration between the MDL and Report Limit
U- Undetected; the parameter was qualified as undetected during data validation
Abbreviations used in comparisons:
/GW - Indicates exceedance of the WVDEP groundwater de minimis standard (December 2022)
[1] Trivalent chromium de minimis standards used to screen total chromium analytical results as no source of hexavalent chromium was present.

Table 2-2D
SPLP Data (Herbicides) and Comparison to Direct Contact Screening Values
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

Chemical	Sample Name Sample Location Date Collected Sample Type On-Site/Off-Site CAS No.	WVDEP Groundwater De Minimis Standard (µg/L) GW	SS-15 0-2' SS15 07/14/22 Investigation On-Site	SB-15 6-8' SS15 07/14/22 Investigation On-Site	SS-16 2-4' SS16 07/14/22 Investigation On-Site	SB-16 8-10' SS16 07/14/22 Investigation On-Site	SS-17 2-4' SS17 07/14/22 Investigation On-Site	SB-17 4-5' SS17 07/14/22 Investigation On-Site	FD-1 0-2' SS15 07/14/22 Duplicate On-Site	FD-2 6-8' SS15 07/14/22 Duplicate On-Site
Herbicides (µg/L)										
2,4-Dichlorophenoxyacetic acid (2,4-D)	94-75-7	70	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
4-(2,4-Dichlorophenoxy)butyric acid (2,4-DB)	94-82-6	450	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dalapon	75-99-0	200	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dicamba	1918-00-9	570	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Dichloroprop	120-36-5	Nav	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Dinoseb	88-85-7	7	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2-Methyl-4-chlorophenoxyacetic acid (MCPA)	94-74-6	7.5	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100
2-(4-chloro-2-methylphenoxy)propanoic acid (MCPP)	7085-19-0	Nav	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100
Pentachlorophenol	87-86-5	1	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
2,4,5-Trichlorophenoxyacetic acid (2,4,5-T)	93-76-5	160	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
2-(2,4,5-Trichlorophenoxy) propionic acid (2,4,5-TP)	93-72-1	50	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Criteria Exceeded in Sample										

Notes:

Nav - not available

J - analyte is present at an estimated concentration between the MDL and Report Limit

UJ - per data validation report, data are to be cautiously as they are estimated data with some quality control issues.

1 -The QC sample type MS for method SW846 8151A was outside the control limits for the analyte Pentachlorophenol. The % Recovery was reported as 57.3 and the control limits were 63 to 109.

2 -The QC sample type MSD for method SW846 8151A was outside the control limits for the analyte Pentachlorophenol. The % Recovery was reported as 57.6 and the control limits were 63 to 109.

Abbreviations used in comparisons:

/GW - Indicates exceedance of the WVDEP groundwater de minimis standard (December 2022)

Table 2-2E
SPLP Data (PCBs) and Comparison to Direct Contact Screening Values
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

Chemical	Sample Name Sample Location Date Collected Sample Type On-Site/Off-Site CAS No.	WVDEP Groundwater De Minimis Standard (µg/L) GW	SS-15 0-2' SS15 07/14/22 Investigation On-Site	SB-15 6-8' SS15 07/14/22 Investigation On-Site	SS-16 2-4' SS16 07/14/22 Investigation On-Site	SB-16 8-10' SS16 07/14/22 Investigation On-Site	SS-17 2-4' SS17 07/14/22 Investigation On-Site	SB-17 4-5' SS17 07/14/22 Investigation On-Site	FD-1 0-2' SS15 07/14/22 Duplicate On-Site	FD-2 6-8' SS15 07/14/22 Duplicate On-Site
Polychlorinated Biphenyls (ug/L)										
Aroclor-1016	12674-11-2	0.22	< 0.80	< 0.80	< 0.40	< 0.80	< 0.40	< 0.40	< 0.40	< 0.40
Aroclor-1221	11104-28-2	0.0079	< 0.80	< 0.80	< 0.40	< 0.80	< 0.40	< 0.40	< 0.40	< 0.40
Aroclor-1232	11141-16-5	0.0079	< 0.80	< 0.80	< 0.40	< 0.80	< 0.40	< 0.40	< 0.40	< 0.40
Aroclor-1242	53469-21-9	0.0079	< 0.80	< 0.80	< 0.40	< 0.80	< 0.40	< 0.40	< 0.40	< 0.40
Aroclor-1248	12672-29-6	0.0079	< 0.80	< 0.80	< 0.40	< 0.80	< 0.40	< 0.40	< 0.40	< 0.40
Aroclor-1254	11097-69-1	0.0079	< 0.80	< 0.80	< 0.40	< 0.80	< 0.40	< 0.40	< 0.40	< 0.40
Aroclor-1260	11096-82-5	0.0079	< 0.80	< 0.80	< 0.40	< 0.80	< 0.40	< 0.40	< 0.40	< 0.40
Criteria Exceeded in Sample										

Notes:
Abbreviations used in comparisons:

/GW - Indicates exceedance of the WVDEP groundwater de minimis standard (December 2022)

Table 2-3
Analytical Sample Summary
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

Sample Name	Sampling Depth (ft bgs)	Sample Date(s)	On-Site vs. Off-Site	Analytical Parameters						Sample Retained for Risk Assessment? (Yes or No)	Comments / Rationale
				VOCs	SVOCs	PAHs	Metals	PCBs	Herbicides		
Surface Soil											
SS-01	0-0.5	10/17/17	Off-Site	X	X	X	X	X	X	**Yes**	
SS-14	0-0.5	10/17/17	On-Site	---	X	X	X	X	X	**Yes**	duplicate of SS-01
SS-02	0-0.5	10/17/17	Off-Site	---	X	X	X	X	X	**Yes**	
SS-03	0-0.5	10/17/17	On-Site	---	X	X	X	X	X	**Yes**	
SS-04	0-0.5	10/16/17	On-Site	---	X	X	X	X	X	**Yes**	
SS-05	0-0.5	10/16/17	On-Site	---	X	X	X	X	X	**Yes**	
SS-06	0-0.5	10/16/17	On-Site	X	X	X	X	X	X	**Yes**	
SS-07	0-0.5	10/16/17	On-Site	X	X	X	X	X	X	**Yes**	
SS-13	0-0.5	10/16/17	On-Site	---	X	X	X	X	X	**Yes**	duplicate of SS-07
SS-08	0-0.5	10/16/17	On-Site	X	X	X	X	X	X	**Yes**	
SS-09	0-0.5	10/16/17	On-Site	X	X	X	X	X	X	**Yes**	
SS-10	0-0.5	10/16/17	On-Site	X	---	---	---	---	X	**Yes**	
SS-11	0-0.5	10/16/17	On-Site	---	X	X	X	X	X	**Yes**	
SS-12	0-0.5	10/17/17	On-Site	---	X	X	X	X	X	**Yes**	
SS-15	0-2	7/14/22	On-Site	X	---	X	X	X	X	**Yes**	
FD-1	0-2	7/14/22	On-Site	X	---	X	X	X	X	**Yes**	duplicate of SS-15
Unsaturated Subsurface Soil											
SB-01	7.0-9.3	10/17/17	Off-Site	X	X	X	X	X	X	**Yes**	
SB-03	13.5-15.0	10/17/17	On-Site	X	X	X	X	X	X	**Yes**	
SB-04	1.9-3.8	10/16/17	On-Site	X	X	X	X	X	X	**Yes**	
SB-05	5.3-7.0	10/16/17	Off-Site	X	X	X	X	X	X	**Yes**	
SB-06	6.0-7.0	10/16/17	On-Site	X	X	X	X	X	X	**Yes**	
SB-07	11.5-13.0	10/16/17	On-Site	X	X	X	X	X	X	**Yes**	
SB-08	4.0-6.0	10/17/17	On-Site	X	X	X	X	X	X	**Yes**	
SB-09	9.2-10.0	10/17/17	On-Site	X	X	X	X	X	X	**Yes**	
SB-10	2.0-7.1	10/16/17	On-Site	---	X	X	X	X	X	**Yes**	
SB-12	4.5-6.1	10/17/17	On-Site	X	X	X	X	X	X	**Yes**	
SB-13	9.3-11.1	10/17/17	On-Site	X	X	X	X	X	X	**Yes**	
SB-15	6-8	7/14/22	On-Site	X	---	X	X	X	X	**Yes**	
FD-2	6-8	7/14/22	On-Site	X	---	X	X	X	X	**Yes**	duplicate of SB-15
Synthetic Precipitation Leaching Procedure (SPLP)											
SS-15 0-2'	0-2	7/14/22	On-Site	X	---	X	X	X	X	**Yes**	
SB-15 6-8'	6-8	7/14/22	On-Site	X	---	X	X	X	X	**Yes**	
SS-16 2-4'	2-4	7/14/22	On-Site	X	---	X	X	X	X	**Yes**	
SB-16 8-10'	8-10	7/14/22	On-Site	X	---	X	X	X	X	**Yes**	
SS-17 2-4'	2-4	7/14/22	On-Site	X	---	X	X	X	X	**Yes**	
SB-17 4-5'	4-5	7/14/22	On-Site	X	---	X	X	X	X	**Yes**	
FD-1 0-2'	0-2	7/14/22	On-Site	X	---	X	X	X	X	**Yes**	duplicate of SS-15 0-2'
FD-2 6-8'	6-8	7/14/22	On-Site	X	---	X	X	X	X	**Yes**	duplicate of SB-15 6-8'

Notes:

ft bgs - feet below ground surface

"---" - not applicable

VOCs - volatile organic compounds

SVOCs - semi-volatile organic compounds

PAHs - polycyclic aromatic hydrocarbons

PCBs - polychlorinated biphenyls

Table 3-1
Selection of Direct Contact Contaminants of Concern for Surface Soil
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

Constituent of Potential Concern (COPC)	Frequency of Detection (FOD) [1]	Minimum Reporting Limit (µg/Kg)	Maximum Reporting Limit (µg/Kg)	Minimum Detected Concentration (µg/Kg)	Maximum Detected Concentration (µg/Kg)	Sample with Maximum Detect	Residential Soil DeMinimis Standard (µg/Kg) [2]	Industrial Soil DeMinimis Standard (µg/Kg) [2]	WV Natural Background Values	Reporting Limit Exceeds Res. Criteria?	Reporting Limit Exceeds Ind. Criteria?	Direct Contact Residential Contaminant of Concern (COC)	Direct Contact Industrial Contaminant of Concern (COC)	Comment
VOCs														
1,1,1-Trichloroethane	0/7	38	49	ND	ND	---	640,000	640,000	Nav	No	No	No	No	
1,1,2,2-Tetrachloroethane	0/7	38	49	ND	ND	---	640	28,000	Nav	No	No	No	No	
1,1,2-Trichloroethane	0/7	38	49	ND	ND	---	1,200	6,800	Nav	No	No	No	No	
1,1,2-Trichlorotrifluoroethane	0/7	38	49	ND	ND	---	910,000	910,000	Nav	No	No	No	No	
1,1-Dichloroethane	0/7	38	49	ND	ND	---	3,800	170,000	Nav	No	No	No	No	
1,1-Dichloroethene	0/7	38	49	ND	ND	---	240,000	1,100,000	Nav	No	No	No	No	
1,2,3-Trichlorobenzene	0/7	38	160	ND	ND	---	Nav	Nav	Nav	No	No	No	No	
1,2,4-Trichlorobenzene	0/7	38	160	ND	ND	---	24,000	280,000	Nav	No	No	No	No	
1,2-Dibromo-3-chloropropane (DBCP)	0/7	130	160	ND	ND	---	5.7	690	Nav	Yes	No	No	No	Reporting limit exceeds residential standard, but constituent not detected in any samples.
1,2-Dibromoethane	0/7	38	49	ND	ND	---	39	1,700	Nav	Yes	No	No	No	Reporting limit exceeds residential standard, but constituent not detected in any samples.
1,2-Dichlorobenzene	0/7	38	49	ND	ND	---	380,000	380,000	Nav	No	No	No	No	
1,2-Dichloroethane	0/7	38	160	ND	ND	---	500	22,000	Nav	No	No	No	No	
1,2-Dichloropropane	0/7	38	49	ND	ND	---	2,700	71,000	Nav	No	No	No	No	
1,3-Dichlorobenzene	0/7	38	49	ND	ND	---	Nav	Nav	Nav	No	No	No	No	
1,4-Dichlorobenzene	0/7	38	49	ND	ND	---	2,800	120,000	Nav	No	No	No	No	
2-Butanone	2/7	250	290	230 J	380	SS-10 (0-0.5')	28,000,000	28,000,000	Nav	No	No	No	No	
2-Hexanone	0/7	38	49	ND	ND	---	Nav	Nav	Nav	No	No	No	No	
4-Methyl-2-pentanone	0/7	38	49	ND	ND	---	3,400,000	3,400,000	Nav	No	No	No	No	
Acetone	0/7	130	220	ND	ND	---	61,000,000	110,000,000	Nav	No	No	No	No	
Benzene	0/7	38	49	ND	ND	---	1,200	54,000	Nav	No	No	No	No	
Bromochloromethane	0/7	38	49	ND	ND	---	Nav	Nav	Nav	No	No	No	No	
Bromodichloromethane	0/7	38	49	ND	ND	---	310	14,000	Nav	No	No	No	No	
Bromoform	0/7	38	49	ND	ND	---	20,000	910,000	Nav	No	No	No	No	
Bromomethane	0/7	130	160	ND	ND	---	7,300	32,000	Nav	No	No	No	No	
Carbon disulfide	0/7	38	49	ND	ND	---	740,000	740,000	Nav	No	No	No	No	
Carbon tetrachloride	0/7	38	49	ND	ND	---	700	31,000	Nav	No	No	No	No	
Chlorobenzene	0/7	38	49	ND	ND	---	290,000	760,000	Nav	No	No	No	No	
Chloroethane	0/7	130	160	ND	ND	---	2,100,000	2,100,000	Nav	No	No	No	No	
Chloroform	0/7	38	49	ND	ND	---	340	15,000	Nav	No	No	No	No	
Chloromethane	0/7	130	160	ND	ND	---	120,000	500,000	Nav	No	No	No	No	
cis-1,2-Dichloroethene	0/7	38	49	ND	ND	---	17,000	80,000	Nav	No	No	No	No	
cis-1,3-Dichloropropene	0/7	38	49	ND	ND	---	Nav	Nav	Nav	No	No	No	No	
Cyclohexane	0/7	38	160	ND	ND	---	120,000	120,000	Nav	No	No	No	No	
Cyclohexanone	0/6	38	44	ND	ND	---	5,100,000	5,100,000	Nav	No	No	No	No	
Dibromochloromethane	0/7	38	49	ND	ND	---	8,300	390,000	Nav	No	No	No	No	
Dichlorodifluoromethane	0/7	38	160	ND	ND	---	94,000	400,000	Nav	No	No	No	No	
Ethylbenzene	0/7	38	49	ND	ND	---	6,200	270,000	Nav	No	No	No	No	
Isopropylbenzene	0/7	38	49	ND	ND	---	270,000	270,000	Nav	No	No	No	No	
m,p-Xylene	5/7	80	98	30 J	89	SS-07 (0-0.5')	Nav	Nav	Nav	No	No	No	No	
Methyl acetate	4/7	250	270	99 J	230 J	SS-01 (0-0.5')	23,000,000	29,000,000	Nav	No	No	No	No	
Methyl tert-butyl ether	0/7	38	49	ND	ND	---	50,000	2,200,000	Nav	No	No	No	No	
Methylcyclohexane	4/7	39	49	73	190	SS-07 (0-0.5')	Nav	Nav	Nav	No	No	No	No	
Methylene chloride	1/7	38	44	380 J	380 J	FD-1 (0-2') Duplicate of SS-15	58,000	3,300,000	Nav	No	No	No	No	
Naphthalene	0/1	160	160	ND	ND	---	2,400	110,000	Nav	No	No	No	No	
o-Xylene	4/7	40	49	17 J	53	SS-10 (0-0.5')	Nav	Nav	Nav	No	No	No	No	
Styrene	0/7	38	49	ND	ND	---	870,000	870,000	Nav	No	No	No	No	
Tetrachloroethene	0/7	38	49	ND	ND	---	25,000	170,000	Nav	No	No	No	No	
Toluene	4/7	39	49	25 J	110	SS-07 (0-0.5')	820,000	820,000	Nav	No	No	No	No	
trans-1,2-Dichloroethene	0/7	38	49	ND	ND	---	75,000	320,000	Nav	No	No	No	No	
trans-1,3-Dichloropropene	0/7	38	49	ND	ND	---	Nav	Nav	Nav	No	No	No	No	
Trichloroethene	0/7	38	49	ND	ND	---	1,000	20,000	Nav	No	No	No	No	
Trichlorofluoromethane	0/7	38	49	ND	ND	---	790,000	1,200,000	Nav	No	No	No	No	
Vinyl chloride	0/7	38	49	ND	ND	---	61	18,000	Nav	No	No	No	No	
Xylenes, Total	4/7	120	150	47 J	140	SS-07 (0-0.5')	260,000	260,000	Nav	No	No	No	No	

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Selection of Direct Contact Contaminants of Concern for Surface Soil
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

Constituent of Potential Concern (COPC)	Frequency of Detection (FOD) [1]	Minimum Reporting Limit (µg/Kg)	Maximum Reporting Limit (µg/Kg)	Minimum Detected Concentration (µg/Kg)	Maximum Detected Concentration (µg/Kg)	Sample with Maximum Detect	Residential Soil DeMinimis Standard (µg/Kg) [2]	Industrial Soil DeMinimis Standard (µg/Kg) [2]	WV Natural Background Values	Reporting Limit Exceeds Res. Criteria?	Reporting Limit Exceeds Ind. Criteria?	Direct Contact Residential Contaminant of Concern (COC)	Direct Contact Industrial Contaminant of Concern (COC)	Comment
SVOCs														
1,1`-Biphenyl	7/11	210	390	6.4 J	260	SS-05 (0-0.5')	51,000	210,000	Nav	No	No	No	No	
1,2,4,5-Tetrachlorobenzene	0/11	360	3,900	ND	ND	---	17,000	150,000	Nav	No	No	No	No	
1,4-Dioxane	0/11	180	2,000	ND	ND	---	5,400	250,000	Nav	No	No	No	No	
2,2`-Oxybis(1-chloropropane)	0/11	35	390	ND	ND	---	5,100	230,000	Nav	No	No	No	No	
2,3,4,6-Tetrachlorophenol	0/11	72	790 UJ*	ND	ND	---	1,900,000	25,000,000	Nav	No	No	No	No	
2,4,5-Trichlorophenol	0/11	35	390	ND	ND	---	6,300,000	82,000,000	Nav	No	No	No	No	
2,4,6-Trichlorophenol	0/11	35	390	ND	ND	---	49,000	820,000	Nav	No	No	No	No	
2,4-Dichlorophenol	0/11	35	390	ND	ND	---	190,000	2,500,000	Nav	No	No	No	No	
2,4-Dimethylphenol	0/11	35	390 UJ*	ND	ND	---	1,300,000	16,000,000	Nav	No	No	No	No	
2,4-Dinitrophenol	0/11	35	390 R*	ND	ND	---	130,000	1,600,000	Nav	No	No	No	No	
2,4-Dinitrotoluene	0/11	35	390	ND	ND	---	1,700	74,000	Nav	No	No	No	No	
2,6-Dinitrotoluene	0/11	35	390	ND	ND	---	360	15,000	Nav	Yes	No	No	No	Reporting limit exceeds residential standard, but constituent not detected in any samples.
2-Chloronaphthalene	0/11	7.1	78	ND	ND	---	5,000,000	50,000,000	Nav	No	No	No	No	
2-Chlorophenol	0/11	35	390 UJ*	ND	ND	---	340,000	3,900,000	Nav	No	No	No	No	
2-Methylphenol	0/11	35	390	ND	ND	---	3,200,000	41,000,000	Nav	No	No	No	No	
2-Nitroaniline	0/11	35	390	ND	ND	---	630,000	8,000,000	Nav	No	No	No	No	
2-Nitrophenol	0/11	35	390	ND	ND	---	Nav	Nav	Nav	No	No	No	No	
3&4-Methylphenol	0/11	35	390	ND	ND	---	3,200,000	41,000,000	Nav	No	No	No	No	
3,3'-Dichlorobenzidine	0/11	180	2,000	ND	ND	---	1,200	51,000	Nav	Yes	No	No	No	Reporting limit exceeds residential standard, but constituent not detected in any samples.
3-Nitroaniline	0/11	35	390	ND	ND	---	Nav	Nav	Nav	No	No	No	No	
4,6-Dinitro-2-methylphenol	0/11	35	390 R*	ND	ND	---	Nav	Nav	Nav	No	No	No	No	
4-Bromophenyl phenyl ether	0/11	35	390	ND	ND	---	Nav	Nav	Nav	No	No	No	No	
4-Chloro-3-methylphenol	0/11	35	390	ND	ND	---	Nav	Nav	Nav	No	No	No	No	
4-Chloroaniline	0/11	72	790	ND	ND	---	2,700	110,000	Nav	No	No	No	No	
4-Chlorophenyl phenyl ether	0/11	35	390 UJ*	ND	ND	---	Nav	Nav	Nav	No	No	No	No	
4-Nitroaniline	0/11	180	2,000	ND	ND	---	Nav	Nav	Nav	No	No	No	No	
4-Nitrophenol	0/11	35	390 UJ*	ND	ND	---	Nav	Nav	Nav	No	No	No	No	
Acetophenone	0/11	35	390	ND	ND	---	2,500,000	2,500,000	Nav	No	No	No	No	
Atrazine	0/11	35	390	ND	ND	---	2,400	100,000	Nav	No	No	No	No	
Benzaldehyde	0/11	72	790	ND	ND	---	170,000	1,200,000	Nav	No	No	No	No	
Bis(2-chloroethoxy)methane	0/11	35	390 UJ*	ND	ND	---	Nav	Nav	Nav	No	No	No	No	
Bis(2-chloroethyl)ether	0/11	35	390	ND	ND	---	240	11,000	Nav	Yes	No	No	No	Reporting limit exceeds residential standard, but constituent not detected in any samples.
Bis(2-ethylhexyl)phthalate	5/11	36	380	35 J	620	SS-13 (0-0.5')	39,000	1,600,000	Nav	No	No	No	No	
Butyl benzyl phthalate	4/11	36	390	49	500 J*	SS-12 (0-0.5')	290,000	12,000,000	Nav	No	No	No	No	
Caprolactam	0/11	35	390 UJ*	ND	ND	---	31,000,000	400,000,000	Nav	No	No	No	No	
Carbazole	7/11	35	390 UJ*	190 J	440	SS-04 (0-0.5')	Nav	Nav	Nav	No	No	No	No	
Dibenzofuran	8/11	35	390 UJ*	30 J	720	SS-04 (0-0.5')	78,000	1,200,000	Nav	No	No	No	No	
Diethyl phthalate	0/11	35	390 UJ*	ND	ND	---	51,000,000	660,000,000	Nav	No	No	No	No	
Dimethyl phthalate	0/11	35	390 R*	ND	ND	---	Nav	Nav	Nav	No	No	No	No	
Di-n-butyl phthalate	0/11	35	390	ND	ND	---	6,300,000	82,000,000	Nav	No	No	No	No	
Di-n-octyl phthalate	0/11	35	390	ND	ND	---	Nav	Nav	Nav	No	No	No	No	
Hexachlorobenzene	0/11	35	390	ND	ND	---	220	10,000	Nav	Yes	No	No	No	Reporting limit exceeds residential standard, but constituent not detected in any samples.
Hexachlorobutadiene	0/11	35	390 UJ*	ND	ND	---	1,300	17,000	Nav	No	No	No	No	
Hexachlorocyclopentadiene	0/11	35	390 R*	ND	ND	---	1,900	8,000	Nav	No	No	No	No	
Hexachloroethane	0/11	35	390 UJ*	ND	ND	---	2,000	86,000	Nav	No	No	No	No	
Isophorone	0/11	180	2,000	ND	ND	---	570,000	24,000,000	Nav	No	No	No	No	
Nitrobenzene	0/11	180	2,000	ND	ND	---	5,500	240,000	Nav	No	No	No	No	
N-Nitrosodi-n-propylamine	0/11	35	390 UJ*	ND	ND	---	78	3,300	Nav	Yes	No	No	No	Reporting limit exceeds residential standard, but constituent not detected in any samples.
N-Nitrosodiphenylamine	0/11	35	390 UJ*	ND	ND	---	110,000	7,200,000	Nav	No	No	No	No	
Pentachlorophenol	0/11	35	390	ND	ND	---	1,000	40,000	Nav	No	No	No	No	
Phenol	1/11	35	390	47	47	SS-02 (0-0.5')	19,000,000	250,000,000	Nav	No	No	No	No	

Table 3-1
Selection of Direct Contact Contaminants of Concern for Surface Soil
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

Constituent of Potential Concern (COPC)	Frequency of Detection (FOD) [1]	Minimum Reporting Limit (µg/Kg)	Maximum Reporting Limit (µg/Kg)	Minimum Detected Concentration (µg/Kg)	Maximum Detected Concentration (µg/Kg)	Sample with Maximum Detect	Residential Soil DeMinimis Standard (µg/Kg) [2]	Industrial Soil DeMinimis Standard (µg/Kg) [2]	WV Natural Background Values	Reporting Limit Exceeds Res. Criteria?	Reporting Limit Exceeds Ind. Criteria?	Direct Contact Residential Contaminant of Concern (COC)	Direct Contact Industrial Contaminant of Concern (COC)	Comment
PAHs														
2-Methylnaphthalene	11/11	---	---	1.9 J	150	SS-04 (0-0.5')	310,000	4,700,000	Nav	---	---	No	No	
Acenaphthene	12/12	---	---	1.0 J	420	SS-04 (0-0.5')	4,100,000	47,000,000	Nav	---	---	No	No	
Acenaphthylene	12/12	---	---	9.1	10,000	SS-04 (0-0.5')	4,200,000	51,000,000	Nav	---	---	No	No	
Anthracene	12/12	---	---	9.2	7,700	SS-04 (0-0.5')	23,000,000	350,000,000	Nav	---	---	No	No	
Benzo(a)anthracene	12/12	---	---	19	42,000	SS-04 (0-0.5')	1,500	320,000	Nav	---	---	**Yes**	No	
Benzo(a)pyrene	12/12	---	---	23	36,000	SS-04 (0-0.5')	110	21,000	Nav	---	---	**Yes**	**Yes**	
Benzo(b)fluoranthene	12/12	---	---	51	47,000	SS-04 (0-0.5')	1,100	210,000	Nav	---	---	**Yes**	No	
Benzo(g,h,i)perylene	12/12	---	---	20	15,000	SS-04 (0-0.5')	1,800,000	23,000,000	Nav	---	---	No	No	
Benzo(k)fluoranthene	12/12	---	---	16	16,000	SS-04 (0-0.5')	11,000	2,100,000	Nav	---	---	**Yes**	No	
Chrysene	12/12	---	---	28	39,000	SS-04 (0-0.5')	110,000	21,000,000	Nav	---	---	No	No	
Dibenzo(a,h)anthracene	12/12	---	---	4.7	4,100	SS-04 (0-0.5')	110	21,000	Nav	---	---	**Yes**	No	
Fluoranthene	12/12	---	---	32.0	70,000	SS-04 (0-0.5')	2,400,000	30,000,000	Nav	---	---	No	No	
Fluorene	12/12	---	---	2.1 J	1,100	SS-04 (0-0.5')	2,900,000	37,000,000	Nav	---	---	No	No	
Indeno(1,2,3-cd)pyrene	12/12	---	---	24	17,000	SS-04 (0-0.5')	1,100	210,000	Nav	---	---	**Yes**	No	
Naphthalene	12/12	---	---	1.4 J	230	SS-04 (0-0.5')	2,400	110,000	Nav	---	---	No	No	
Phenanthrene	12/12	---	---	16	8,500	SS-04 (0-0.5')	23,000,000	350,000,000	Nav	---	---	No	No	
Pyrene	12/12	---	---	44	72,000	SS-04 (0-0.5')	2,300,000	34,000,000	Nav	---	---	No	No	
Herbicides														
2,4-Dichlorophenoxyacetic acid (2,4-D)	0/13	72.4	133	ND	ND	---	700,000	9,600,000	Nav	No	No	No	No	
4-(2,4-Dichlorophenoxy)butyric acid (2,4-DB)	0/13	72.4	133	ND	ND	---	1,900,000	25,000,000	Nav	No	No	No	No	
2,4,5-Trichlorophenoxyacetic acid (2,4,5-T)	0/13	72.4	226	ND	ND	---	630,000	8,200,000	Nav	No	No	No	No	
2-(2,4,5-Trichlorophenoxy) propionic acid (2,4,5-TP)	0/13	72.4	133	ND	ND	---	510,000	6,600,000	Nav	No	No	No	No	
Dalapon	0/1	125	133	ND	ND	---	1,900,000	25,000,000	Nav	No	No	No	No	
Dicamba	0/1	125	133	ND	ND	---	1,900,000	25,000,000	Nav	No	No	No	No	
Dichloroprop	0/1	125	133	ND	ND	---	Nav	Nav	Nav	No	No	No	No	
Dinoseb	0/1	213	226	ND	ND	---	63,000	820,000	Nav	No	No	No	No	
MCPA	0/1	15,000	16,000	ND	ND	---	32,000	410,000	Nav	No	No	No	No	
MCPP	0/1	15,000	16,000	ND	ND	---	Nav	Nav	Nav	No	No	No	No	
Pentachlorophenol	0/1	125	133	ND	ND	---	1,000	40,000	Nav	No	No	No	No	
Metals/Other [3]														
Mercury	12/12	---	---	0.015 J	0.98	SS-04 (0-0.5')	3.1	3.1	0.09	---	---	No	No	
Aluminum	11/11	---	---	3,500	9,200	SS-05 (0-0.5')	77,000	1,000,000	77120	---	---	No	No	
Antimony	9/11	3.7	4.5 U*	1.4	49	SS-04 (0-0.5')	31	470	0.89	No	No	**Yes**	No	
Arsenic	12/12	---	---	4.4	400	SS-04 (0-0.5')	0.68	30	13.1	---	---	**Yes**	**Yes**	
Barium	12/12	---	---	36	1,200	SS-04 (0-0.5')	15,000	220,000	565	---	---	No	No	
Beryllium	11/11	---	---	0.11 J	1.0	SS-05 (0-0.5')	160	2,300	2.8	---	---	No	No	
Cadmium	6/12	0.77 U*	9.1 U*	0.72 J	2.6	SS-13 (0-0.5')	37	530	0.5	No	No	No	No	
Calcium	11/11	---	---	2900	270,000	SS-13 (0-0.5')	Nav	Nav	3300	---	---	No	No	
Chromium*	12/12	---	---	8.7	48	SS-03 (0-0.5')	120,000	1,000,000	57.4	---	---	No	No	
Cobalt	11/11	---	---	4.2	15	SS-04 (0-0.5')	23	350	23.8	---	---	No	No	
Copper	11/11	---	---	12	1,100	SS-04 (0-0.5')	3,100	47,000	27.5	---	---	No	No	
Iron	11/11	---	---	8,000	120,000	SS-04 (0-0.5')	55,000	820,000	39380	---	---	**Yes**	No	
Lead	12/12	---	---	9.3	3,500	SS-04 (0-0.5')	100**	247***	38	---	---	**Yes**	**No**	
Magnesium	11/11	---	---	600	12,000	SS-11 (0-0.5')	Nav	Nav	5640	---	---	No	No	
Manganese	11/11	---	---	160	1,100	SS-09 (0-0.5')	1,800	26,000	1998	---	---	No	No	
Nickel	11/11	---	---	6.8	30	SS-04 (0-0.5')	1,500	22,000	34.4	---	---	No	No	
Potassium	11/11	---	---	330 J+*	750	SS-11 (0-0.5')	Nav	Nav	19880	---	---	No	No	
Selenium	12/12	---	---	1.4	4.3 J	SS-13 (0-0.5')	390	5,800	0.8	---	---	No	No	
Silver	3/12	0.37	0.45	0.16 J,J+*	0.44 J	FD-1 (0-2') Duplicate of SS-15	390	5,800	<1	No	No	No	No	
Sodium	11/11	---	---	25	4100 J+*	SS-05 (0-0.5')	Nav	Nav	3600	---	---	No	No	
Thallium	0/11	0.71	9.1	ND	ND	---	0.78	12	0.8	Yes	No	No	No	Reporting limit exceeds residential standard, but constituent not detected in any samples.
Vanadium	11/11	---	---	7.4	29 J+*	SS-05 (0-0.5')	460	8,400	98.8	---	---	No	No	
Zinc	11/11	---	---	110	3100 B	SS-05 (0-0.5')	23,000	350,000	103	---	---	No	No	

Table 3-1
Selection of Direct Contact Contaminants of Concern for Surface Soil
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

Constituent of Potential Concern (COPC)	Frequency of Detection (FOD) [1]	Minimum Reporting Limit (µg/Kg)	Maximum Reporting Limit (µg/Kg)	Minimum Detected Concentration (µg/Kg)	Maximum Detected Concentration (µg/Kg)	Sample with Maximum Detect	Residential Soil DeMinimis Standard (µg/Kg) [2]	Industrial Soil DeMinimis Standard (µg/Kg) [2]	WV Natural Background Values	Reporting Limit Exceeds Res. Criteria?	Reporting Limit Exceeds Ind. Criteria?	Direct Contact Residential Contaminant of Concern (COC)	Direct Contact Industrial Contaminant of Concern (COC)	Comment
PCBs														
Aroclor-1016	0/12	71	230	ND	ND	---	5,500	82,000	Nav	No	No	No	No	
Aroclor-1221	0/12	71	230	ND	ND	---	260	12,000	Nav	No	No	No	No	
Aroclor-1232	0/12	71	230	ND	ND	---	220	10,000	Nav	No	No	No	No	
Aroclor-1242	0/12	71	230	ND	ND	---	310	15,000	Nav	No	No	No	No	
Aroclor-1248	0/12	71	230	ND	ND	---	310	15,000	Nav	No	No	No	No	
Aroclor-1254	2/12	71	230	180	350	SS-07 (0-0.5')	320	15,000	Nav	No	No	**Yes**	No	
Aroclor-1260	3/12	71	230	45 J	140	SS-07 (0-0.5')	330	16,000	Nav	No	No	No	No	
Aroclor-1262	0/11	71	86	ND	ND	---	Nav	Nav	Nav	No	No	No	No	
Aroclor-1268	0/11	71	86	ND	ND	---	Nav	Nav	Nav	No	No	No	No	

Notes:
Nav - No screening value available
ND - Constituent not detected
"---" - not applicable
J - analyte is present at an estimated concentration between the MDL and Report Limit
B - analyte detected in the associated Method Blank above the Reporting Limit
J* - per data validation report, data are to be used cautiously as they are estimated data with some quality control issues
J+* - per data validation report, the data are an estimated value with potential high bias
R* - per data validation report, data are not to be used
U* - per data validation report, the parameter was qualified as undetected during data validation
UJ* - per data validation report, data are undetected at an estimated quantitation limit because of a quality control outlier
** = May 2024 USEPA Residential Regional Screening Level (RSL) based on multiple sources of lead
*** = Industrial screening value of 247 mg/kg is based on proposed WVDEP industrial soil de minimis standard for lead (426 mg/kg) adjusted from a target blood lead level of 5 ug/dL to 3.5 ug/dL to account for multiple sources of lead
[1] For those soil samples that had a duplicate sample collected, the higher of the two concentrations from the original and duplicate sample were used to select the maximum detected concentration. In addition, the original and duplicate sample detected results were counted as one sample for purposes of frequency of detection.
[2] WVDEP residential and industrial soil de minimis standard (November 30, 2023)
[3] The analytical results and screening values for metals are in mg/kg rather than ug/kg.
[5] Trivalent chromium de minimis standards utilized to screen total chromium analytical results due to no source of hexavalent chromium.

Table 3-2
Selection of Direct Contact Contaminants of Concern for Subsurface Soil
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

Constituent of Potential Concern (COPC)	Frequency of Detection (FOD) [1]	Minimum Reporting Limit (µg/Kg)	Maximum Reporting Limit (µg/Kg)	Minimum Detected Concentration (µg/Kg)	Maximum Detected Concentration (µg/Kg)	Sample with Maximum Detect	Residential Soil DeMinimis Standard (µg/Kg) [2]	Industrial Soil DeMinimis Standard (µg/Kg) [2]	WV Natural Background Values	Reporting Limit Exceeds Res. Criteria?	Reporting Limit Exceeds Ind. Criteria?	Direct Contact Residential Contaminant of Concern (COC)	Direct Contact Industrial Contaminant of Concern (COC)	Comment
VOCs														
1,1,1-Trichloroethane	0/11	36	41	ND	ND	---	640,000	640,000	Nav	No	No	No	No	
1,1,2,2-Tetrachloroethane	0/11	36	41	ND	ND	---	640	28,000	Nav	No	No	No	No	
1,1,2-Trichloroethane	0/11	36	41	ND	ND	---	1,200	6,800	Nav	No	No	No	No	
1,1,2-Trichlorotrifluoroethane	0/11	36	41	ND	ND	---	910,000	910,000	Nav	No	No	No	No	
1,1-Dichloroethane	0/11	36	41	ND	ND	---	3,800	170,000	Nav	No	No	No	No	
1,1-Dichloroethene	0/11	36	41	ND	ND	---	240,000	1,100,000	Nav	No	No	No	No	
1,2,3-Trichlorobenzene	0/11	36	120	ND	ND	---	Nav	Nav	Nav	No	No	No	No	
1,2,4-Trichlorobenzene	0/11	36	120	ND	ND	---	24,000	280,000	Nav	No	No	No	No	
1,2-Dibromo-3-chloropropane (DBCP)	0/11	120	140	ND	ND	---	5.7	690	Nav	Yes	No	No	No	Reporting limit exceeds residential standard, but constituent not detected in any samples.
1,2-Dibromoethane	0/11	36	41	ND	ND	---	39	1,700	Nav	Yes	No	No	No	Reporting limit exceeds residential standard, but constituent not detected in any samples.
1,2-Dichlorobenzene	0/11	36	41	ND	ND	---	380,000	380,000	Nav	No	No	No	No	
1,2-Dichloroethane	0/11	36	120	ND	ND	---	500	22,000	Nav	No	No	No	No	
1,2-Dichloropropane	0/11	36	41	ND	ND	---	2,700	71,000	Nav	No	No	No	No	
1,3-Dichlorobenzene	0/11	36	41	ND	ND	---	Nav	Nav	Nav	No	No	No	No	
1,4-Dichlorobenzene	0/11	36	41	ND	ND	---	2,800	120,000	Nav	No	No	No	No	
2-Butanone	1/11	240	280	130 J	130 J	FD-2 (Duplicate of SB-15 6-8')	28,000,000	28,000,000	Nav	No	No	No	No	
2-Hexanone	0/11	36	41	ND	ND	---	Nav	Nav	Nav	No	No	No	No	
4-Methyl-2-pentanone	0/11	36	41	ND	ND	---	3,400,000	3,400,000	Nav	No	No	No	No	
Acetone	0/11	120	140	ND	ND	---	61,000,000	110,000,000	Nav	No	No	No	No	
Benzene	0/11	36	41	ND	ND	---	1,200	54,000	Nav	No	No	No	No	
Bromochloromethane	0/11	36	41	ND	ND	---	Nav	Nav	Nav	No	No	No	No	
Bromodichloromethane	0/11	36	41	ND	ND	---	310	14,000	Nav	No	No	No	No	
Bromoform	0/11	36	41	ND	ND	---	20,000	910,000	Nav	No	No	No	No	
Bromomethane	0/11	120	140	ND	ND	---	7,300	32,000	Nav	No	No	No	No	
Carbon disulfide	0/11	36	41	ND	ND	---	740,000	740,000	Nav	No	No	No	No	
Carbon tetrachloride	0/11	36	41	ND	ND	---	700	31,000	Nav	No	No	No	No	
Chlorobenzene	0/11	36	41	ND	ND	---	290,000	760,000	Nav	No	No	No	No	
Chloroethane	0/11	120	140	ND	ND	---	2,100,000	2,100,000	Nav	No	No	No	No	
Chloroform	0/11	36	41	ND	ND	---	340	15,000	Nav	No	No	No	No	
Chloromethane	0/11	120	140	ND	ND	---	120,000	500,000	Nav	No	No	No	No	
cis-1,2-Dichloroethene	0/11	36	41	ND	ND	---	17,000	80,000	Nav	No	No	No	No	
cis-1,3-Dichloropropene	0/11	36	41	ND	ND	---	Nav	Nav	Nav	No	No	No	No	
Cyclohexane	0/11	36	120	ND	ND	---	120,000	120,000	Nav	No	No	No	No	
Cyclohexanone	0/10	36	41	ND	ND	---	5,100,000	5,100,000	Nav	No	No	No	No	
Dibromochloromethane	0/11	36	41	ND	ND	---	8,300	390,000	Nav	No	No	No	No	
Dichlorodifluoromethane	0/11	36	120	ND	ND	---	94,000	400,000	Nav	No	No	No	No	
Ethylbenzene	0/11	36	41	ND	ND	---	6,200	270,000	Nav	No	No	No	No	
Isopropylbenzene	0/11	36	41	ND	ND	---	270,000	270,000	Nav	No	No	No	No	
m,p-Xylene	0/11	72	83	ND	ND	---	Nav	Nav	Nav	No	No	No	No	
Methyl acetate	1/11	240	280	200 J	200 J	SB-15 (6-8')	23,000,000	29,000,000	Nav	No	No	No	No	
Methyl tert-butyl ether	0/11	36	41	ND	ND	---	50,000	2,200,000	Nav	No	No	No	No	
Methylcyclohexane	0/11	36	41	ND	ND	---	Nav	Nav	Nav	No	No	No	No	
Methylene chloride	1/11	36	41	230 J	230 J	SB-15 (6-8')	58,000	3,300,000	Nav	No	No	No	No	
Naphthalene	0/1	120	120	ND	ND	---	2,400	110,000	Nav	No	No	No	No	
o-Xylene	0/11	36	41	ND	ND	---	Nav	Nav	Nav	No	No	No	No	
Styrene	0/11	36	41	ND	ND	---	870,000	870,000	Nav	No	No	No	No	
Tetrachloroethene	0/11	36	41	ND	ND	---	25,000	170,000	Nav	No	No	No	No	
Toluene	0/11	36	41	ND	ND	---	820,000	820,000	Nav	No	No	No	No	
trans-1,2-Dichloroethene	0/11	36	41	ND	ND	---	75,000	320,000	Nav	No	No	No	No	
trans-1,3-Dichloropropene	0/11	36	41	ND	ND	---	Nav	Nav	Nav	No	No	No	No	
Trichloroethene	0/11	36	41	ND	ND	---	1,000	20,000	Nav	No	No	No	No	
Trichlorofluoromethane	0/11	36	41	ND	ND	---	790,000	1,200,000	Nav	No	No	No	No	
Vinyl chloride	0/11	36	41	ND	ND	---	61	18,000	Nav	No	No	No	No	
Xylenes, Total	0/11	110	120	ND	ND	---	260,000	260,000	Nav	No	No	No	No	

Table 3-2
Selection of Direct Contact Contaminants of Concern for Subsurface Soil
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

Constituent of Potential Concern (COPC)	Frequency of Detection (FOD) [1]	Minimum Reporting Limit (µg/Kg)	Maximum Reporting Limit (µg/Kg)	Minimum Detected Concentration (µg/Kg)	Maximum Detected Concentration (µg/Kg)	Sample with Maximum Detect	Residential Soil DeMinimis Standard (µg/Kg) [2]	Industrial Soil DeMinimis Standard (µg/Kg) [2]	WV Natural Background Values	Reporting Limit Exceeds Res. Criteria?	Reporting Limit Exceeds Ind. Criteria?	Direct Contact Residential Contaminant of Concern (COC)	Direct Contact Industrial Contaminant of Concern (COC)	Comment
SVOCs														
1,1`-Biphenyl	0/11	36	190	ND	ND	---	51,000	210,000	Nav	No	No	No	No	
1,2,4,5-Tetrachlorobenzene	0/11	360	1,900	ND	ND	---	17,000	150,000	Nav	No	No	No	No	
1,4-Dioxane	0/11	180	950	ND	ND	---	5,400	250,000	Nav	No	No	No	No	
2,2`-Oxybis(1-chloropropane)	0/11	36	190	ND	ND	---	5,100	230,000	Nav	No	No	No	No	
2,3,4,6-Tetrachlorophenol	0/11	73	380	ND	ND	---	1,900,000	25,000,000	Nav	No	No	No	No	
2,4,5-Trichlorophenol	0/11	36	190	ND	ND	---	6,300,000	82,000,000	Nav	No	No	No	No	
2,4,6-Trichlorophenol	0/11	36	190	ND	ND	---	49,000	820,000	Nav	No	No	No	No	
2,4-Dichlorophenol	0/11	36	190	ND	ND	---	190,000	2,500,000	Nav	No	No	No	No	
2,4-Dimethylphenol	0/11	36	190	ND	ND	---	1,300,000	16,000,000	Nav	No	No	No	No	
2,4-Dinitrophenol	0/11	36	190	ND	ND	---	130,000	1,600,000	Nav	No	No	No	No	
2,4-Dinitrotoluene	0/11	36	190	ND	ND	---	1,700	74,000	Nav	No	No	No	No	
2,6-Dinitrotoluene	0/11	36	190	ND	ND	---	360	15,000	Nav	No	No	No	No	
2-Chloronaphthalene	0/11	7.3	38	ND	ND	---	5,000,000	50,000,000	Nav	No	No	No	No	
2-Chlorophenol	0/11	36	190	ND	ND	---	340,000	3,900,000	Nav	No	No	No	No	
2-Methylphenol	0/11	36	190	ND	ND	---	3,200,000	41,000,000	Nav	No	No	No	No	
2-Nitroaniline	0/11	36	190	ND	ND	---	630,000	8,000,000	Nav	No	No	No	No	
2-Nitrophenol	0/11	36	190	ND	ND	---	Nav	Nav	Nav	No	No	No	No	
3&4-Methylphenol	0/11	36	190	ND	ND	---	3,200,000	41,000,000	Nav	No	No	No	No	
3,3'-Dichlorobenzidine	0/11	180	950	ND	ND	---	1,200	51,000	Nav	No	No	No	No	
3-Nitroaniline	0/11	36	190	ND	ND	---	Nav	Nav	Nav	No	No	No	No	
4,6-Dinitro-2-methylphenol	0/11	36	190	ND	ND	---	Nav	Nav	Nav	No	No	No	No	
4-Bromophenyl phenyl ether	0/11	36	190	ND	ND	---	Nav	Nav	Nav	No	No	No	No	
4-Chloro-3-methylphenol	0/11	36	190	ND	ND	---	Nav	Nav	Nav	No	No	No	No	
4-Chloroaniline	0/11	73	380	ND	ND	---	2,700	110,000	Nav	No	No	No	No	
4-Chlorophenyl phenyl ether	0/11	36	190	ND	ND	---	Nav	Nav	Nav	No	No	No	No	
4-Nitroaniline	0/11	180	950	ND	ND	---	Nav	Nav	Nav	No	No	No	No	
4-Nitrophenol	0/11	36	190	ND	ND	---	Nav	Nav	Nav	No	No	No	No	
Acetophenone	0/11	36	190	ND	ND	---	2,500,000	2,500,000	Nav	No	No	No	No	
Atrazine	0/11	36	190	ND	ND	---	2,400	100,000	Nav	No	No	No	No	
Benzaldehyde	0/11	73	380	ND	ND	---	170,000	1,200,000	Nav	No	No	No	No	
Bis(2-chloroethoxy)methane	0/11	36	190	ND	ND	---	Nav	Nav	Nav	No	No	No	No	
Bis(2-chloroethyl)ether	0/11	36	190	ND	ND	---	240	11,000	Nav	No	No	No	No	
Bis(2-ethylhexyl)phthalate	0/11	36	190	ND	ND	---	39,000	1,600,000	Nav	No	No	No	No	
Butyl benzyl phthalate	0/11	36	190	ND	ND	---	290,000	12,000,000	Nav	No	No	No	No	
Caprolactam	0/11	36	190	ND	ND	---	31,000,000	400,000,000	Nav	No	No	No	No	
Carbazole	0/11	36	190	ND	ND	---	Nav	Nav	Nav	No	No	No	No	
Dibenzofuran	0/11	36	190	ND	ND	---	78,000	1,200,000	Nav	No	No	No	No	
Diethyl phthalate	0/11	36	190	ND	ND	---	51,000,000	660,000,000	Nav	No	No	No	No	
Dimethyl phthalate	0/11	36	190	ND	ND	---	Nav	Nav	Nav	No	No	No	No	
Di-n-butyl phthalate	0/11	36	190	ND	ND	---	6,300,000	82,000,000	Nav	No	No	No	No	
Di-n-octyl phthalate	0/11	36	190	ND	ND	---	Nav	Nav	Nav	No	No	No	No	
Hexachlorobenzene	0/11	36	190	ND	ND	---	220	10,000	Nav	No	No	No	No	
Hexachlorobutadiene	0/11	36	190	ND	ND	---	1,300	17,000	Nav	No	No	No	No	
Hexachlorocyclopentadiene	0/11	36	190	ND	ND	---	1,900	8,000	Nav	No	No	No	No	
Hexachloroethane	0/11	36	190	ND	ND	---	2,000	86,000	Nav	No	No	No	No	
Isophorone	0/11	180	950	ND	ND	---	570,000	24,000,000	Nav	No	No	No	No	
Nitrobenzene	0/11	180	950	ND	ND	---	5,500	240,000	Nav	No	No	No	No	
N-Nitrosodi-n-propylamine	0/11	36	190	ND	ND	---	78	3,300	Nav	Yes	No	No	No	Reporting limit exceeds residential standard, but constituent not detected in any samples.
N-Nitrosodiphenylamine	0/11	36	190	ND	ND	---	110,000	7,200,000	Nav	No	No	No	No	
Pentachlorophenol	0/11	36	190	ND	ND	---	1,000	40,000	Nav	No	No	No	No	
Phenol	1/11	36	190	51	51	SB-07 (11.5-13')	19,000,000	250,000,000	Nav	No	No	No	No	

Table 3-2
Selection of Direct Contact Contaminants of Concern for Subsurface Soil
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

Constituent of Potential Concern (COPC)	Frequency of Detection (FOD) [1]	Minimum Reporting Limit (µg/Kg)	Maximum Reporting Limit (µg/Kg)	Minimum Detected Concentration (µg/Kg)	Maximum Detected Concentration (µg/Kg)	Sample with Maximum Detect	Residential Soil DeMinimis Standard (µg/Kg) [2]	Industrial Soil DeMinimis Standard (µg/Kg) [2]	WV Natural Background Values	Reporting Limit Exceeds Res. Criteria?	Reporting Limit Exceeds Ind. Criteria?	Direct Contact Residential Contaminant of Concern (COC)	Direct Contact Industrial Contaminant of Concern (COC)	Comment
PAHs														
2-Methylnaphthalene	2/11	3.7	3.9	0.47 J	27	SB-06 (6-7')	310,000	4,700,000	Nav	No	No	No	No	
Acenaphthene	2/12	3.7	4.6	0.29 J	16	SB-06 (6-7')	4,100,000	47,000,000	Nav	No	No	No	No	
Acenaphthylene	8/12	3.8	4.6	1.2 J	360	SB-06 (6-7')	4,200,000	51,000,000	Nav	No	No	No	No	
Anthracene	7/12	3.8	4.6	0.21 J	200	SB-06 (6-7')	23,000,000	350,000,000	Nav	No	No	No	No	
Benzo(a)anthracene	7/12	3.8	4.6	1.2 J	730	SB-06 (6-7')	1,500	320,000	Nav	No	No	No	No	
Benzo(a)pyrene	7/12	3.8	4.6	1.2 J	640	SB-06 (6-7')	110	21,000	Nav	No	No	**Yes**	No	
Benzo(b)fluoranthene	7/12	3.8	4.6	1.8 J	880	SB-06 (6-7')	1,100	210,000	Nav	No	No	No	No	
Benzo(g,h,i)perylene	4/12	3.8	4.6	1.1 J	390	SB-06 (6-7')	1,800,000	23,000,000	Nav	No	No	No	No	
Benzo(k)fluoranthene	7/12	3.8	4.6	0.88 J	290	SB-06 (6-7')	11,000	2,100,000	Nav	No	No	No	No	
Chrysene	7/12	3.8	4.6	0.84 J	680	SB-06 (6-7')	110,000	21,000,000	Nav	No	No	No	No	
Dibenzo(a,h)anthracene	3/12	3.7	4.6	0.76 J	96	SB-06 (6-7')	110	21,000	Nav	No	No	No	No	
Fluoranthene	4/12	3.8	3.9	5.8	1,400	SB-06 (6-7')	2,400,000	30,000,000	Nav	No	No	No	No	
Fluorene	4/12	3.8	4.6	0.33 J	57	SB-06 (6-7')	2,900,000	37,000,000	Nav	No	No	No	No	
Indeno(1,2,3-cd)pyrene	6/12	3.8	4.6	0.24 J	490	SB-06 (6-7')	1,100	210,000	Nav	No	No	No	No	
Naphthalene	2/12	3.7	4.6	0.5 J	25	SB-06 (6-7')	2,400	110,000	Nav	No	No	No	No	
Phenanthrene	7/12	3.8	4.6	0.43 J	470	SB-06 (6-7')	23,000,000	350,000,000	Nav	No	No	No	No	
Pyrene	5/12	3.8	3.9	6.6	1,200	SB-06 (6-7')	2,300,000	34,000,000	Nav	No	No	No	No	
Herbicides														
2,4-DB	0/12	75.1	117	ND	ND	---	700,000	9,600,000	Nav	No	No	No	No	
2,4,5-T (Trichlorophenoxyacetic acid)	0/12	75.1	199	ND	ND	---	1,900,000	25,000,000	Nav	No	No	No	No	
2,4-D (Dichlorophenoxyacetic acid)	0/12	75.1	117	ND	ND	---	630,000	8,200,000	Nav	No	No	No	No	
Silvex (2,4,5-TP)	0/12	75.1	117	ND	ND	---	510,000	6,600,000	Nav	No	No	No	No	
Dalapon	0/1	117	117	ND	ND	---	1,900,000	25,000,000	Nav	No	No	No	No	
Dicamba	0/1	117	117	ND	ND	---	1,900,000	25,000,000	Nav	No	No	No	No	
Dichloroprop	0/1	117	117	ND	ND	---	Nav	Nav	Nav	No	No	No	No	
Dinoseb	0/1	199	199	ND	ND	---	63,000	820,000	Nav	No	No	No	No	
MCPA	0/1	14,000	14,000	ND	ND	---	32,000	410,000	Nav	No	No	No	No	
MCPP	0/1	14,000	14,000	ND	ND	---	Nav	Nav	Nav	No	No	No	No	
Pentachlorophenol	0/1	117	117	ND	ND	---	1,000	40,000	Nav	No	No	No	No	
Metals/Other [3]														
Mercury	12/12	---	---	0.022	0.12	SB-06 (6-7')	3.1	3.1	0.09	---	---	No	No	
Aluminum	11/11	---	---	6,300	12,000	SB-09 (9.2-10')	77,000	1,000,000	77120	---	---	No	No	
Antimony	11/11	---	---	1.1	5.7	SB-06 (6-7')	31	470	0.89	---	---	No	No	
Arsenic	12/12	---	---	4.0 J*	17	SB-06 (6-7')/SB-09 (9.2-10')	0.68	30	13.1	---	---	**Yes**	No	
Barium	12/12	---	---	21	98	SB-06 (6-7')	15,000	220,000	565	---	---	No	No	
Beryllium	7/11	0.15 U*	0.19 U*	0.14 J	0.44	SB-09 (9.2-10')	160	2,300	2.8	No	No	No	No	
Cadmium	0/12	0.73	0.94	ND	ND	---	37	530	0.5	No	No	No	No	
Calcium	11/11	---	---	480	4,000	SB-06 (6-7')	Nav	Nav	3300	---	---	No	No	
Chromium[4]	12/12	---	---	11 J+*	22 J+*	SB-01 (7-9.3')	120,000	1,000,000	57.4	---	---	No	No	
Cobalt	11/11	---	---	3.8	15	SB-09 (9.2-10')	23	350	23.8	---	---	No	No	
Copper	11/11	---	---	4.3	41	SB-06 (6-7')	3,100	47,000	27.5	---	---	No	No	
Iron	11/11	---	---	17,000	35,000	SB-06 (6-7')/SB-09 (9.2-10')	55,000	820,000	39380	---	---	No	No	
Lead	12/12	---	---	8.3	130	SB-06 (6-7')	100**	247***	38	---	---	**Yes**	No	
Magnesium	11/11	---	---	450	1,400	SB-01 (7-9.3')	Nav	Nav	5640	---	---	No	No	
Manganese	11/11	---	---	49	580	SB-05 (5.3-7')	1,800	26,000	1998	---	---	No	No	
Nickel	11/11	---	---	2.7	11	SB-01 (7-9.3')	1,500	22,000	34.4	---	---	No	No	
Potassium	11/11	---	---	340 J+*	590	SB-13 (9.3-11.1')	Nav	Nav	19880	---	---	No	No	
Selenium	12/12	---	---	0.38	2.2	SB-09 (9.2-10')	390	5,800	0.8	---	---	No	No	
Silver	1/12	0.36	0.47	0.18 J	0.18 J	SB-15 (6-8')	390	5,800	1	No	No	No	No	
Sodium	9/11	16 U*	18 U*	19	340 J+*	SB-05 (5.3-7')	Nav	Nav	3600	No	No	No	No	
Thallium	0/11	0.73	0.94	ND	ND	---	0.78	12	0.8	Yes	No	No	No	Reporting limit exceeds residential standard, but constituent not detected in any samples.
Vanadium	11/11	---	---	20 J+	27	SB-13 (9.3-11.1')	460	8,400	98.8	---	---	No	No	
Zinc	11/11	---	---	16 B,J+*	470 B,J+*	SB-06 (6-7')	23,000	350,000	103	---	---	No	No	

Table 3-2
Selection of Direct Contact Contaminants of Concern for Subsurface Soil
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

Constituent of Potential Concern (COPC)	Frequency of Detection (FOD) [1]	Minimum Reporting Limit (µg/Kg)	Maximum Reporting Limit (µg/Kg)	Minimum Detected Concentration (µg/Kg)	Maximum Detected Concentration (µg/Kg)	Sample with Maximum Detect	Residential Soil DeMinimis Standard (µg/Kg) [2]	Industrial Soil DeMinimis Standard (µg/Kg) [2]	WV Natural Background Values	Reporting Limit Exceeds Res. Criteria?	Reporting Limit Exceeds Ind. Criteria?	Direct Contact Residential Contaminant of Concern (COC)	Direct Contact Industrial Contaminant of Concern (COC)	Comment
PCBs														
Aroclor-1016	0/12	74	78	ND	ND	---	5,500	82,000	Nav	No	No	No	No	
Aroclor-1221	0/12	74	78	ND	ND	---	260	12,000	Nav	No	No	No	No	
Aroclor-1232	0/12	74	78	ND	ND	---	220	10,000	Nav	No	No	No	No	
Aroclor-1242	0/12	74	78	ND	ND	---	310	15,000	Nav	No	No	No	No	
Aroclor-1248	0/12	74	78	ND	ND	---	310	15,000	Nav	No	No	No	No	
Aroclor-1254	0/12	74	78	ND	ND	---	320	15,000	Nav	No	No	No	No	
Aroclor-1260	0/12	74	78	ND	ND	---	330	16,000	Nav	No	No	No	No	
Aroclor-1262	0/11	74	78	ND	ND	---	Nav	Nav	Nav	No	No	No	No	
Aroclor-1268	0/11	74	78	ND	ND	---	Nav	Nav	Nav	No	No	No	No	

Notes:
Nav - No screening value available
ND - Constituent not detected
"---" - not applicable
J - analyte is present at an estimated concentration between the MDL and Report Limit
B - analyte detected in the associated Method Blank above the Reporting Limit
J* - per data validation report, data are to be used cautiously as they are estimated data with some quality control issues
J+* - per data validation report, the data are an estimated value with potential high bias
U* - per data validation report, the parameter was qualified as undetected during data validation
** = May 2024 USEPA Residential Regional Screening Level (RSL) based on multiple sources of lead
*** = Industrial screening value of 247 mg/kg is based on proposed WVDEP industrial soil de minimis standard for lead (426 mg/kg) adjusted from a target blood lead level of 5 ug/dL to 3.5 ug/dL to account for multiple sources of lead
[1] For those soil samples that had a duplicate sample collected, the higher of the two concentrations from the original and duplicate sample were used to select the maximum detected concentration. In addition, the original and duplicate sample detected results were counted as one sample for purposes of frequency of detection.
[2] WVDEP residential and industrial soil de minimis standard (November 30, 2023)
[3] The analytical results and screening values for metals are in mg/kg rather than ug/kg.
[4] Trivalent chromium de minimis standards utilized to screen total chromium analytical results due to no source of hexavalent chromium.

Table 3-3
Selection of Direct Contact Constituents of Concern for Groundwater from SPLP Samples
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

Constituent of Potential Concern (COPC)	Frequency of Detection (FOD) [1]	Minimum Reporting Limit (µg/Kg)	Maximum Reporting Limit (µg/Kg)	Minimum Detected Concentration (µg/Kg)	Maximum Detected Concentration (µg/Kg)	Sample with Maximum Detect	Groundwater DeMinimis Standard (µg/L) [2]	Reporting Limit Exceeds Res. Criteria?	Direct Contact Contaminant of Concern (COC)	Comment
VOCs										
1,1,1-Trichloroethane	0/6	20	20	ND	ND	---	200	No	No	
1,1,2,2-Tetrachloroethane	0/6	20	20	ND	ND	---	0.076	Yes	No	Reporting limit exceeds groundwater standard, but constituent not detected in any samples.
1,1,2-Trichloroethane	0/6	20	20	ND	ND	---	5	Yes	No	Reporting limit exceeds groundwater standard, but constituent not detected in any samples.
1,1,2-Trichlorotrifluoroethane	0/6	20	20	ND	ND	---	10000	No	No	
1,1-Dichloroethane	0/6	20	20	ND	ND	---	2.8	Yes	No	Reporting limit exceeds groundwater standard, but constituent not detected in any samples.
1,1-Dichloroethene	0/6	20	20	ND	ND	---	7	Yes	No	Reporting limit exceeds groundwater standard, but constituent not detected in any samples.
1,2,3-Trichlorobenzene	0/6	20	20	ND	ND	---	Nav	No	No	
1,2,4-Trichlorobenzene	0/6	20	20	ND	ND	---	70	No	No	
1,2-Dibromo-3-chloropropane (DBCP)	0/6	20	20	ND	ND	---	0.2	Yes	No	Reporting limit exceeds groundwater standard, but constituent not detected in any samples.
1,2-Dibromoethane	0/6	20	20	ND	ND	---	0.05	Yes	No	Reporting limit exceeds groundwater standard, but constituent not detected in any samples.
1,2-Dichlorobenzene	0/6	20	20	ND	ND	---	600	No	No	
1,2-Dichloroethane	0/6	20	20	ND	ND	---	5	Yes	No	Reporting limit exceeds groundwater standard, but constituent not detected in any samples.
1,2-Dichloropropane	0/6	20	20	ND	ND	---	5	Yes	No	Reporting limit exceeds groundwater standard, but constituent not detected in any samples.
1,3-Dichlorobenzene	0/6	20	20	ND	ND	---	Nav	No	No	
1,4-Dichlorobenzene	0/6	20	20	ND	ND	---	75	No	No	
2-Butanone (MEK)	0/6	100	100	ND	ND	---	5600	No	No	
2-Hexanone	0/6	100	100	ND	ND	---	Nav	No	No	
4-Methyl-2-pentanone	0/6	20	20	ND	ND	---	1200	No	No	
Acetone	0/6	200	280	ND	ND	---	14000	No	No	
Benzene	0/6	20	20	ND	ND	---	5	Yes	No	Reporting limit exceeds groundwater standard, but constituent not detected in any samples.
Bromochloromethane	0/6	20	20	ND	ND	---	Nav	No	No	
Bromodichloromethane	0/6	20	20	ND	ND	---	80	No	No	
Bromoform	0/6	20	20	ND	ND	---	80	No	No	
Bromomethane	0/6	20	20	ND	ND	---	7.5	Yes	No	Reporting limit exceeds groundwater standard, but constituent not detected in any samples.
Carbon disulfide	0/6	20	20	ND	ND	---	810	No	No	
Carbon tetrachloride	0/6	20	20	ND	ND	---	5	Yes	No	Reporting limit exceeds groundwater standard, but constituent not detected in any samples.
Chlorobenzene	0/6	20	20	ND	ND	---	100	No	No	
Chloroethane	0/6	20	20	ND	ND	---	21000	No	No	
Chloroform	0/6	20	20	ND	ND	---	80	No	No	
Chloromethane	0/6	20	20	ND	ND	---	190	No	No	
cis-1,2-Dichloroethene	0/6	20	20	ND	ND	---	70	No	No	
cis-1,3-Dichloropropene	0/6	20	20	ND	ND	---	Nav	No	No	
Cyclohexanone	0/6	200	200	ND	ND	---	1400	No	No	
Dibromochloromethane	0/6	20	20	ND	ND	---	80	No	No	
Dichlorodifluoromethane	0/6	20	20	ND	ND	---	200	No	No	
Ethylbenzene	0/6	20	20	ND	ND	---	700	No	No	
Isopropylbenzene	0/6	20	20	ND	ND	---	450	No	No	
m,p-Xylene	1/6	40	40	18 J	18 J	SS-15 (0-2')	Nav	No	No	
Methyl acetate	0/6	40	40	ND	ND	---	5300	No	No	
Methyl tert-butyl ether (MTBE)	0/6	20	20	ND	ND	---	14	No	No	
Methylcyclohexane	0/6	20	20	ND	ND	---	Nav	No	No	
Methylene chloride	0/6	100	100	ND	ND	---	5	Yes	No	Reporting limit exceeds groundwater standard, but constituent not detected in any samples.
Naphthalene	0/6	100	100	ND	ND	---	0.12	Yes	No	Reporting limit exceeds groundwater standard, but constituent not detected in any samples.
o-Xylene	1/6	20	20	9.0 J	9.0 J	SS-15 (0-2')	Nav	No	No	
Styrene	0/6	20	20	ND	ND	---	100	No	No	
Tetrachloroethene	0/6	20	20	ND	ND	---	5	Yes	No	Reporting limit exceeds groundwater standard, but constituent not detected in any samples.
Toluene	1/6	20	20	16 J	16 J	SS-15 (0-2')	1000	No	No	
trans-1,2-Dichloroethene	0/6	20	20	ND	ND	---	100	No	No	
trans-1,3-Dichloropropene	0/6	20	20	ND	ND	---	Nav	No	No	
Trichloroethene	0/6	20	20	ND	ND	---	5	Yes	No	Reporting limit exceeds groundwater standard, but constituent not detected in any samples.
Trichlorofluoromethane	0/6	20	20	ND	ND	---	1100	No	No	
Vinyl chloride	0/6	20	20	ND	ND	---	2	Yes	No	Reporting limit exceeds groundwater standard, but constituent not detected in any samples.
Xylenes, Total	1/6	60	60	27 J	27 J	SS-15 (0-2')	10000	No	No	

Table 3-3
Selection of Direct Contact Constituents of Concern for Groundwater from SPLP Samples
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

Constituent of Potential Concern (COPC)	Frequency of Detection (FOD) [1]	Minimum Reporting Limit (µg/Kg)	Maximum Reporting Limit (µg/Kg)	Minimum Detected Concentration (µg/Kg)	Maximum Detected Concentration (µg/Kg)	Sample with Maximum Detect	Groundwater DeMinimis Standard (µg/L) [2]	Reporting Limit Exceeds Res. Criteria?	Direct Contact Contaminant of Concern (COC)	Comment
PAHs										
1-Methylnaphthalene	0/6	0.34	0.68	ND	ND	---	1.1	No	No	
2-Chloronaphthalene	0/4	0.34	0.68	ND	ND	---	330	No	No	
2-Methylnaphthalene	0/6	0.34	0.68	ND	ND	---	36	No	No	
Acenaphthene	0/6	0.34	0.68	ND	ND	---	240	No	No	
Acenaphthylene	0/6	0.34	0.68	ND	ND	---	240	No	No	
Anthracene	0/6	0.34	0.68	ND	ND	---	1800	No	No	
Benzo(a)anthracene	0/6	0.34	0.68	ND	ND	---	0.03	Yes	No	Reporting limit exceeds groundwater standard, but constituent not detected in any samples.
Benzo(a)pyrene	0/6	0.34	0.68	ND	ND	---	0.2	Yes	No	Reporting limit exceeds groundwater standard, but constituent not detected in any samples.
Benzo(b)fluoranthene	0/6	0.34	0.68	ND	ND	---	0.25	Yes	No	Reporting limit exceeds groundwater standard, but constituent not detected in any samples.
Benzo(g,h,i)perylene	0/6	0.34	0.68	ND	ND	---	600	No	No	
Benzo(k)fluoranthene	0/6	0.34	0.68	ND	ND	---	2.5	No	No	
Chrysene	0/6	0.34	0.68	ND	ND	---	25	No	No	
Dibenzo(a,h)anthracene	0/6	0.34	0.68	ND	ND	---	0.025	Yes	No	Reporting limit exceeds groundwater standard, but constituent not detected in any samples.
Fluoranthene	1/6	0.34	0.68	0.084 J	0.084 J	SS-17 (2-4')	800	No	No	
Fluorene	0/6	0.34	0.68	ND	ND	---	150	No	No	
Indeno(1,2,3-cd)pyrene	0/6	0.34	0.68	ND	ND	---	0.25	Yes	No	Reporting limit exceeds groundwater standard, but constituent not detected in any samples.
Naphthalene	0/6	0.34	0.68	ND	ND	---	0.12	Yes	No	Reporting limit exceeds groundwater standard, but constituent not detected in any samples.
Phenanthrene	3/6	0.68	0.68	0.080 J	0.29 J	SS-17 (2-4')	1700	No	No	
Pyrene	0/6	0.34	0.68	ND	ND	---	79	No	No	
Herbicides										
2,4-Dichlorophenoxyacetic acid (2,4-D)	0/6	1.0	1.0	ND	ND	---	70	No	No	
4-(2,4-Dichlorophenoxy)butyric acid (2,4-DB)	0/6	1.0	1.0	ND	ND	---	450	No	No	
Dalapon	0/6	1.0	1.0	ND	ND	---	200	No	No	
Dicamba	0/6	0.20	0.20	ND	ND	---	570	No	No	
Dichloroprop	0/6	0.20	0.20	ND	ND	---	Nav	No	No	
Dinoseb	0/6	1.0	1.0	ND	ND	---	7	No	No	
2-Methyl-4-chlorophenoxyacetic acid (MCPA)	0/6	100	100	ND	ND	---	7.5	Yes	No	Reporting limit exceeds groundwater standard, but constituent not detected in any samples.
2-(4-chloro-2-methylphenoxy)propanoic acid (MCPP)	0/6	100	100	ND	ND	---	Nav	No	No	
Pentachlorophenol	0/6	0.20	0.20	ND	ND	---	1	No	No	
2,4,5-Trichlorophenoxyacetic acid (2,4,5-T)	0/6	0.20	0.20	ND	ND	---	160	No	No	
2-(2,4,5-Trichlorophenoxy) propionic acid (2,4,5-TP)	0/6	0.20	0.20	ND	ND	---	50	No	No	
Metals [3]										
Mercury	0/6	0.00020	0.00020	ND	ND	---	0.002	No	No	
Arsenic	0/6	0.0050	0.0050	ND	ND	---	0.01	No	No	
Barium	3/6	0.0050	0.0050	0.0043 J	0.036	FD-1 (Duplicate of SS-15 0-2')	2	No	No	
Cadmium	0/6	0.010	0.010	ND	ND	---	0.005	Yes	No	Reporting limit exceeds groundwater standard, but constituent not detected in any samples.
Chromium[4]	2/6	0.0050	0.0050	0.00098 J	0.0041 J	SS-15 (0-2')	22	No	No	
Lead	2/6	0.0050	0.0050	0.0014 J	0.0019 J		0.015	No	No	
Selenium	0/6	0.010	0.010	ND	ND	---	0.05	No	No	
Silver	0/6	0.0050	0.0050	ND	ND	---	0.094	No	No	

Table 3-3
Selection of Direct Contact Constituents of Concern for Groundwater from SPLP Samples
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

Constituent of Potential Concern (COPC)	Frequency of Detection (FOD) [1]	Minimum Reporting Limit (µg/Kg)	Maximum Reporting Limit (µg/Kg)	Minimum Detected Concentration (µg/Kg)	Maximum Detected Concentration (µg/Kg)	Sample with Maximum Detect	Groundwater DeMinimis Standard (µg/L) [2]	Reporting Limit Exceeds Res. Criteria?	Direct Contact Contaminant of Concern (COC)	Comment
PCBs										
Aroclor-1016	0/6	0.40	0.80	ND	ND	---	0.22	Yes	No	Reporting limit exceeds groundwater standard, but constituent not detected in any samples.
Aroclor-1221	0/6	0.40	0.80	ND	ND	---	0.0079	Yes	No	Reporting limit exceeds groundwater standard, but constituent not detected in any samples.
Aroclor-1232	0/6	0.40	0.80	ND	ND	---	0.0079	Yes	No	Reporting limit exceeds groundwater standard, but constituent not detected in any samples.
Aroclor-1242	0/6	0.40	0.80	ND	ND	---	0.0079	Yes	No	Reporting limit exceeds groundwater standard, but constituent not detected in any samples.
Aroclor-1248	0/6	0.40	0.80	ND	ND	---	0.0079	Yes	No	Reporting limit exceeds groundwater standard, but constituent not detected in any samples.
Aroclor-1254	0/6	0.40	0.80	ND	ND	---	0.0079	Yes	No	Reporting limit exceeds groundwater standard, but constituent not detected in any samples.
Aroclor-1260	0/6	0.40	0.80	ND	ND	---	0.0079	Yes	No	Reporting limit exceeds groundwater standard, but constituent not detected in any samples.

Notes:
Nav - No screening value available
ND - Constituent not detected
"---" - not applicable
J - analyte is present at an estimated concentration between the MDL and Report Limit

[1] For those SPLP samples that had a duplicate sample collected, the higher of the two concentrations from the original and duplicate sample were used to select the maximum detected concentration. In addition, the original and duplicate sample detected results were counted as one sample for purposes of frequency of detection.

[2] WVDEP groundwater de minimis standard (November 30, 2023)

[3] The analytical results and screening values for metals are in mg/kg rather than ug/kg.

[4] Trivalent chromium de minimis standards utilized to screen total chromium analytical results due to no source of hexavalent chromium.

Table 3-4
Summary of Direct Contact Constituents of Concern
Human Health and Ecological Risk Assessment Report
Former Hinton Ice House
Hinton, West Virginia

Constituents of Concern (COC)	Soils		
	Surface Soil [1]	Subsurface Soil [1]	SPLP [2]
	0-2 ft-bgs	>2 ft-bgs	0-10 ft-bgs
Polycyclic Aromatic Hydrocarbons (PAHs)			
Benzo(a)anthracene	Res	---	---
Benzo(a)pyrene	Res, Ind	Res	---
Benzo(b)fluoranthene	Res	---	---
Benzo(k)fluoranthene	Res	---	---
Dibenzo(a,h)anthracene	Res	---	---
Indeno(1,2,3-cd)pyrene	Res	---	---
Metals			
Antimony	Res	---	---
Arsenic	Res, Ind	Res	---
Iron	Res	---	---
Lead	Res, Ind	Res	---
Polychlorinated Biphenyls (PCBs)			
Aroclor-1254	Res	---	---

Notes:

"---" indicates constituent was not retained as a COC for the identified medium

SPLP - synthetic precipitation leaching procedure

Res - indicates an exceedance of the WVDEP soil *de minimis* standard, last updated November 2023

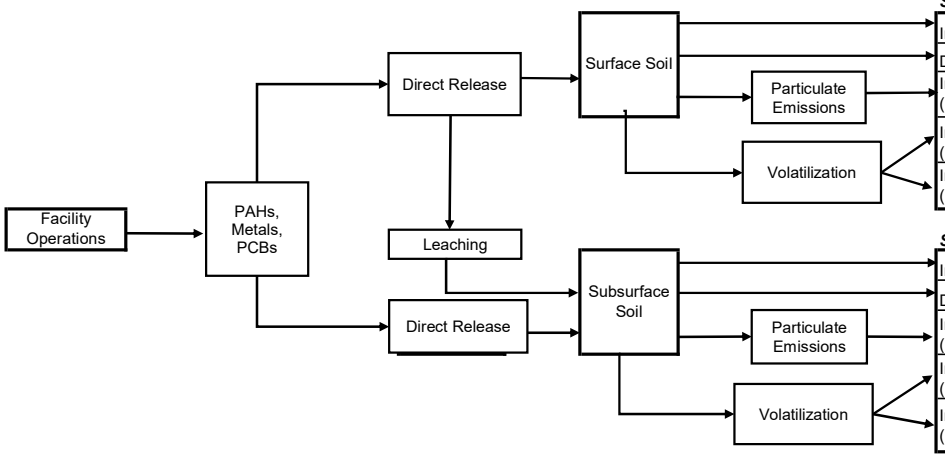
Ind - indicates an exceedance of the WVDEP soil *de minimis* standard, last updated November 2023

See Table 2-4 for a list of sample locations used to select direct contact COC.

[1] Any site-related constituent in soil samples located on Site that exceeded a WVDEP residential or industrial soil *de minimis* standard was retained as a direct contact COC.

[2] Any site-related constituent in SPLP samples located on Site that exceeded a WVDEP groundwater *de minimis* standard was retained as a direct contact COC.

Table 4-1
Potential Constituent Migration Routes, Receptors, and Exposure Pathways
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia



Source	Migration Route Analysis: Constituents	Transport Mechanism to Media	Media	Transport Mechanism to Receptor	Exposure Pathway	Receptors: On-Site							
						Current	Future	Future	Future	Current	Future	Future	Future
						Outdoor Worker		Maintenance Worker	Indoor Worker	Trespasser	Construction Worker	Utility Worker	Recreational User
					Maximum Excavation Depth by Scenario	2 ft-bgs		2 ft-bgs	NA	NA	10 ft-bgs	4 ft-bgs	2 ft-bgs
					Surface Soil:								
					Incidental Ingestion	Qual [1]	Quant	Quant	---	Quant	Quant [2]	Quant [2]	Quant
					Dermal Contact	Qual [1]	Quant	Quant	---	Quant	Quant [2]	Quant [2]	Quant
					Inhalation of Particulates (Outdoor/Trench Air)	Qual [1]	Quant	Quant	---	Quant	Quant [2]	Quant [2]	Quant
					Inhalation of Volatiles (Indoor Air via Vapor Intrusion)	---	---	---	NR	---	---	---	---
					Inhalation of Volatiles (Outdoor/Trench Air)	NR	NR	NR	---	NR	NR	NR	Quant
					Subsurface Soil:								
					Incidental Ingestion	---	---	---	---	---	NR	NR	---
					Dermal Contact	---	---	---	---	---	NR	NR	---
					Inhalation of Particulates (Outdoor/Trench Air)	---	---	---	---	---	NR	NR	---
					Inhalation of Volatiles (Indoor Air via Vapor Intrusion)	---	---	---	NR	---	---	---	---
					Inhalation of Volatiles (Outdoor/Trench Air)	NR	NR	NR	---	NR	NR	NR	NR

Notes:

Quant - exposure pathway is complete and was retained for quantitative risk analysis for that medium for the receptor.

Qual - exposure pathway was retained qualitatively, but was not quantitatively evaluated.

NR - indicates that the exposure pathway is not retained for that medium for the receptor.

ft-bgs - feet below ground surface

"---" - indicates that the exposure pathway is not applicable to the receptor.

NA - not applicable

[1] The quantitative evaluation of the future outdoor worker scenario will be protective of the current outdoor worker because the exposure parameters for the future outdoor worker are more conservative than the current outdoor worker.

[2] One quantiative risk calculation will be completed for a construction worker and utility worker because direct contact COC retained based on industrial soil *de minimis* standard exceedances were only identified in surface soil. Thus, the exposure scenarios for these receptors are the same.

Table 5-1
Source Concentrations
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

Constituent of Concern (COC)	Source Concentrations by Media		Source Concentrations by Receptor and Exposure Pathway					
	On-Site		On-Site					
			Future Recreational User [2]		Future Maintenance Worker, Future Outdoor Worker, and Current Trespasser [3]		Future Construction/Utility Worker [4]	
	Surface Soil [1]		Incidental Ingestion and Dermal Contact	Inhalation of Volatiles and Particulates (Ambient Air)	Incidental Ingestion and Dermal Contact	Inhalation of Particulates (Ambient Air)	Incidental Ingestion and Dermal Contact	Inhalation of Particulates (Trench Air)
	0-2 ft bgs							
	mg/kg		mg/kg	µg/kg	mg/kg	µg/kg	mg/kg	µg/kg
Polycyclic Aromatic Hydrocarbons (PAHs)								
Benzo(a)anthracene	38.7	UCL	38.7	38,662	---	---	---	---
Benzo(a)pyrene	33.2	UCL	33.2	33,232	33.2	33,232	33.2	33,232
Benzo(b)fluoranthene	43.4	UCL	43.4	43,441	---	---	---	---
Benzo(k)fluoranthene	5.7	UCL	5.7	5,743	---	---	---	---
Dibenzo(a,h)anthracene	1.5	UCL	1.5	1,516	---	---	---	---
Indeno(1,2,3-cd)pyrene	6.2	UCL	6.2	6,233	---	---	---	---
Metals								
Antimony	28.9	UCL	28.9	28,920	---	---	---	---
Arsenic	188.6	UCL	188.6	188,600	188.6	188,600	188.6	188,600
Iron	59,016	UCL	59,016	59,016,000	---	---	---	---
Lead	650.8	Mean	---	---	---	---	---	---
Polychlorinated Biphenyls (PCBs)								
Aroclor-1254	0.35	Max	0.35	350	---	---	---	---

Notes:

mg/kg - milligram per kilogram
µg/kg - microgram per kilogram
ft bgs - feet below ground surface
UCL - upper confidence level of the mean concentration
Max - maximum concentration
Mean - arithmetic mean

"---" - indicates constituent was not retained as a COC for the receptor

[1] ProUCL 5.1 was used to derive source concentrations for surface soil 0-2 ft bgs. The maximum concentration was conservatively used as the source concentration for those subsets with fewer than 10 samples/detections. For lead, the mean was used in accordance with WVDEP Voluntary Remediation Program (VRP) guidance (WVDEP 2023).

[2] The future recreational user may be exposed to COC in surface soil via incidental ingestion of soil, dermal contact with soil, and inhalation of particulates in ambient air from soil. Therefore, the source concentrations for surface soil (0-2 ft bgs) were used to evaluate soil exposure pathways for this receptor for those COC that exceeded the residential soil *de minimis* standards.

[3] The future maintenance worker, future outdoor worker, and current trespasser may be exposed to COC in surface soil via incidental ingestion of soil, dermal contact with soil, and inhalation of particulates in ambient air from soil. Therefore, the source concentrations for surface soil (0-2 ft bgs) were used to evaluate soil exposure pathways for these receptors for those COC that exceeded the industrial soil *de minimis* standards.

[4] The future construction/utility worker may be exposed to COC in surface soil via incidental ingestion of soil, dermal contact with soil, and inhalation of particulates in ambient air from soil. Therefore, the source concentrations for surface soil (0-2 ft bgs) were used to evaluate soil exposure pathways for these receptors for those COC that exceeded the industrial soil *de minimis* standards.

Parameter			Value	Units	Comments/References	Equations
Time spent outdoors						
$T_{out\,,\,1\text{-}2}$	Total time spent outdoors (1-2 years)	=	2	hours/day	IEUBK default, 1-2 years	
$T_{out,2\text{-}3}$	Total time spent outdoors (2-3 years)	=	3	hours/day	IEUBK default, 2-3 years	
$T_{out,3\text{-}7}$	Total time spent outdoors (3-7 years)	=	4	hours/day	IEUBK default, 3-7 years	
T_{site}	Time spent at site	=	3	hours/day	default assumption for a recreational user at a community park (WVDEP 2023a)	
Lead Exposure Parameters						
$f_{site\,,\,1\text{-}2}$	Fraction of daily outdoor time spent at site on days site visited (1-2 years)	=	1	unitless	calculated	$f_{site} = \frac{T_{site}}{T_{out}}$
$f_{yard,1\text{-}2}$	Fraction of daily outdoor time spent at home on days site visited (1-2 years)	=	0	unitless	calculated	
$f_{site\,,\,2\text{-}3}$	Fraction of daily outdoor time spent at site on days site visited (2-3 years)	=	1	unitless	calculated	$f_{yard} = 1 - f_{site}$
$f_{yard,2\text{-}3}$	Fraction of daily outdoor time spent at home on days site visited (2-3 years)	=	0	unitless	calculated	
$f_{site\,,\,3\text{-}7}$	Fraction of daily outdoor time spent at site on days site visited (3-7 years)	=	0.75	unitless	calculated	$EF_{yard} = 1 - EF_{site}$
$f_{yard,3\text{-}7}$	Fraction of daily outdoor time spent at home on days site visited (3-7 years)	=	0.25	unitless	calculated	
EF_{site}	Exposure frequency expressed as fraction of the days/week child visits site during exposure period	=	0.29	unitless	based on 2 site visits per week (professional judgement)	
EF_{yard}	Exposure frequency expressed as fraction of the days/week child does not visit site during exposure period	=	0.71	unitless	calculated	$PbS_{site} = \frac{PbS_w - PbS_{yard} \times \left[\left(f_{yard} \times EF_{site}\right) + EF_{yard}\right]}{EF_{site} \times f_{site}}$
Lead Concentrations						
PbS_{yard}	Average soil lead concentration at home	=	38	mg/kg	90th percentile background soil lead concentration in West Virginia (WVDEP 2023a)	
PbS_{w}	Weighted soil lead concentration	=	100	mg/kg	May 2024 USEPA residential soil regional screening level for multiple sources of lead	
Lead Screening Values						
$PbS_{site,1\text{-}2}$	Target soil lead concentration at site (1-2 years)	=	255	mg/kg	calculated	
$PbS_{site,2\text{-}3}$	Target soil lead concentration at site (2-3 years)	=	255	mg/kg	calculated	
$PbS_{site,3\text{-}7}$	Target soil lead concentration at site (3-7 years)	=	327	mg/kg	calculated	
$\boldsymbol{PbS_{site,target}}$	**Target soil lead concentration at site**	**=**	**255**	**mg/kg**	**calculated**	

Table 6-1
Chemical Properties
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

Chemical	CAS No.	Molecular Weight Value (g/mol)	Molecular Weight Source	Melting Point Value (°C)	Melting Point Source	Boiling Point Value (°C)	Boiling Point Source
Polycyclic Aromatic Hydrocarbons (PAHs)							
Benzo(a)anthracene	56-55-3	2.3E+02	RAIS	8.4E+01	RAIS	4.4E+02	RAIS
Benzo(a)pyrene	50-32-8	2.5E+02	RAIS	1.8E+02	RAIS	5.0E+02	RAIS
Benzo(b)fluoranthene	205-99-2	2.5E+02	RAIS	1.7E+02	RAIS	4.4E+02	RAIS
Benzo(k)fluoranthene	207-08-9	2.5E+02	RAIS	2.2E+02	RAIS	4.8E+02	RAIS
Dibenz(a,h)anthracene	53-70-3	2.8E+02	RAIS	2.7E+02	RAIS	5.2E+02	RAIS
Indeno[1,2,3-cd]pyrene	193-39-5	2.8E+02	RAIS	1.6E+02	RAIS	5.4E+02	RAIS
Metals							
Antimony	7440-36-0	1.2E+02	RAIS	6.3E+02	RAIS	1.6E+03	RAIS
Arsenic	7440-38-2	7.5E+01	RAIS	2.7E+02	RAIS	6.2E+02	RAIS
Iron	7439-89-6	5.6E+01	RAIS	1.5E+03	RAIS	3.0E+03	RAIS
Polychlorinated Biphenyls (PCBs)							
Aroclor-1254	11097-69-1	3.3E+02	RAIS	1.3E+02	RAIS	3.8E+02	RAIS

Notes:
g/mol - grams per mole
^{o}C - degrees Celsius

Sources:
RAIS - Risk Assessment Information System website (http://www.rais.ornl.gov) (Accessed on March 28, 2024)

Table 6-1
Chemical Properties
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

Chemical	CAS No.	Water Solubility Value (mg/L)	Water Solubility Source	Vapor Pressure Value (mm Hg)	Vapor Pressure Source	Log of Octanol-Water Part. Coef. (Log K_{ow}) Value (L/L)	Log of Octanol-Water Part. Coef. (Log K_{ow}) Source	Octanol-Water Part. Coef. (K_{ow}) Value (L/L)	Octanol-Water Part. Coef. (K_{ow}) Source
Polycyclic Aromatic Hydrocarbons (PAHs)									
Benzo(a)anthracene	56-55-3	9.4E-03	RAIS	2.1E-07	RAIS	5.8E+00	RAIS	5.8E+05	RAIS
Benzo(a)pyrene	50-32-8	1.6E-03	RAIS	5.5E-09	RAIS	6.1E+00	RAIS	1.3E+06	RAIS
Benzo(b)fluoranthene	205-99-2	1.5E-03	RAIS	5.0E-07	RAIS	5.8E+00	RAIS	6.0E+05	RAIS
Benzo(k)fluoranthene	207-08-9	8.0E-04	RAIS	9.7E-10	RAIS	6.1E+00	RAIS	1.3E+06	RAIS
Dibenz(a,h)anthracene	53-70-3	2.5E-03	RAIS	9.6E-10	RAIS	6.8E+00	RAIS	5.6E+06	RAIS
Indeno[1,2,3-cd]pyrene	193-39-5	1.9E-04	RAIS	1.3E-10	RAIS	6.7E+00	RAIS	5.0E+06	RAIS
Metals									
Antimony	7440-36-0	N/A		0.0E+00	RAIS	N/A		N/A	
Arsenic	7440-38-2	N/A		0.0E+00	RAIS	N/A		N/A	
Iron	7439-89-6	N/A		0.0E+00	RAIS	N/A		N/A	
Polychlorinated Biphenyls (PCBs)									
Aroclor-1254	11097-69-1	4.3E-02	RAIS	7.7E-05	RAIS	6.5E+00	RAIS	3.2E+06	RAIS

Notes:
mg/L - milligrams per liter
mm Hg - millimeters of mercury
L/L - liters per liter
N/A - not applicable

Sources:
RAIS - Risk Assessment Information System website (http://www.rais.ornl.gov) (Accessed on March 28, 2024)

Table 6-1
Chemical Properties
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

Chemical	CAS No.	Organic Carbon Part. Coef. (K_{oc}) Value (mg/Kg / mg/L)	Source	Soil-Water Partition Coefficient (K_d) Value (cm^3/g) or (L/kg)	Source	Henry's Law Constant Value (atm-m^3/mol)	Source	Unitless Henry's Law Constant Value (unitless)	Source
Polycyclic Aromatic Hydrocarbons (PAHs)									
Benzo(a)anthracene	56-55-3	1.8E+05	RAIS	---	Calculated	1.2E-05	RAIS	4.9E-04	RAIS
Benzo(a)pyrene	50-32-8	5.9E+05	RAIS	---	Calculated	4.6E-07	RAIS	1.9E-05	RAIS
Benzo(b)fluoranthene	205-99-2	6.0E+05	RAIS	---	Calculated	6.6E-07	RAIS	2.7E-05	RAIS
Benzo(k)fluoranthene	207-08-9	5.9E+05	RAIS	---	Calculated	5.8E-07	RAIS	2.4E-05	RAIS
Dibenz(a,h)anthracene	53-70-3	1.9E+06	RAIS	---	Calculated	1.4E-07	RAIS	5.8E-06	RAIS
Indeno[1,2,3-cd]pyrene	193-39-5	2.0E+06	RAIS	---	Calculated	3.5E-07	RAIS	1.4E-05	RAIS
Metals									
Antimony	7440-36-0	N/A		4.5E+01	RAIS	N/A		N/A	
Arsenic	7440-38-2	N/A		2.9E+01	RAIS	N/A		N/A	
Iron	7439-89-6	N/A		2.5E+01	RAIS	N/A		N/A	
Polychlorinated Biphenyls (PCBs)									
Aroclor-1254	11097-69-1	1.3E+05	RAIS	---	---	2.8E-04	RAIS	1.2E-02	RAIS

Notes:

mg/kg / mg/L - milligrams per kilogram per milligram per liter

atm-m^3/mol - atmosphere cubic meter per mole

N/A - not applicable

Sources:

RAIS - Risk Assessment Information System website (http://www.rais.ornl.gov) (Accessed on March 28, 2024)

cm^3/g - cubic centimeters per gram

L/kg - liters per kilogram

Calculated - calculated from organic carbon partition coefficient (Koc) and fraction of organic carbon in soil (foc) in the applicable volailization models

Table 6-1
Chemical Properties
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

Chemical	CAS No.	Vapor Phase Diffusivity Value (cm^2/s)	Vapor Phase Diffusivity Source	Water Phase Diffusivity Value (cm^2/s)	Water Phase Diffusivity Source
Polycyclic Aromatic Hydrocarbons (PAHs)					
Benzo(a)anthracene	56-55-3	2.6E-02	RAIS	6.7E-06	RAIS
Benzo(a)pyrene	50-32-8	2.5E-02	RAIS	6.6E-06	RAIS
Benzo(b)fluoranthene	205-99-2	2.5E-02	RAIS	6.4E-06	RAIS
Benzo(k)fluoranthene	207-08-9	2.5E-02	RAIS	6.4E-06	RAIS
Dibenz(a,h)anthracene	53-70-3	2.4E-02	RAIS	6.0E-06	RAIS
Indeno[1,2,3-cd]pyrene	193-39-5	2.5E-02	RAIS	6.4E-06	RAIS
Metals					
Antimony	7440-36-0	N/A		N/A	
Arsenic	7440-38-2	N/A		N/A	
Iron	7439-89-6	N/A		N/A	
Polychlorinated Biphenyls (PCBs)					
Aroclor-1254	11097-69-1	2.4E-02	RAIS	6.1E-06	RAIS

Notes:
cm^2/s - centimeters squared per second
N/A - not applicable

Sources:
RAIS - Risk Assessment Information System website (http://www.rais.ornl.gov) (Accessed on March 28, 2024)

Table 6-2
Cancer Slope Factors and Inhalation Unit Risks
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

Chemical	CAS No.	Mutagenic? (Yes/No)	Oral CSF		Dermal CSF			IUR	
			CSF_O		GIABS		CSF_D		
			$(mg/kg\text{-}day)^{-1}$	Source	(unitless)	Source	$(mg/kg\text{-}day)^{-1}$	$(ug/m^3)^{-1}$	Source
Polycyclic Aromatic Hydrocarbons (PAHs)							---		
Benzo(a)anthracene	56-55-3	**Yes**	1.0E-01	USEPA 2024	1	RAGS-E	1.0E-01	6.0E-05	USEPA 2024
Benzo(a)pyrene	50-32-8	**Yes**	1.0E+00	IRIS	1	RAGS-E	1.0E+00	6.0E-04	IRIS
Benzo(b)fluoranthene	205-99-2	**Yes**	1.0E-01	USEPA 2024	1	RAGS-E	1.0E-01	6.0E-05	USEPA 2024
Benzo(k)fluoranthene	207-08-9	**Yes**	1.0E-02	USEPA 2024	1	RAGS-E	1.0E-02	6.0E-06	USEPA 2024
Dibenz(a,h)anthracene	53-70-3	**Yes**	1.0E+00	USEPA 2024	1	RAGS-E	1.0E+00	6.0E-04	USEPA 2024
Indeno[1,2,3-cd]pyrene	193-39-5	**Yes**	1.0E-01	USEPA 2024	1	RAGS-E	1.0E-01	6.0E-05	USEPA 2024
Metals							---		
Antimony	7440-36-0	No	---	---	---	---	---	---	---
Arsenic	7440-38-2	No	1.5E+00	IRIS	1	RAGS-E	1.5E+00	4.3E-03	IRIS
Iron	7439-89-6	No	---	---	---	---	---	---	---
Polychlorinated Biphenyls (PCBs)							---		
Aroclor-1254	11097-69-1	No	2.0E+00	USEPA 2024	1	RAGS-E	2.0E+00	5.7E-04	USEPA 2024

Notes:

CSF - Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$ - per milligram per kilogram per day

IUR - Inhalation Unit Risk $(\mu g/m^3)^{-1}$ - per microgram per cubic meter

GIABS - fraction of constituent absorbed in gastrointestinal tract

$$CSF_D = \frac{CSF_O}{GIABS}$$

Sources:

IRIS - Integrated Risk Information System

RAGS-E - Risk Assessment Guidance for Superfund (RAGS) Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

USEPA 2024 - United States Environmental Protection Agency, Regional Screening Level Tables, May 2024

Table 6-3
Chronic Reference Doses and Reference Concentrations
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

		Oral RfD		Dermal RfD			Inhalation RfC	
		RfD_O		GIABS		RfD_D	RfC	
Chemical	CAS No.	(mg/kg-day)	Source	(unitless)	Source	(mg/kg-day)	(mg/m^3)	Source
Polycyclic Aromatic Hydrocarbons (PAHs)								
Benzo(a)anthracene	56-55-3	---	---	---	---	---	---	---
Benzo(a)pyrene	50-32-8	3.0E-04	IRIS	1	RAGS-E	3.0E-04	2.0E-06	IRIS
Benzo(b)fluoranthene	205-99-2	---	---	---	---	---	---	---
Benzo(k)fluoranthene	207-08-9	---	---	---	---	---	---	---
Dibenz(a,h)anthracene	53-70-3	---	---	---	---	---	---	---
Indeno[1,2,3-cd]pyrene	193-39-5	---	---	---	---	---	---	---
Metals								
Antimony	7440-36-0	4.0E-04	IRIS	0.15	RAGS-E	6.0E-05	3.0E-04	ATSDR
Arsenic	7440-38-2	3.0E-04	IRIS	1	RAGS-E	3.0E-04	1.5E-05	CalEPA
Iron	7439-89-6	7.0E-01	PPRTV	1	RAGS-E	7.0E-01	---	---
Polychlorinated Biphenyls (PCBs)								
Aroclor-1254	11097-69-1	2.0E-05	IRIS	1	RAGS-E	2.0E-05	---	---

Notes:

RfD - Reference Dose mg/kg-day - milligram per kilogram per day

RfC - Reference Concentration mg/m^3 - milligram per cubic meter

GIABS - fraction of constituent absorbed in gastrointestinal tract

$$RfD_D = RfD_O * GIABS$$

Sources:

ATSDR - Intermediate Minimal Risk Level (MRL) from the Agency for Toxic Substances and Disease Registry

CalEPA - California EPA Cancer Potency Factor

IRIS - Integrated Risk Information System

PPRTV - EPA Provisional Peer Reviewed Toxicity Value

RAGS-E - Risk Assessment Guidance for Superfund (RAGS) Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

Table 6-4
Subchronic Reference Doses and Reference Concentrations
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

		Oral RfD		Dermal RfD			Inhalation RfC	
		RfD_O		GIABS		RfD_D	RfC	
Chemical	CAS No.	(mg/kg-day)	Source	(unitless)	Source	(mg/kg-day)	(mg/m^3)	Source
Polycyclic Aromatic Hydrocarbons (PAHs)								
Benzo(a)anthracene	56-55-3	---	---	---	---	---	---	---
Benzo(a)pyrene	50-32-8	3.0E-04	chronic (IRIS)	1	RAGS-E	3.0E-04	2.0E-06	chronic (IRIS)
Benzo(b)fluoranthene	205-99-2	---	---	---	---	---	---	---
Benzo(k)fluoranthene	207-08-9	---	---	---	---	---	---	---
Dibenz(a,h)anthracene	53-70-3	---	---	---	---	---	---	---
Indeno[1,2,3-cd]pyrene	193-39-5	---	---	---	---	---	---	---
Metals								
Antimony	7440-36-0	4.0E-04	PPRTV	0.15	RAGS-E	6.0E-05	1.0E-03	ATSDR
Arsenic	7440-38-2	3.0E-04	chronic (IRIS)	1	RAGS-E	3.0E-04	1.5E-05	chronic (CalEPA)
Iron	7439-89-6	7.0E-01	PPRTV	1	RAGS-E	7.0E-01	---	---
Polychlorinated Biphenyls (PCBs)								
Aroclor-1254	11097-69-1	3.0E-05	ATSDR	1	RAGS-E	3.0E-05	---	---

Notes:
RfD - Reference Dose mg/kg-day - milligram per kilogram per day
RfC - Reference Concentration mg/m^3 - milligram per cubic meter
GIABS - fraction of constituent absorbed in gastrointestinal tract

$$RfD_D = RfD_O * GIABS$$

Sources:
ATSDR - Intermediate Minimal Risk Level (MRL) from the Agency for Toxic Substances and Disease Registry
CalEPA - California EPA Cancer Potency Factor
chronic - chronic value used as subchronic value
IRIS - Integrated Risk Information System
PPRTV - EPA Provisional Peer Reviewed Toxicity Value
RAGS-E - Risk Assessment Guidance for Superfund (RAGS) Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

Table 6-5
Cancer Slope Factors and Inhalation Unit Risks - Tumor Type or Target Organ
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

Chemical	CAS No.	Oral Tumor Type or Target Organ	Inhalation Tumor Type or Target Organ
Polycyclic Aromatic Hydrocarbons (PAHs)			
Benzo(a)anthracene	56-55-3	probable human carcinogen - based on sufficient evidence of carcinogenicity in animals	probable human carcinogen - based on sufficient evidence of carcinogenicity in animals
Benzo(a)pyrene	50-32-8	forestomach, esophagus, tongue, and larynx tumors; gastrointestinal	squamous cell neoplasia in the larynx, pharynx, trachea, nasal cavity, esophagus, and forestomach; gastrointestinal and respiratory
Benzo(b)fluoranthene	205-99-2	probable human carcinogen - based on sufficient evidence of carcinogenicity in animals	probable human carcinogen - based on sufficient evidence of carcinogenicity in animals
Benzo(k)fluoranthene	207-08-9	probable human carcinogen - based on sufficient evidence of carcinogenicity in animals	probable human carcinogen - based on sufficient evidence of carcinogenicity in animals
Dibenz(a,h)anthracene	53-70-3	probable human carcinogen - based on sufficient evidence of carcinogenicity in animals	probable human carcinogen - based on sufficient evidence of carcinogenicity in animals
Indeno[1,2,3-cd]pyrene	193-39-5	probable human carcinogen - based on sufficient evidence of carcinogenicity in animals	probable human carcinogen - based on sufficient evidence of carcinogenicity in animals
Metals			
Antimony	7440-36-0	---	---
Arsenic	7440-38-2	skin cancer	lung cancer
Iron	7439-89-6	---	---
Polychlorinated Biphenyls (PCBs)			
Aroclor-1254	11097-69-1	liver hepatocellular adenomas, carcinomas, cholangiomas, or cholangiocarcinomas; liver	liver hepatocellular adenomas, carcinomas, cholangiomas, or cholangiocarcinomas; liver

Notes:
Sources used include:
IRIS - Integrated Risk Information System (http://www.epa.gov/IRIS/)
RAIS - Risk Assessment Information System website (http://www.rais.ornl.gov) (Accessed on March 28, 2024)
California Environmental Protection Agency (http://www.oehha.ca/library/chemical-databases)

Table 6-6
Chronic Reference Doses and Reference Concentrations - Critical Effect or Target Organ
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

Chemical	CAS No.	Oral Critical Effect	Target Organ System	Inhalation Critical Effect	Target Organ System
Polycyclic Aromatic Hydrocarbons (PAHs)					
Benzo(a)anthracene	56-55-3	---	---	---	
Benzo(a)pyrene	50-32-8	neurobehavioral changes	developmental system	decreased embryo/fetal survival	developmental system
Benzo(b)fluoranthene	205-99-2	---	---	---	---
Benzo(k)fluoranthene	207-08-9	---	---	---	---
Dibenz(a,h)anthracene	53-70-3	---	---	---	---
Indeno[1,2,3-cd]pyrene	193-39-5	---	---	---	---
Metals					
Antimony	7440-36-0	longevity, blood glucose, and cholesterol	whole body	increase in alveolar/intra-alveolar macrophages; increase in chronic interstitial inflammation; decreases in lung clearance	respiratory system
Arsenic	7440-38-2	hyperpigmentation, keratosis, possible vascular complications	skin and hematological system	respiratory irritation	respiratory system
Iron	7439-89-6	adverse gastrointestinal effects	gastrointestinal tract	---	---
Polychlorinated Biphenyls (PCBs)					
Aroclor-1254	11097-69-1	ocular exudate, inflamed and prominent Meibomian glands, distorted growth of finger and toe nails; decreased antibody (IgG and IgM) response to sheep erythrocytes	whole body	---	---

Notes:
Sources used include:
IRIS - Integrated Risk Information System (http://www.epa.gov/IRIS/)
RAIS - Risk Assessment Information System website (http://www.rais.ornl.gov) (Accessed on March 28, 2024)
California Environmental Protection Agency (http://www.oehha.ca/library/chemical-databases)

Table 6-7
Subchronic Reference Doses and Reference Concentrations - Critical Effect or Target Organ
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

Chemical	CAS No.	Oral Critical Effect	Target Organ System	Inhalation Critical Effect or Target Organ	Target Organ System
Polycyclic Aromatic Hydrocarbons (PAHs)					
Benzo(a)anthracene	56-55-3	---	---	---	---
Benzo(a)pyrene	50-32-8	neurobehavioral changes [1]	developmental system [1]	decreased embryo/fetal survival [1]	developmental system [1]
Benzo(b)fluoranthene	205-99-2	---	---	---	---
Benzo(k)fluoranthene	207-08-9	---	---	---	---
Dibenz(a,h)anthracene	53-70-3	---	---	---	---
Indeno[1,2,3-cd]pyrene	193-39-5	---	---	---	---
Metals					
Antimony	7440-36-0	reduced lifespan and serum chemistry changes	whole body	squamous metaplasia in epiglottis epithelium; increases in relative lung weight	respiratory system
Arsenic	7440-38-2	hyperpigmentation, keratosis, possible vascular complications [1]	skin and hematological system [1]	respiratory irritation [1]	respiratory system [1]
Iron	7439-89-6	adverse gastrointestinal effects	gastrointestinal tract	---	---
Polychlorinated Biphenyls (PCBs)					
Aroclor-1254	11097-69-1	decreased behavioral performance	nervous system	---	---

Notes:
Sources used include:
IRIS - Integrated Risk Information System (http://www.epa.gov/IRIS/)
RAIS - Risk Assessment Information System website (https://rais.ornl.gov) (Accessed on March 28, 2024)
California Environmental Protection Agency (http://www.oehha.ca/library/chemical-databases)
[1] Indicates the chronic critical effect and/or target organ because a chronic RfD or RfC was used to represent subchronic exposure.

Table 6-8
Absorption Adjustment Factors for COC in Soil
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

Chemical	CAS No.	Absorption Adjustment Factor for Ingestion of Soil (AAF_{ing-s}) Value (unitless)	Basis	Absorption Adjustment Factor for Dermal Contact with Soil (AAF_{derm-s}) Value (unitless)	Basis
Polycyclic Aromatic Hydrocarbons (PAHs)					
Benzo(a)anthracene	56-55-3	1	conservative assumption	0.13	RAGS-E
Benzo(a)pyrene	50-32-8	1	conservative assumption	0.13	RAGS-E
Benzo(b)fluoranthene	205-99-2	1	conservative assumption	0.13	RAGS-E
Benzo(k)fluoranthene	207-08-9	1	conservative assumption	0.13	RAGS-E
Dibenz(a,h)anthracene	53-70-3	1	conservative assumption	0.13	RAGS-E
Indeno[1,2,3-cd]pyrene	193-39-5	1	conservative assumption	0.13	RAGS-E
Metals					
Antimony	7440-36-0	1	conservative assumption	--- [1]	RAGS-E
Arsenic	7440-38-2	0.6	USEPA 2024	0.03	RAGS-E
Iron	7439-89-6	1	conservative assumption	--- [1]	RAGS-E
Polychlorinated Biphenyls (PCBs)					
Aroclor-1254	11097-69-1	1	conservative assumption	0.14	RAGS-E

Notes:

RAGS-E - Risk Assessment Guidance for Superfund (RAGS) Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

USEPA 2024 - United States Environmental Protection Agency, Regional Screening Level Tables, May 2024

[1] In accordance with RAGS-E, there are no default dermal absorption values for inorganic compounds because the speciation of the compound is critical to the dermal absorption and there are too little data to extrapolate a reasonable default value.

Table 7-1
Summary of Exposure Assumptions for On-Site Maintenance Worker
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

Parameter			Value	Units	Comments/References
$IR_{ing\text{-}s}$	Incidental Soil Ingestion Rate	=	100	mg-soil/day	default assumption for an outdoor worker (WVDEP 2023)
SA	Exposed Surface Area - Soil	=	3,527	cm^2/day	default assumption for a commercial/industrial receptor (WVDEP 2023)
AF	Soil Adherence Factor	=	0.12	mg/cm^2	default assumption for a commercial/industrial receptor (WVDEP 2023)
CF_1	Conversion Factor	=	1.0E-06	kg/mg	---
CF_2	Conversion Factor	=	1.0E+03	µg/mg	---
FI	Fraction of Daily Total - Soil Ing	=	1	unitless	assumes 100% of daily soil ingestion occurs from soil at the site
FC	Fraction of Daily Total - Soil Derm	=	1	unitless	assumes 100% of daily soil contact occurs from soil at the site
ET	Exposure Time	=	4	hours/day	time spent outdoors (professional judgment)
EF	Exposure Frequency	=	72	days/year	based on 3 days a week for 6 months (assumes warm months; May - Oct.) (professional judgment)
ED	Exposure Duration	=	25	years	default assumption for a commercial/industrial receptor (WVDEP 2023)
BW	Body Weight	=	80	kg	default assumption for an adult (WVDEP 2023)
AT (c)	Averaging Time-Carcinogenic (Ing/Derm)	=	25,550	days	averaging time for a carcinogen based on lifetime of 70 years (lifetime in years x 365 days/year) (USEPA 1989)
AT (nc)	Averaging Time-Noncarcinogenic (Ing/Derm)	=	9,125	days	averaging time for a noncarcinogen (ED x 365 days/year) (USEPA 1989)
AT (c)	Averaging Time-Carcinogenic (Inhalation)	=	613,200	hours	averaging time for a carcinogen based on lifetime of 70 years (lifetime in years x 365 days/year x 24 hours/day) (USEPA 2009)
AT (nc)	Averaging Time-Noncarcinogenic (Inhalation)	=	219,000	hours	averaging time for a noncarcinogen (ED in years x 365 days/year x 24 hours/day) (USEPA 2009)
$IF_{ing\text{-}s}$ *(c)*	Ing Intake Factor (Carcinogenic) - Soil	=	8.81E-08	kg/kg-day	calculated
$IF_{ing\text{-}s}$ *(nc)*	Ing Intake Factor (Noncarcinogenic) - Soil	=	2.47E-07	kg/kg-day	calculated
$AD_{derm\text{-}s}$ *(c)*	Absorbed Dose (Carcinogenic) - Soil	=	3.73E-07	kg/kg-day	calculated
$AD_{derm\text{-}s}$ *(nc)*	Absorbed Dose (Noncarcinogenic) - Soil	=	1.04E-06	kg/kg-day	calculated
EC_c	Inh Exposure Concentration (Carcinogenic)	=	chem-spec.	$µg/m^3$	calculated
EC_{nc}	Inh Exposure Concentration (Noncarcinogenic)	=	chem-spec.	$µg/m^3$	calculated
CS_{src}	Source Concentration in Soil	=	chem-spec.	mg/kg or µg/kg	measured value
TF	Transfer Factor - Ing/Derm - All Media	=	1	unitless	conservative assumption
$TF_{a\text{-}part}$	Transfer Factor - Inh (particulates) - Soil		7.35E-10	kg/m^3	default value $(1.36E+9\ m^3/kg)^{-1}$ (USEPA 2024)
CA_a	Concentration in Outdoor Air	=	chem-spec.	$µg/m^3$	calculated value
$AAF_{ing\text{-}s}$	Absorption Adjustment Factor-Soil Ing	=	1	mg/mg	conservative assumption
$AAF_{derm\text{-}s}$	Absorption Adjustment Factor-Soil Derm	=	chem-spec.	mg/mg	chemical - specific
$I_{ing\text{-}s}$	Intake for Ingestion of Soil	=	chem-spec.	mg/kg-day	chemical - specific
$I_{derm\text{-}s}$	Intake for Dermal Contact with Soil	=	chem-spec.	mg/kg-day	chemical - specific
CSF_O	Oral Cancer Slope Factor	=	chem-spec.	$(mg/kg\text{-}day)^{-1}$	chemical - specific
RfD_O	Oral Reference Dose	=	chem-spec.	mg/kg-day	chemical - specific
CSF_D	Dermal Cancer Slope Factor	=	chem-spec.	$(mg/kg\text{-}day)^{-1}$	chemical - specific
RfD_D	Dermal Reference Dose	=	chem-spec.	mg/kg-day	chemical - specific
IUR	Inhalation Unit Risk	=	chem-spec.	$(µg/m^3)^{-1}$	chemical - specific
RfC	Reference Concentration	=	chem-spec.	(mg/m^3)	chemical - specific

References:

ASTM 2015. Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites. American Society for Testing and Materials, Designation E1739-95, Reapproved 2015.

USEPA 1989. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part A). U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, EPA/540/1-89/002, December 1989.

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USEPA 2011. Exposure Factors Handbook: 2011 Edition. U.S. Environmental Protection Agency, EPA/600/R-090/052F, September 2011.

USEPA 2024. Regional Screening Table User's Guide. U.S. Environmental Protection Agency. https://www.epa.gov/risk/regional-screening-levels-rsls-users-guide, May 2024.

WVDEP 2023. West Virginia Voluntary Remediation Program Guidance Manual, West Virginia Department of Environmental Protection, October 2023.

Equations

Incidental Ingestion of Soil

$$IF_{ing-s} = \frac{IR_{ing-s} * CF_1 * FI * EF * ED}{BW * AT}$$

$$I_{ing-s} = CS_{src} * TF * AAF_{ing-s} * IF_{ing-s}$$

$$Risk = I_{ing-s\,(c)} * CSF_O \qquad HI = \frac{I_{ing-s\,(nc)}}{RfD_O}$$

Dermal Contact with Soil

$$AD_{derm-s} = \frac{SA * AF * CF_1 * FC * EF * ED}{BW * AT}$$

$$I_{derm} = CS_{src} * TF * AAF_{derm-s} * AD_{derm-s}$$

$$Risk = I_{derm-s\,(c)} * CSF_D \qquad HI = \frac{I_{derm\,-s\,(nc)}}{RfD_D}$$

Inhalation of Constituents Emitted from Soil (Volatiles and Particulates)

$$EC = \frac{CA_a * ET * EF * ED}{AT}$$

$$CA_a = CS_{src} * TF_{a-vol} \qquad CA_a = CS_{src} * TF_{a-part}$$

$$Risk = EC_c * IUR \qquad HI = \frac{EC_{nc}}{RfC * CF_2}$$

Notes:
Equations are based on guidance from USEPA RAGS Part A and USEPA RAGS Part F.

Parameter			Value	Units	Comments/References
$IR_{ing\text{-}s}$	Incidental Soil Ingestion Rate	=	100	mg-soil/day	default assumption for an outdoor worker (WVDEP 2023)
SA	Exposed Surface Area - Soil	=	3,527	cm²/day	default assumption for a commercial/industrial receptor (WVDEP 2023)
AF	Soil Adherence Factor	=	0.12	mg/cm²	default assumption for a commercial/industrial receptor (WVDEP 2023)
CF_1	Conversion Factor	=	1.0E-06	kg/mg	---
CF_2	Conversion Factor	=	1.0E+03	µg/mg	---
FI	Fraction of Daily Total - Soil Ing	=	1	unitless	assumes 100% of daily soil ingestion occurs from soil at the site
FC	Fraction of Daily Total - Soil Derm	=	1	unitless	assumes 100% of daily soil contact occurs from soil at the site
ET	Exposure Time	=	8	hours/day	default assumption for a commercial/industrial receptor (WVDEP 2023)
EF	Exposure Frequency	=	250	days/year	default assumption for a commercial/industrial receptor (WVDEP 2023)
ED	Exposure Duration	=	25	years	default assumption for a commercial/industrial receptor (WVDEP 2023)
BW	Body Weight	=	80	kg	default assumption for an adult (WVDEP 2023)
AT (c)	Averaging Time-Carcinogenic (Ing/Derm)	=	25,550	days	averaging time for a carcinogen based on lifetime of 70 years (lifetime in years x 365 days/year) (USEPA 1989)
AT (nc)	Averaging Time-Noncarcinogenic (Ing/Derm)	=	9,125	days	averaging time for a noncarcinogen (ED x 365 days/year) (USEPA 1989)
AT (c)	Averaging Time-Carcinogenic (Inhalation)	=	613,200	hours	averaging time for a carcinogen based on lifetime of 70 years (lifetime in years x 365 days/year x 24 hours/day) (USEPA 2009)
AT (nc)	Averaging Time-Noncarcinogenic (Inhalation)	=	219,000	hours	averaging time for a noncarcinogen (ED in years x 365 days/year x 24 hours/day) (USEPA 2009)
$IF_{ing\text{-}s}$ *(c)*	Ing Intake Factor (Carcinogenic) - Soil	=	3.06E-07	kg/kg-day	calculated
$IF_{ing\text{-}s}$ *(nc)*	Ing Intake Factor (Noncarcinogenic) - Soil	=	8.56E-07	kg/kg-day	calculated
$AD_{derm\text{-}s}$ *(c)*	Absorbed Dose (Carcinogenic) - Soil	=	1.29E-06	kg/kg-day	calculated
$AD_{derm\text{-}s}$ *(nc)*	Absorbed Dose (Noncarcinogenic) - Soil	=	3.62E-06	kg/kg-day	calculated
EC_c	Inh Exposure Concentration (Carcinogenic)	=	chem-spec.	µg/m³	calculated
EC_{nc}	Inh Exposure Concentration (Noncarcinogenic)	=	chem-spec.	µg/m³	calculated
CS_{src}	Source Concentration in Soil	=	chem-spec.	mg/kg or µg/kg	measured value
TF	Transfer Factor - Ing/Derm - All Media	=	1	unitless	conservative assumption
$TF_{a\text{-}part}$	Transfer Factor - Inh (particulates) - Soil		7.35E-10	kg/m³	default value (1.36E+9 $m^3/kg)^{-1}$ (USEPA 2024)
CA_a	Concentration in Outdoor Air	=	chem-spec.	µg/m³	calculated value
$AAF_{ing\text{-}s}$	Absorption Adjustment Factor-Soil Ing	=	1	mg/mg	conservative assumption
$AAF_{derm\text{-}s}$	Absorption Adjustment Factor-Soil Derm	=	chem-spec.	mg/mg	chemical - specific
$I_{ing\text{-}s}$	Intake for Ingestion of Soil	=	chem-spec.	mg/kg-day	chemical - specific
$I_{derm\text{-}s}$	Intake for Dermal Contact with Soil	=	chem-spec.	mg/kg-day	chemical - specific
CSF_O	Oral Cancer Slope Factor	=	chem-spec.	$(mg/kg\text{-}day)^{-1}$	chemical - specific
RfD_O	Oral Reference Dose	=	chem-spec.	mg/kg-day	chemical - specific
CSF_D	Dermal Cancer Slope Factor	=	chem-spec.	$(mg/kg\text{-}day)^{-1}$	chemical - specific
RfD_D	Dermal Reference Dose	=	chem-spec.	mg/kg-day	chemical - specific
IUR	Inhalation Unit Risk	=	chem-spec.	$(µg/m^3)^{-1}$	chemical - specific
RfC	Reference Concentration	=	chem-spec.	(mg/m^3)	chemical - specific

References:

ASTM 2015. Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites. American Society for Testing and Materials, Designation E1739-95, Reapproved 2015.

USEPA 1989. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part A). U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, EPA/540/1-89/002, December 1989.

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USEPA 2024. Regional Screening Table User's Guide. U.S. Environmental Protection Agency. https://www.epa.gov/risk/regional-screening-levels-rsls-users-guide, May 2024.

WVDEP 2023. West Virginia Voluntary Remediation Program Guidance Manual, West Virginia Department of Environmental Protection, October 2023.

Equations

Incidental Ingestion of Soil

$$IF_{ing-s} = \frac{IR_{ing-s} * CF_1 * FI * EF * ED}{BW * AT}$$

$$I_{ing} = CS_{src} * TF * AAF_{ing-s} * IF_{ing-s}$$

$$Risk = I_{ing\ (c)} * CSF_O \qquad HI = \frac{I_{ing-s\ (nc)}}{RfD_O}$$

Dermal Contact with Soil

$$AD_{derm-s} = \frac{SA * AF * CF_1 * FC * EF * ED}{BW * AT}$$

$$I_{derm-s} = CS_{src} * TF * AAF_{derm-s} * AD_{derm-s}$$

$$Risk = I_{derm-s\ (c)} * CSF_D \qquad HI = \frac{I_{derm\ -s\ (nc)}}{RfD_D}$$

Inhalation of Constituents Emitted from Soil (Volatiles and Particulates)

$$EC = \frac{CA_a * ET * EF * ED}{AT}$$

$$CA_a = CS_{src} * TF_{a-vol} \qquad CA_a = CS_{src} * TF_{a-part}$$

$$Risk = EC_c * IUR \qquad HI = \frac{EC_{nc}}{RfC * CF_2}$$

Notes:
Equations are based on guidance from USEPA RAGS Part A and USEPA RAGS Part F.

Table 7-3
Summary of Exposure Assumptions for On-Site Construction Worker
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

Parameter			Value	Units	Comments/References
$IR_{ing\text{-}s}$	Incidental Soil Ingestion Rate	=	330	mg-soil/day	default assumption for a construction/utility worker (WVDEP 2023)
SA	Exposed Surface Area - Soil	=	3,527	cm^2/day	default assumption for a construction/utility worker (WVDEP 2023)
AF	Soil Adherence Factor	=	0.3	mg/cm^2	default assumption for a construction/utility worker (WVDEP 2023)
CF_1	Conversion Factor	=	1.0E-06	kg/mg	---
CF_2	Conversion Factor	=	1.0E+03	µg/mg	---
FI	Fraction of Daily Total - Soil Ing	=	1	unitless	assumes 100% of daily soil ingestion occurs from soil at the site
FC	Fraction of Daily Total - Soil Derm	=	1	unitless	assumes 100% of daily soil contact occurs from soil at the site
ET	Exposure Time	=	8	hours/day	default assumption for a construction/utility worker (WVDEP 2023)
EF	Exposure Frequency	=	30	days/year	default assumption for a construction/utility worker based on acreage of site (WVDEP 2023)
ED	Exposure Duration	=	1	years	default value for a construction scenario (USEPA 2024)
BW	Body Weight	=	80	kg	default assumption for an adult (WVDEP 2023)
AT (c)	Averaging Time-Carcinogenic (Ing/Derm)	=	25,550	days	averaging time for a carcinogen based on lifetime of 70 years (lifetime in years x 365 days/year) (USEPA 1989)
AT (nc)	Averaging Time-Noncarcinogenic (Ing/Derm)	=	350	days	default assumption for a construction/utility worker (WVDEP 2023)
AT (c)	Averaging Time-Carcinogenic (Inhalation)	=	613,200	hours	averaging time for a carcinogen based on lifetime of 70 years (lifetime in years x 365 days/year x 24 hours/day) (USEPA 2009)
AT (nc)	Averaging Time-Noncarcinogenic (Inhalation)	=	8,400	hours	default assumption for a construction/utility worker (WVDEP 2023)
$IF_{ing\text{-}s}$ *(c)*	Ing Intake Factor (Carcinogenic) - Soil	=	4.84E-09	kg/kg-day	calculated
$IF_{ing\text{-}s}$ *(nc)*	Ing Intake Factor (Noncarcinogenic) - Soil	=	3.54E-07	kg/kg-day	calculated
$AD_{derm\text{-}s}$ *(c)*	Absorbed Dose (Carcinogenic) - Soil	=	1.55E-08	kg/kg-day	calculated
$AD_{derm\text{-}s}$ *(nc)*	Absorbed Dose (Noncarcinogenic) - Soil	=	1.13E-06	kg/kg-day	calculated
EC_c	Inh Exposure Concentration (Carcinogenic)	=	chem-spec.	µg/m^3	calculated
EC_{nc}	Inh Exposure Concentration (Noncarcinogenic)	=	chem-spec.	µg/m^3	calculated
CS_{src}	Source Concentration in Soil	=	chem-spec.	mg/kg or µg/kg	measured value
TF	Transfer Factor - Ing/Derm - All Media	=	1	unitless	conservative assumption
$TF_{a\text{-}part}$	Transfer Factor - Inh (particulates) - Soil	=	7.35E-10	kg/m^3	default value (1.36E+9 m^3/kg)$^{-1}$ (USEPA 2024)
CA_a	Concentration in Trench Air	=	chem-spec.	µg/m^3	calculated value
$AAF_{ing\text{-}s}$	Absorption Adjustment Factor-Soil Ing	=	chem-spec.	mg/mg	chemical - specific
$AAF_{derm\text{-}s}$	Absorption Adjustment Factor-Soil Derm	=	chem-spec.	mg/mg	chemical - specific
$I_{ing\text{-}s}$	Intake for Ingestion of Soil	=	chem-spec.	mg/kg-day	chemical - specific
$I_{derm\text{-}s}$	Intake for Dermal Contact with Soil	=	chem-spec.	mg/kg-day	chemical - specific
CSF_O	Oral Cancer Slope Factor	=	chem-spec.	(mg/kg-day)$^{-1}$	chemical - specific
RfD_O	Oral Reference Dose	=	chem-spec.	mg/kg-day	chemical - specific
CSF_D	Dermal Cancer Slope Factor	=	chem-spec.	(mg/kg-day)$^{-1}$	chemical - specific
RfD_D	Dermal Reference Dose	=	chem-spec.	mg/kg-day	chemical - specific
IUR	Inhalation Unit Risk	=	chem-spec.	(µg/m^3)$^{-1}$	chemical - specific
RfC	Reference Concentration	=	chem-spec.	(mg/m^3)	chemical - specific

References:

USEPA 1989. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part A). U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, EPA/540/1-89/002, December 1989.

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Equations

Incidental Ingestion of Soil

$$IF_{ing} = \frac{IR_{ing-s} * CF_1 * FI * EF * ED}{BW * AT}$$

$$I_{ing-s} = CS_{src} * TF * AAF_{ing-s} * IF_{ing}$$

$$Risk = I_{ing-s\,(c)} * CSF_O \qquad HI = \frac{I_{ing\ \ (nc)}}{RfD_O}$$

Dermal Contact with Soil

$$AD_{der} = \frac{SA * AF * CF_1 * FC * EF * ED}{BW * AT}$$

$$I_{derm} = CS_{src} * TF * AAF_{derm} * AD_{derm}$$

$$Risk = I_{der\ \ (c)} * CSF_D \qquad HI = \frac{I_{derm\ -s\,(nc)}}{RfD_D}$$

Inhalation of Constituents Emitted from Soil (Volatiles and Particulates)

$$EC = \frac{CA_a * ET * EF * ED}{AT}$$

$$CA_a = CS_{src} * TF_{a-vol} \qquad CA_a = CS_{src} * TF_{a-part}$$

$$Risk = EC_c * IUR \qquad HI = \frac{EC_{nc}}{RfC * CF_2}$$

Notes:
Equations are based on guidance from USEPA RAGS Part A and USEPA RAGS Part F.

Table 7-4
Summary of Exposure Assumptions for On-Site Recreational User
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

Parameter			Value	Units	Comments/References
$IR_{ing\text{-}s\ \text{-}child}$	Incidental Soil Ingestion Rate - Child	=	200	mg-soil/day	default assumption for a child (WVDEP 2023)
$IR_{ing\text{-}s\ \text{-}adult}$	Incidental Soil Ingestion Rate - Adult	=	100	mg-soil/day	default assumption for an adult (WVDEP 2023)
SA_{child}	Exposed Surface Area - Soil - Child	=	3,450	cm^2/day	default assumption for a child recreational user at a community park exposed to soil (WVDEP 2023)
SA_{adult}	Exposed Surface Area - Soil - Adult	=	8,890	cm^2/day	default assumption for an adult recreational user at a community park exposed to soil (WVDEP 2023)
AF_{child}	Soil Adherence Factor - Child	=	0.4	mg/cm^2	default assumption for a child recreational user at a community park exposed to soil (WVDEP 2023)
AF_{adult}	Soil Adherence Factor - Adult	=	0.2	mg/cm^2	default assumption for an adult recreational user at a community park exposed to soil (WVDEP 2023)
CF_{1}	Conversion Factor	=	1.0E-06	kg/mg	---
CF_{2}	Conversion Factor	=	1.0E+03	µg/mg	---
FI	Fraction of Daily Total - Soil Ing	=	1	unitless	assumes 100% of daily soil ingestion occurs from soil at the site
FC	Fraction of Daily Total - Soil Derm	=	1	unitless	assumes 100% of daily soil contact occurs from soil at the site
ET	Exposure Time	=	3	hours/day	default assumption for a recreational user at a community park (WVDEP 2023)
EF	Exposure Frequency	=	52	days/year	default assumption for a recreational user at a community park (WVDEP 2023)
ED_{total}	Exposure Duration - Total	=	26	years	default assumption for a resident (WVDEP 2023)
ED_{child}	Exposure Duration - Child	=	6	years	default assumption for a child resident (WVDEP 2023)
ED_{adult}	Exposure Duration - Adult	=	20	years	default assumption for an adult resident (WVDEP 2023)
$ED_{<2}$	Mutagenic Exposure Duration - Child <2 years	=	2	years	based on age range of 0 to 2 years (WVDEP 2023)
$ED_{2\text{-}6}$	Mutagenic Exposure Duration - Child 2-6 years	=	4	years	based on age range of 2 to 6 years (WVDEP 2023)
$ED_{>6\text{-}16}$	Mutagenic Exposure Duration - Adult >6-16 years	=	10	years	based on age range of 6 to 16 years (WVDEP 2023)
$ED_{>16}$	Mutagenic Exposure Duration - Adult >16 years	=	10	years	based on age range of 16 to 26 years (WVDEP 2023)
$ADAF_{<2}$	Age-Dependent Adjustment Factor - Child <2 years	=	10	unitless	based on age range of 0 to 2 years (USEPA 2024)
$ADAF_{2\text{-}6}$	Age-Dependent Adjustment Factor - Child 2-6 years	=	3	unitless	based on age range of 2 to 6 years (USEPA 2024)
$ADAF_{>6\text{-}16}$	Age-Dependent Adjustment Factor - Adult >6-16 years	=	3	unitless	based on age range of 6 to 16 years (USEPA 2024)
$ADAF_{>16}$	Age-Dependent Adjustment Factor - Adult >16 years	=	1	unitless	based on age range of 16 to 26 years (USEPA 2024)
BW_{child}	Body Weight - Child	=	15	kg	default assumption for a child (WVDEP 2023)
BW_{adult}	Body Weight - Adult	=	80	kg	default assumption for an adult (WVDEP 2023)
$AT\ (c)$	Averaging Time-Carcinogenic (Ing/Derm)	=	25,550	days	averaging time for a carcinogen based on lifetime of 70 years (lifetime in years x 365 days/year) (USEPA 1989)
$AT\ (nc)_{total}$	Averaging Time-Noncarcinogenic (Ing/Derm) - Total	=	9,490	days	averaging time for a noncarcinogen (ED x 365 days/year) (USEPA 1989)
$AT\ (nc)_{child}$	Averaging Time-Noncarcinogenic (Ing/Derm) - Child	=	2,190	days	averaging time for a noncarcinogen (ED x 365 days/year) (USEPA 1989)
$AT\ (nc)_{adult}$	Averaging Time-Noncarcinogenic (Ing/Derm) - Adult	=	7,300	days	averaging time for a noncarcinogen (ED x 365 days/year) (USEPA 1989)
$AT\ (c)$	Averaging Time-Carcinogenic (Inhalation)	=	613,200	hours	averaging time for a carcinogen based on lifetime of 70 years (lifetime in years x 365 days/year x 24 hours/day) (USEPA 2009)
$AT\ (nc)_{total}$	Averaging Time-Noncarcinogenic (Inhalation) - Total	=	227,760	hours	averaging time for a noncarcinogen (ED in years x 365 days/year x 24 hours/day) (USEPA 2009)
$IF_{ing\text{-}s}\ (c)_{child}$	Ing Intake Factor (Carcinogenic) - Soil - Child	=	1.63E-07	kg/kg-day	calculated
$IF_{ing\text{-}s}\ (c)_{adult}$	Ing Intake Factor (Carcinogenic) - Soil - Adult	=	5.09E-08	kg/kg-day	calculated
$IF_{ing\text{-}s}\ (c)_{total}$	Ing Intake Factor (Carcinogenic) - Soil - Total	=	2.14E-07	kg/kg-day	calculated
$AIF_{ing\text{-}s}\ (child)$	Age-Adjusted Ing Intake Factor (Mutagenic) - Soil - Child	=	8.68E-07	kg/kg-day	calculated
$AIF_{ing\text{-}s}\ (adult)$	Age-Adjusted Ing Intake Factor (Mutagenic) - Soil - Adult	=	1.02E-07	kg/kg-day	calculated
$AIF_{ing\text{-}s}\ (total)$	Age-Adjusted Ing Intake Factor (Mutagenic) - Soil - Total	=	9.70E-07	kg/kg-day	calculated
$IF_{ing\text{-}s}\ (nc)_{child}$	Ing Intake Factor (Noncarcinogenic) - Soil - Child	=	1.90E-06	kg/kg-day	calculated
$IF_{ing\text{-}s}\ (nc)_{adult}$	Ing Intake Factor (Noncarcinogenic) - Soil - Adult	=	1.78E-07	kg/kg-day	calculated
$IF_{ing\text{-}s}\ (nc)_{total}$	Ing Intake Factor (Noncarcinogenic) - Soil - Total	=	2.08E-06	kg/kg-day	calculated
$AD_{derm\text{-}s}\ (c)_{child}$	Absorbed Dose (Carcinogenic) - Soil - Child	=	1.12E-06	kg/kg-day	calculated
$AD_{derm\text{-}s}\ (c)_{adult}$	Absorbed Dose (Carcinogenic) - Soil - Adult	=	9.05E-07	kg/kg-day	calculated
$AD_{derm\text{-}s}\ (c)_{total}$	Absorbed Dose (Carcinogenic) - Soil - Total	=	2.03E-06	kg/kg-day	calculated
$AAD_{derm\text{-}s}\ (child)$	Age-Adjusted Absorbed Dose (Mutagenic) - Soil - Child	=	5.99E-06	kg/kg-day	calculated
$AAD_{derm\text{-}s}\ (adult)$	Age-Adjusted Absorbed Dose (Mutagenic) - Soil - Adult	=	1.81E-06	kg/kg-day	calculated
$AAD_{derm\text{-}s}\ (total)$	Age-Adjusted Absorbed Dose (Mutagenic) - Soil - Total	=	7.80E-06	kg/kg-day	calculated
$AD_{derm\text{-}s}\ (nc)_{child}$	Absorbed Dose (Noncarcinogenic) - Soil - Child	=	1.31E-05	kg/kg-day	calculated
$AD_{derm\text{-}s}\ (nc)_{adult}$	Absorbed Dose (Noncarcinogenic) - Soil - Adult	=	3.17E-06	kg/kg-day	calculated
$AD_{derm\text{-}s}\ (nc)_{total}$	Absorbed Dose (Noncarcinogenic) - Soil - Total	=	1.63E-05	kg/kg-day	calculated
EC_{c}	Inh Exposure Concentration (Carcinogenic)	=	chem-spec.	unitless	calculated
EC_{nc}	Inh Exposure Concentration (Noncarcinogenic)	=	chem-spec.	unitless	calculated

Parameter			Value	Units	Comments/References
AED	Combined Age-Dependent Adjustment Factor	=	1.12E+04	hours	calculated
CS_{src}	Source Concentration in Soil	=	chem-spec.	mg/kg or µg/kg	measured value
TF	Transfer Factor - Ing/Derm - All Media	=	1	unitless	conservative assumption
$TF_{a\text{-}vol}$	Transfer Factor - Inh (volatiles) - Soil	=	chem-spec.	kg/m^3	calculated using the soil volatilization model from the Soil Screening Guidance (USEPA 2002)
$TF_{a\text{-}part}$	Transfer Factor - Inh (particulates) - Soil		7.35E-10	kg/m^3	default value $(1.36E+9\ m^3/kg)^{-1}$ (USEPA 2024)
VF	Volatilization Factor - Groundwater	=	chem-spec.	L/m^3	calculated using the groundwater volatilization model (ASTM 2015)
CA_a	Concentration in Outdoor Air	=	chem-spec.	$µg/m^3$	calculated value
$AAF_{ing\text{-}s}$	Absorption Adjustment Factor-Soil Ing	=	chem-spec.	mg/mg	chemical - specific
$AAF_{derm\text{-}s}$	Absorption Adjustment Factor-Soil Derm	=	chem-spec.	mg/mg	chemical - specific
$I_{ing\text{-}s}$	Intake for Ingestion of Soil	=	chem-spec.	mg/kg-day	chemical - specific
$I_{derm\text{-}s}$	Intake for Dermal Contact with Soil	=	chem-spec.	mg/kg-day	chemical - specific
CSF_O	Oral Cancer Slope Factor	=	chem-spec.	$(mg/kg\text{-}day)^{-1}$	chemical - specific
RfD_O	Oral Reference Dose	=	chem-spec.	mg/kg-day	chemical - specific
CSF_D	Dermal Cancer Slope Factor	=	chem-spec.	$(mg/kg\text{-}day)^{-1}$	chemical - specific
RfD_D	Dermal Reference Dose	=	chem-spec.	mg/kg-day	chemical - specific
IUR	Inhalation Unit Risk	=	chem-spec.	$(µg/m^3)^{-1}$	chemical - specific
RfC	Reference Concentration	=	chem-spec.	(mg/m^3)	chemical - specific

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Equations

Incidental Ingestion of Soil - Non-mutagenic Carcinogens and Noncarcinogens

$$IF_{ing-s} = \frac{IR_{ing-s} * CF_1 * FI * EF * ED}{BW * AT}$$

$$IF_{ing-s}(total) = IF_{ing} \quad (child) + IF_{ing-s}(adult)$$

$$I_{ing-s} = CS_{src} * TF * AAF_{ing-s} * IF_{ing-s}$$

$$Risk = I_{ing-s\,(c)} * CSF_O \qquad HI = \frac{I_{ing-s\,(nc)}}{RfD_O}$$

Dermal Contact with Soil - Non-mutagenic Carcinogens and Noncarcinogens

$$AD_{derm-s} = \frac{SA * AF * CF_1 * FC * EF * ED}{BW * AT}$$

$$AD_{derm-s}(total) = AD_{derm-s}(child) + AD_{derm-s}(adult)$$

$$I_{derm-} = CS_{src} * TF * AAF_{der} \quad * AD_{derm-s}$$

$$Risk = I_{der\ \ s\,(c)} * CSF_D \qquad HI = \frac{I_{derm-s\,(nc)}}{RfD_D}$$

Inhalation of Constituents Emitted from Soil (Volatiles and Particulates) to Outdoor Air - Non-mutagenic Carcinogens and Noncarcinogens

$$EC = \frac{CA_a * ET * EF * ED}{AT}$$

$$CA_a = CS_{src} * TF_{a-vol} \qquad CA_a = CS_{src} * TF_{a-par}$$

$$Risk = EC_c * IUR \qquad HI = \frac{EC_{nc}}{RfC * CF_2}$$

Incidental Ingestion of Soil - Mutagenic Carcinogens

$$AIF_{ing} \quad (child) = [(ADAF_{<2} * ED_{<2} * EF_{<2}) + (ADAF_{2-6} * ED_{2-6} * EF_{2-6})] * \frac{IR_C * FI * CF_1}{BWc * AT_C}$$

$$AIF_{ing} \quad (adult) = [(ADAF_{>6-1} * ED_{>6-16} * EF_{>6-16}) + (ADAF_{>16} * ED_{>16} * EF_{>16})] * \frac{IR_A * FI * CF_1}{BW_A * AT_C}$$

$$AIF_{ing-s}(total) = AIF_{ing-} \ (child) + AIF_{ing-s}(adult)$$

$$I_{ing} = CS_{src} * TF * AAF_{ing-s} * AIF_{ing-s}$$

$$Risk = I_{ing-s} * CSF_O$$

Dermal Contact with Soil - Mutagenic Carcinogens

$$AAD_{derm-s}(child) = [(ADAF_{<2} * ED_{<2} * EF_{<2}) + (ADAF_{2-6} * ED_{2-6} * EF_{2-6})] * \frac{SA_C * AF_C * CF_1 * FC}{BWc * AT_C}$$

$$AAD_{derm-s}(adult) = [(ADAF_{>6-16} * ED_{>6-16} * EF_{>6-16}) + (ADAF_{>16} * ED_{>16} * EF_{>16})] * \frac{SA_A * AF_A * CF_1 * FC}{BW_A * AT_C}$$

$$AIF_{derm-} \ (total) = AIF_{derm-s}(child) + AIF_{derm-} \ (adult)$$

$$I_{derm} = CS_{src} * TF * AAF_{derm} \quad * AIF_{derm-s}$$

$$Risk = I_{derm-} * CSF_D$$

Inhalation of Constituents Emitted from Soil (Volatiles and Particulates) to Outdoor Air - Mutagenic Carcinogens

$$AED = (ADAF_{<2} * ED_{<2} * EF_{<2} * ET_{<2}) + (ADAF_{2-6} * ED_{2-6} * EF_{2-6} * ET_{2-6}) + (ADAF_{>6-16} * ED_{>6-16} * EF_{>6-16} * ET_{>6-16}) + (ADAF_{>16} * ED_{>16} * EF_{>1} * ET_{>16})$$

$$CA_a = CS_{src} * TF_{a-vo} \qquad CA_a = CS_{src} * TF_{a-part}$$

$$EC_c = \frac{CA_a * AED}{AT_c}$$

$$Risk = EC_c * IUR$$

Notes:
Equations are based on guidance from USEPA RAGS Part A and USEPA RAGS Part F.

Parameter			Value	Units	Comments/References
$IR_{ing\text{-}s\ -child}$	Incidental Soil Ingestion Rate - Child	=	0	mg-soil/day	default assumption for a child is 200 mg-soil/day (WVDEP 2023); however, this parameter was excluded based on the age range of the trespasser
$IR_{ing\text{-}s\ -adult}$	Incidental Soil Ingestion Rate - Adult	=	100	mg-soil/day	default assumption for an adult (WVDEP 2023)
SA_{child}	Exposed Surface Area - Soil - Child	=	0	cm²/day	default assumption for a child exposed to soil is 2,373 cm^2/day (WVDEP 2023); however, this parameter was excluded based on the age range of the trespasser
SA_{adult}	Exposed Surface Area - Soil - Adult	=	6,032	cm²/day	default assumption for an adult exposed to soil (WVDEP 2023)
AF_{child}	Soil Adherence Factor - Child	=	0	mg/cm²	default assumption for a child exposed to soil is 0.2 mg/cm^2 (WVDEP 2023); however, this parameter was excluded based on the age range of the trespasser
AF_{adult}	Soil Adherence Factor - Adult	=	0.07	mg/cm²	default assumption for an adult exposed to soil (WVDEP 2023)
CF_{1}	Conversion Factor	=	1.0E-06	kg/mg	---
CF_{2}	Conversion Factor	=	1.0E+03	µg/mg	---
FI	Fraction of Daily Total - Soil Ing	=	1	unitless	assumes 100% of daily soil ingestion occurs from soil at the site
FC	Fraction of Daily Total - Soil Derm	=	1	unitless	assumes 100% of daily soil contact occurs from soil at the site
ET	Exposure Time	=	2	hours/day	professional judgement
EF	Exposure Frequency	=	52	days/year	professional judgement; assumes exposure to soil occurs 2 days per week during the warmer months (approximately 26 weeks; May - Oct)
ED_{total}	Exposure Duration - Total	=	13	years	professional judgement based on age range of 13-26 years old
ED_{child}	Exposure Duration - Child	=	0	years	default assumption for a child resident is 6 years (WVDEP 2023); however, this parameter was excluded based on the age range of the trespasser
ED_{adult}	Exposure Duration - Adult	=	13	years	default assumption for an adult resident is 20 years (WVDEP 2023); however, this parameter was modified based on the age range of the trespasser
$ED_{<2}$	Mutagenic Exposure Duration - Child <2 years	=	0	years	2 years based on age range of 0 to 2 years (WVDEP 2023); however, this age range was excluded for the trespasser
$ED_{2\text{-}6}$	Mutagenic Exposure Duration - Child 2-6 years	=	0	years	4 years based on age range of 2 to 6 years (WVDEP 2023); however, this age range was excluded for the trespasser
$ED_{>6\text{-}16}$	Mutagenic Exposure Duration - Adult >6-16 years	=	3	years	default age range is 6 to 16 years (WVDEP 2023); however, trespasser only 13-16 years applies to the trespasser
$ED_{>16}$	Mutagenic Exposure Duration - Adult >16 years	=	10	years	based on age range of 16 to 26 years (WVDEP 2023)
$ADAF_{<2}$	Age-Dependent Adjustment Factor - Child <2 years	=	10	unitless	based on age range of 0 to 2 years (USEPA 2024)
$ADAF_{2\text{-}6}$	Age-Dependent Adjustment Factor - Child 2-6 years	=	3	unitless	based on age range of 2 to 6 years (USEPA 2024)
$ADAF_{>6\text{-}16}$	Age-Dependent Adjustment Factor - Adult >6-16 years	=	3	unitless	based on age range of 6 to 16 years (USEPA 2024)
$ADAF_{>16}$	Age-Dependent Adjustment Factor - Adult >16 years	=	1	unitless	based on age range of 16 to 26 years (USEPA 2024)
BW_{child}	Body Weight - Child	=	15	kg	default assumption for a child is 15 kg (WVDEP 2023); however, this parameter was excluded based on the age range of the trespasser
BW_{adult}	Body Weight - Adult	=	80	kg	default assumption for an adult (WVDEP 2023)
AT (c)	Averaging Time-Carcinogenic (Ing/Derm)	=	25,550	days	averaging time for a carcinogen based on lifetime of 70 years (lifetime in years x 365 days/year) (USEPA 1989)
$AT\ (nc)_{total}$	Averaging Time-Noncarcinogenic (Ing/Derm) - Total	=	4,745	days	averaging time for a noncarcinogen (ED x 365 days/year) (USEPA 1989)
$AT\ (nc)_{child}$	Averaging Time-Noncarcinogenic (Ing/Derm) - Child	=	0	days	averaging time for a noncarcinogen (ED x 365 days/year) (USEPA 1989)
$AT\ (nc)_{adult}$	Averaging Time-Noncarcinogenic (Ing/Derm) - Adult	=	4,745	days	averaging time for a noncarcinogen (ED x 365 days/year) (USEPA 1989)
AT (c)	Averaging Time-Carcinogenic (Inhalation)	=	613,200	hours	averaging time for a carcinogen based on lifetime of 70 years (lifetime in years x 365 days/year x 24 hours/day) (USEPA 2009)
$AT\ (nc)_{total}$	Averaging Time-Noncarcinogenic (Inhalation) - Total	=	113,880	hours	averaging time for a noncarcinogen (ED in years x 365 days/year x 24 hours/day) (USEPA 2009)
$IF_{ing\text{-}s}\ (c)_{child}$	Ing Intake Factor (Carcinogenic) - Soil - Child	=	0.00E+00	kg/kg-day	calculated
$IF_{ing\text{-}s}\ (c)_{adult}$	Ing Intake Factor (Carcinogenic) - Soil - Adult	=	3.31E-08	kg/kg-day	calculated
$IF_{ing\text{-}s}\ (c)_{total}$	Ing Intake Factor (Carcinogenic) - Soil - Total	=	3.31E-08	kg/kg-day	calculated
$AIF_{ing\text{-}s}\ (child)$	Age-Adjusted Ing Intake Factor (Mutagenic) - Soil - Child	=	0.00E+00	kg/kg-day	calculated
$AIF_{ing\text{-}s}\ (adult)$	Age-Adjusted Ing Intake Factor (Mutagenic) - Soil - Adult	=	4.83E-08	kg/kg-day	calculated
$AIF_{ing\text{-}s}\ (total)$	Age-Adjusted Ing Intake Factor (Mutagenic) - Soil - Total	=	4.83E-08	kg/kg-day	calculated
$IF_{ing\text{-}s}\ (nc)_{child}$	Ing Intake Factor (Noncarcinogenic) - Soil - Child	=	0.00E+00	kg/kg-day	calculated
$IF_{ing\text{-}s}\ (nc)_{adult}$	Ing Intake Factor (Noncarcinogenic) - Soil - Adult	=	1.78E-07	kg/kg-day	calculated
$IF_{ing\text{-}s}\ (nc)_{total}$	Ing Intake Factor (Noncarcinogenic) - Soil - Total	=	1.78E-07	kg/kg-day	calculated
$AD_{derm\text{-}s}\ (c)_{child}$	Absorbed Dose (Carcinogenic) - Soil - Child	=	0.00E+00	kg/kg-day	calculated
$AD_{derm\text{-}s}\ (c)_{adult}$	Absorbed Dose (Carcinogenic) - Soil - Adult	=	1.40E-07	kg/kg-day	calculated
$AD_{derm\text{-}s}\ (c)_{total}$	Absorbed Dose (Carcinogenic) - Soil - Total	=	1.40E-07	kg/kg-day	calculated
$AAD_{derm\text{-}s}\ (child)$	Age-Adjusted Absorbed Dose (Mutagenic) - Soil - Child	=	0.00E+00	kg/kg-day	calculated
$AAD_{derm\text{-}s}\ (adult)$	Age-Adjusted Absorbed Dose (Mutagenic) - Soil - Adult	=	2.04E-07	kg/kg-day	calculated
$AAD_{derm\text{-}s}\ (total)$	Age-Adjusted Absorbed Dose (Mutagenic) - Soil - Total	=	2.04E-07	kg/kg-day	calculated
$AD_{derm\text{-}s}\ (nc)_{child}$	Absorbed Dose (Noncarcinogenic) - Soil - Child	=	0.00E+00	kg/kg-day	calculated
$AD_{derm\text{-}s}\ (nc)_{adult}$	Absorbed Dose (Noncarcinogenic) - Soil - Adult	=	7.52E-07	kg/kg-day	calculated
$AD_{derm\text{-}s}\ (nc)_{total}$	Absorbed Dose (Noncarcinogenic) - Soil - Total	=	7.52E-07	kg/kg-day	calculated
EC_{c}	Inh Exposure Concentration (Carcinogenic)	=	chem-spec.	unitless	calculated
EC_{nc}	Inh Exposure Concentration (Noncarcinogenic)	=	chem-spec.	unitless	calculated

Parameter			Value	Units	Comments/References
AED	Combined Age-Dependent Adjustment Factor	=	1.98E+03	hours	calculated
CS_{src}	Source Concentration in Soil	=	chem-spec.	mg/kg or µg/kg	measured value
TF	Transfer Factor - Ing/Derm - All Media	=	1	unitless	conservative assumption
$TF_{a\text{-}vol}$	Transfer Factor - Inh (volatiles) - Soil	=	chem-spec.	kg/m^3	calculated using the soil volatilization model from the Soil Screening Guidance (USEPA 2002)
$TF_{a\text{-}part}$	Transfer Factor - Inh (particulates) - Soil		7.35E-10	kg/m^3	default value $(1.36E+9\ m^3/kg)^{-1}$ (USEPA 2024)
VF	Volatilization Factor - Groundwater	=	chem-spec.	L/m^3	calculated using the groundwater volatilization model (ASTM 2015)
CA_a	Concentration in Outdoor Air	=	chem-spec.	$µg/m^3$	calculated value
$AAF_{ing\text{-}s}$	Absorption Adjustment Factor-Soil Ing	=	chem-spec.	mg/mg	chemical - specific
$AAF_{derm\text{-}s}$	Absorption Adjustment Factor-Soil Derm	=	chem-spec.	mg/mg	chemical - specific
$I_{ing\text{-}s}$	Intake for Ingestion of Soil	=	chem-spec.	mg/kg-day	chemical - specific
$I_{derm\text{-}s}$	Intake for Dermal Contact with Soil	=	chem-spec.	mg/kg-day	chemical - specific
CSF_O	Oral Cancer Slope Factor	=	chem-spec.	$(mg/kg\text{-}day)^{-1}$	chemical - specific
RfD_O	Oral Reference Dose	=	chem-spec.	mg/kg-day	chemical - specific
CSF_D	Dermal Cancer Slope Factor	=	chem-spec.	$(mg/kg\text{-}day)^{-1}$	chemical - specific
RfD_D	Dermal Reference Dose	=	chem-spec.	mg/kg-day	chemical - specific
IUR	Inhalation Unit Risk	=	chem-spec.	$(µg/m^3)^{-1}$	chemical - specific
RfC	Reference Concentration	=	chem-spec.	(mg/m^3)	chemical - specific

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Equations

Incidental Ingestion of Soil - Non-mutagenic Carcinogens and Noncarcinogens

$$IF_{ing-s} = \frac{IR_{ing} * CF_1 * FI * EF * ED}{BW * AT}$$

$$IF_{ing-s}(total) = IF_{ing-s}(child) + IF_{ing-s}(adult)$$

$$I_{ing-s} = CS_{src} * TF * AAF_{ing-} * IF_{ing-s}$$

$$Risk = I_{ing-s\,(c)} * CSF_O \qquad HI = \frac{I_{ing-s\,(nc)}}{RfD_O}$$

Dermal Contact with Soil - Non-mutagenic Carcinogens and Noncarcinogens

$$AD_{derm-} = \frac{SA * AF * CF_1 * FC * EF * ED}{BW * AT}$$

$$AD_{der} (total) = AD_{derm-s}(child) + AD_{derm-s}(adult)$$

$$I_{derm-s} = CS_{src} * TF * AAF_{der} * AD_{derm-s}$$

$$Risk = I_{derm\ s\,(c)} * CSF_D \qquad HI = \frac{I_{derm-s\,(nc)}}{RfD_D}$$

Inhalation of Constituents Emitted from Soil (Volatiles and Particulates) to Outdoor Air - Non-mutagenic Carcinogens and Noncarcinogens

$$EC = \frac{CA_a * ET * EF * ED}{AT}$$

$$CA_a = CS_{src} * TF_{a-vol} \qquad CA_a = CS_{src} * TF_{a-par}$$

$$Risk = EC_c * IUR \qquad HI = \frac{EC_{nc}}{RfC * CF_2}$$

Incidental Ingestion of Soil - Mutagenic Carcinogens

$$AIF_{ing-s}(child) = [(ADAF_{<2} * ED_{<2} * EF_{<2}) + (ADAF_{2-6} * ED_{2-6} * EF_{2-6})] * \frac{IR_C * FI * CF_1}{BWc * AT_C}$$

$$AIF_{ing-s}(adult) = [(ADAF_{>6-16} * ED_{>6-16} * EF_{>6-16}) + (ADAF_{>16} * ED_{>16} * EF_{>16})] * \frac{IR_A * FI * CF_1}{BW_A * AT_C}$$

$$AIF_{ing-s}(total) = AIF_{ing-}(child) + AIF_{ing-s}(adult)$$

$$I_{ing-s} = CS_{src} * TF * AAF_{ing-s} * AIF_{ing-s}$$

$$Risk = I_{ing-s} * CSF_O$$

Dermal Contact with Soil - Mutagenic Carcinogens

$$AAD_{derm-s}(child) = [(ADAF_{<2} * ED_{<2} * EF_{<2}) + (ADAF_{2-6} * ED_{2-6} * EF_{2-6})] * \frac{SA_C * AF_C * CF_1 * FC}{BWc * AT_C}$$

$$AAD_{derm-s}(adult) = [(ADAF_{>6-16} * ED_{>6-1} * EF_{>6-16}) + (ADAF_{>16} * ED_{>16} * EF_{>16})] * \frac{SA_A * AF_A * CF_1 * FC}{BW_A * AT_C}$$

$$AIF_{der} (total) = AIF_{derm-s}(child) + AIF_{derm-s}(adult)$$

$$I_{derm-s} = CS_{src} * TF * AAF_{derm} * AIF_{derm-s}$$

$$Risk = I_{derm-s} * CSF_D$$

Inhalation of Constituents Emitted from Soil (Volatiles and Particulates) to Outdoor Air - Mutagenic Carcinogens

$$AED = (ADAF_{<2} * ED_{<2} * EF_{<2} * ET_{<2}) + (ADAF_{2-6} * ED_{2-6} * EF_{2-6} * ET_{2-6}) + (ADAF_{>6-1} * ED_{>6-16} * EF_{>6-16} * ET_{>6-16}) + (ADAF_{>16} * ED_{>16} * EF_{>16} * ET_{>16})$$

$$CA_a = CS_{src} * TF_{a-vol} \qquad CA_a = CS_{src} * TF_{a-par}$$

$$EC_c = \frac{CA_a * AED}{AT_c}$$

$$Risk = EC_c * IUR$$

Notes:
Equations are based on guidance from USEPA RAGS Part A and USEPA RAGS Part F.

Table 8-1
Calculation of Risks and Hazard Indices for On-Site Maintenance Worker
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

		Ingestion of Soil									
						Calculation of Risk			Calculation of Hazard Index		
Constituent of Concern	**Mutagenic Constituent? (Yes or No)**	**Source Concentration for Soil CS_{src} (mg/kg)**	**Transfer Factor TF_s (unitless)**	**Exposure Point Concentration for Soil EPC_s (mg/kg)**	**Absorption Adjustment Factor for Ingestion $AAF_{ing\text{-}s}$ (mg/mg)**	**Ingestion Intake (Cancer) $I_{ing\text{-}s}$ (c) (mg/kg-day)**	**Oral Cancer Slope Factor for Soil CSF_O $(mg/kg\text{-}day)^{-1}$**	**Risk from Ingestion of Soil $Risk_{ing\text{-}s}$ (unitless)**	**Ingestion Intake (Noncancer) $I_{ing\text{-}s}$ (nc) (mg/kg-day)**	**Oral Reference Dose for Soil RfD_O (mg/kg-day)**	**Hazard Index from Ingestion of Soil $HI_{ing\text{-}s}$ (unitless)**
Polycyclic Aromatic Hydrocarbons (PAHs)											
Benzo(a)pyrene	**Yes**	33.2	1	3.3E+01	1	2.9E-06	1.0E+00	2.9E-06	8.2E-06	3.0E-04	2.7E-02
Metals											
Arsenic	No	188.6	1	1.9E+02	0.6	1.0E-05	1.5E+00	1.5E-05	2.8E-05	3.0E-04	9.3E-02

Total Risk for Pathway = **2E-05**

Total HI for Pathway = **1E-01**

Table 8-1
Calculation of Risks and Hazard Indices for On-Site Maintenance Worker
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

		Dermal Contact with Soil									
						Calculation of Risk			Calculation of Hazard Index		
Constituent of Concern	**Mutagenic Constituent? (Yes or No)**	**Source Concentration for Soil CS_{src} (mg/kg)**	**Transfer Factor TF_s (unitless)**	**Exposure Point Concentration for Soil EPC_s (mg/kg)**	**Absorption Adjustment Factor for Dermal Contact $AAF_{derm\text{-}s}$ (mg/mg)**	**Dermal Absorbed Dose (Cancer) $I_{derm\text{-}s}$ (c) (mg/kg-day)**	**Dermal Cancer Slope Factor for Soil CSF_D $(mg/kg\text{-}day)^{-1}$**	**Risk from Dermal Contact with Soil $Risk_{derm\text{-}s}$ (unitless)**	**Dermal Absorbed Dose (Noncancer) $I_{derm\text{-}s}$ (nc) (mg/kg-day)**	**Dermal Reference Dose for Soil RfD_D (mg/kg-day)**	**Hazard Index from Dermal Contact with Soil $HI_{derm\text{-}s}$ (unitless)**
Polycyclic Aromatic Hydrocarbons (PAHs)											
Benzo(a)pyrene	**Yes**	33.2	1	3.3E+01	0.13	1.6E-06	1.0E+00	1.6E-06	4.5E-06	3.0E-04	1.5E-02
Metals											
Arsenic	No	188.6	1	1.9E+02	0.03	2.1E-06	1.5E+00	3.2E-06	5.9E-06	3.0E-04	2.0E-02

Total Risk for Pathway = **5E-06**

Total HI for Pathway = **3E-02**

Table 8-1
Calculation of Risks and Hazard Indices for On-Site Maintenance Worker
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

		Inhalation of Particulates Emitted to Outdoor Air from Soil								
					Calculation of Risk			Calculation of Hazard Index		
Constituent of Concern	**Mutagenic Constituent? (Yes or No)**	**Source Concentration for Soil CS_{src} (µg/kg)**	**Transfer Factor $TF_{a\text{-}part}$ (kg/m^3)**	**Outdoor Air Concentration CA_a ($µg/m^3$)**	**Exposure Concentration (Cancer) EC_c ($µg/m^3$)**	**Inhalation Unit Risk Factor IUR $(µg/m^3)^{-1}$**	**Risk from Inhal. of Part. Em. from Soil $Risk_{inhal\text{-}p}$ (unitless)**	**Exposure Concentration (Noncancer) EC_{nc} ($µg/m^3$)**	**Reference Concentration RfC (mg/m^3)**	**Hazard Index from Inhal. of Part. Em. from Soil $HI_{inhal\text{-}p}$ (unitless)**
Polycyclic Aromatic Hydrocarbons (PAHs)										
Benzo(a)pyrene	**Yes**	33,232	7.4E-10	2.4E-05	2.9E-07	6.0E-04	1.7E-10	8.0E-07	2.0E-06	4.0E-04
Metals										
Arsenic	No	188,600	7.4E-10	1.4E-04	1.6E-06	4.3E-03	7.0E-09	4.6E-06	1.5E-05	3.0E-04

Total Risk for Pathway = **7E-09**

Total HI for Pathway = **7E-04**

Table 8-2
Calculation of Risks and Hazard Indices for On-Site Outdoor Worker
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

		Ingestion of Soil									
						Calculation of Risk			Calculation of Hazard Index		
Constituent of Concern	**Mutagenic Constituent? (Yes or No)**	**Source Concentration for Soil CS_{src} (mg/kg)**	**Transfer Factor TF_s (unitless)**	**Exposure Point Concentration for Soil EPC_s (mg/kg)**	**Absorption Adjustment Factor for Ingestion AAF_{ing-s} (mg/mg)**	**Ingestion Intake (Cancer) I_{ing-s} (c) (mg/kg-day)**	**Oral Cancer Slope Factor for Soil CSF_O $(mg/kg\text{-}day)^{-1}$**	**Risk from Ingestion of Soil $Risk_{ing-s}$ (unitless)**	**Ingestion Intake (Noncancer) I_{ing-s} (nc) (mg/kg-day)**	**Oral Reference Dose for Soil RfD_O (mg/kg-day)**	**Hazard Index from Ingestion of Soil HI_{ing-s} (unitless)**
Polycyclic Aromatic Hydrocarbons (PAHs)											
Benzo(a)pyrene	**Yes**	33.2	1	3.3E+01	1	1.0E-05	1.0E+00	1.0E-05	2.8E-05	3.0E-04	9.5E-02
Metals											
Arsenic	No	188.6	1	1.9E+02	0.6	3.5E-05	1.5E+00	5.2E-05	9.7E-05	3.0E-04	3.2E-01

Total Risk for Pathway = **6E-05**

Total HI for Pathway = **4E-01**

Table 8-2
Calculation of Risks and Hazard Indices for On-Site Outdoor Worker
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

		Dermal Contact with Soil									
						Calculation of Risk			Calculation of Hazard Index		
Constituent of Concern	**Mutagenic Constituent? (Yes or No)**	**Source Concentration for Soil CS_{src} (mg/kg)**	**Transfer Factor TF_s (unitless)**	**Exposure Point Concentration for Soil EPC_s (mg/kg)**	**Absorption Adjustment Factor for Dermal Contact $AAF_{derm\text{-}s}$ (mg/mg)**	**Dermal Absorbed Dose (Cancer) $I_{derm\text{-}s}$ (c) (mg/kg-day)**	**Dermal Cancer Slope Factor for Soil CSF_D $(mg/kg\text{-}day)^{-1}$**	**Risk from Dermal Contact with Soil $Risk_{derm\text{-}s}$ (unitless)**	**Dermal Absorbed Dose (Noncancer) $I_{derm\text{-}s}$ (nc) (mg/kg-day)**	**Dermal Reference Dose for Soil RfD_D (mg/kg-day)**	**Hazard Index from Dermal Contact with Soil $HI_{derm\text{-}s}$ (unitless)**
Polycyclic Aromatic Hydrocarbons (PAHs)											
Benzo(a)pyrene	**Yes**	33.2	1	3.3E+01	0.13	5.6E-06	1.0E+00	5.6E-06	1.6E-05	3.0E-04	5.2E-02
Metals											
Arsenic	No	188.6	1	1.9E+02	0.03	7.3E-06	1.5E+00	1.1E-05	2.1E-05	3.0E-04	6.8E-02

Total Risk for Pathway = **2E-05**

Total HI for Pathway = **1E-01**

Table 8-2
Calculation of Risks and Hazard Indices for On-Site Outdoor Worker
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

		Inhalation of Particulates Emitted to Outdoor Air from Soil								
					Calculation of Risk			Calculation of Hazard Index		
Constituent of Concern	**Mutagenic Constituent? (Yes or No)**	**Source Concentration for Soil** CS_{src} **(µg/kg)**	**Transfer Factor** $TF_{a\text{-}part}$ **(kg/m^3)**	**Outdoor Air Concentration** CA_a **(µg/m^3)**	**Exposure Concentration (Cancer)** EC_c **(µg/m^3)**	**Inhalation Unit Risk Factor** IUR **(µg/m^3)$^{-1}$**	**Risk from Inhal. of Part. Em. from Soil** $Risk_{inhal\text{-}p}$ **(unitless)**	**Exposure Concentration (Noncancer)** EC_{nc} **(µg/m^3)**	**Reference Concentration** RfC **(mg/m^3)**	**Hazard Index from Inhal. of Part. Em. from Soil** $HI_{inhal\text{-}p}$ **(unitless)**
Polycyclic Aromatic Hydrocarbons (PAHs)										
Benzo(a)pyrene	**Yes**	33,232	7.4E-10	2.4E-05	2.0E-06	6.0E-04	1.2E-09	5.6E-06	2.0E-06	2.8E-03
Metals										
Arsenic	No	188,600	7.4E-10	1.4E-04	1.1E-05	4.3E-03	4.9E-08	3.2E-05	1.5E-05	2.1E-03

Total Risk for Pathway = **5E-08**

Total HI for Pathway = **5E-03**

Table 8-3
Calculation of Risks and Hazard Indices for On-Site Construction Worker
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

		Ingestion of Soil									
						Calculation of Risk			Calculation of Hazard Index		
Constituent of Concern	**Mutagenic Constituent? (Yes or No)**	**Source Concentration for Soil CS_{src} (mg/kg)**	**Transfer Factor TF_s (unitless)**	**Exposure Point Concentration for Soil EPC_s (mg/kg)**	**Absorption Adjustment Factor for Ingestion AAF_{ing-s} (mg/mg)**	**Ingestion Intake (Cancer) I_{ing-s} (c) (mg/kg-day)**	**Oral Cancer Slope Factor for Soil CSF_O $(mg/kg\text{-}day)^{-1}$**	**Risk from Ingestion of Soil $Risk_{ing-s}$ (unitless)**	**Ingestion Intake (Noncancer) I_{ing-s} (nc) (mg/kg-day)**	**Oral Reference Dose for Soil RfD_O (mg/kg-day)**	**Hazard Index from Ingestion of Soil HI_{ing-s} (unitless)**
Polycyclic Aromatic Hydrocarbons (PAHs)											
Benzo(a)pyrene	**Yes**	33.2	1	3.3E+01	1	1.6E-07	1.0E+00	1.6E-07	1.2E-05	3.0E-04	3.9E-02
Metals											
Arsenic	No	188.6	1	1.9E+02	0.6	5.5E-07	1.5E+00	8.2E-07	4.0E-05	3.0E-04	1.3E-01

Total Risk for Pathway = **1E-06**

Total HI for Pathway = **2E-01**

Table 8-3
Calculation of Risks and Hazard Indices for On-Site Construction Worker
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

		Dermal Contact with Soil									
						Calculation of Risk			Calculation of Hazard Index		
Constituent of Concern	**Mutagenic Constituent? (Yes or No)**	**Source Concentration for Soil CS_{src} (mg/kg)**	**Transfer Factor TF_s (unitless)**	**Exposure Point Concentration for Soil EPC_s (mg/kg)**	**Absorption Adjustment Factor for Dermal Contact $AAF_{derm\text{-}s}$ (mg/mg)**	**Dermal Absorbed Dose (Cancer) $I_{derm\text{-}s}$ (c) (mg/kg-day)**	**Dermal Cancer Slope Factor for Soil CSF_D $(mg/kg\text{-}day)^{-1}$**	**Risk from Dermal Contact with Soil $Risk_{derm\text{-}s}$ (unitless)**	**Dermal Absorbed Dose (Noncancer) $I_{derm\text{-}s}$ (nc) (mg/kg-day)**	**Dermal Reference Dose for Soil RfD_D (mg/kg-day)**	**Hazard Index from Dermal Contact with Soil $HI_{derm\text{-}s}$ (unitless)**
Polycyclic Aromatic Hydrocarbons (PAHs)											
Benzo(a)pyrene	**Yes**	33.2	1	3.3E+01	0.13	6.7E-08	1.0E+00	6.7E-08	4.9E-06	3.0E-04	1.6E-02
Metals											
Arsenic	No	188.6	1	1.9E+02	0.03	8.8E-08	1.5E+00	1.3E-07	6.4E-06	3.0E-04	2.1E-02

Total Risk for Pathway = **2E-07**

Total HI for Pathway = **4E-02**

Table 8-3
Calculation of Risks and Hazard Indices for On-Site Construction Worker
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

		Inhalation of Particulates Emitted to Outdoor Air from Soil								
					Calculation of Risk			Calculation of Hazard Index		
Constituent of Concern	**Mutagenic Constituent? (Yes or No)**	**Source Concentration for Soil** CS_{src} **(µg/kg)**	**Transfer Factor** $TF_{a\text{-}part}$ **(kg/m^3)**	**Outdoor Air Concentration** CA_a **(µg/m^3)**	**Exposure Concentration (Cancer)** EC_c **(µg/m^3)**	**Inhalation Unit Risk Factor** IUR **(µg/m^3)$^{-1}$**	**Risk from Inhal. of Part. Em. from Soil** $Risk_{inhal\text{-}p}$ **(unitless)**	**Exposure Concentration (Noncancer)** EC_{nc} **(µg/m^3)**	**Reference Concentration** RfC **(mg/m^3)**	**Hazard Index from Inhal. of Part. Em. from Soil** $HI_{inhal\text{-}p}$ **(unitless)**
Polycyclic Aromatic Hydrocarbons (PAHs)										
Benzo(a)pyrene	**Yes**	33,232	7.4E-10	2.4E-05	9.6E-09	6.0E-04	5.7E-12	7.0E-07	2.0E-06	3.5E-04
Metals										
Arsenic	No	188,600	7.4E-10	1.4E-04	5.4E-08	4.3E-03	2.3E-10	4.0E-06	1.5E-05	2.6E-04

Total Risk for Pathway = **2E-10**

Total HI for Pathway = **6E-04**

Table 8-4
Calculation of Risks and Hazard Indices for On-Site Recreational User
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

		Ingestion of Soil									
						Calculation of Risk			Calculation of Hazard Index		
Constituent of Concern	**Mutagenic Constituent? (Yes or No)**	**Source Concentration for Soil CS_{src} (mg/kg)**	**Transfer Factor TF_s (unitless)**	**Exposure Point Concentration for Soil EPC_s (mg/kg)**	**Absorption Adjustment Factor for Ingestion AAF_{ing-s} (mg/mg)**	**Ingestion Intake (Cancer) I_{ing-s} (c) (mg/kg-day)**	**Oral Cancer Slope Factor for Soil CSF_O $(mg/kg\text{-}day)^{-1}$**	**Risk from Ingestion of Soil $Risk_{ing-s}$ (unitless)**	**Ingestion Intake (Noncancer) I_{ing-s} (nc) (mg/kg-day)**	**Oral Reference Dose for Soil RfD_O (mg/kg-day)**	**Hazard Index from Ingestion of Soil HI_{ing-s} (unitless)**
Polycyclic Aromatic Hydrocarbons (PAHs)											
Benzo(a)anthracene	**Yes**	38.7	1	3.9E+01	1	3.8E-05	1.0E-01	3.8E-06	8.0E-05	---	---
Benzo(a)pyrene	**Yes**	33.2	1	3.3E+01	1	3.2E-05	1.0E+00	3.2E-05	6.9E-05	3.0E-04	2.3E-01
Benzo(b)fluoranthene	**Yes**	43.4	1	4.3E+01	1	4.2E-05	1.0E-01	4.2E-06	9.0E-05	---	---
Benzo(k)fluoranthene	**Yes**	5.7	1	5.7E+00	1	5.6E-06	1.0E-02	5.6E-08	1.2E-05	---	---
Dibenzo(a,h)anthracene	**Yes**	1.5	1	1.5E+00	1	1.5E-06	1.0E+00	1.5E-06	3.1E-06	---	---
Indeno(1,2,3-cd)pyrene	**Yes**	6.2	1	6.2E+00	1	6.0E-06	1.0E-01	6.0E-07	1.3E-05	---	---
Metals											
Antimony	No	28.9	1	2.9E+01	1	6.2E-06	---	---	6.0E-05	4.0E-04	1.5E-01
Arsenic	No	188.6	1	1.9E+02	0.6	2.4E-05	1.5E+00	3.6E-05	2.4E-04	3.0E-04	7.8E-01
Iron	No	59,016	1	5.9E+04	1	1.3E-02	---	---	1.2E-01	7.0E-01	1.8E-01
Polychlorinated Biphenyls (PCBs)											
Aroclor-1254	No	0.35	1	3.5E-01	1	7.5E-08	2.0E+00	1.5E-07	7.3E-07	2.0E-05	3.6E-02

Notes:

Shaded cells utilize mutagenic equations.

Total Risk for Pathway = **8E-05**

Total HI for Pathway = **1E+00**

Table 8-4
Calculation of Risks and Hazard Indices for On-Site Recreational User
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

		Dermal Contact with Soil									
						Calculation of Risk			Calculation of Hazard Index		
Constituent of Concern	**Mutagenic Constituent? (Yes or No)**	**Source Concentration for Soil CS_{src} (mg/kg)**	**Transfer Factor TF_s (unitless)**	**Exposure Point Concentration for Soil EPC_s (mg/kg)**	**Absorption Adjustment Factor for Dermal Contact $AAF_{derm\text{-}s}$ (mg/mg)**	**Dermal Absorbed Dose (Cancer) $I_{derm\text{-}s}$ (c) (mg/kg-day)**	**Dermal Cancer Slope Factor for Soil CSF_D $(mg/kg\text{-}day)^{-1}$**	**Risk from Dermal Contact with Soil $Risk_{derm\text{-}s}$ (unitless)**	**Dermal Absorbed Dose (Noncancer) $I_{derm\text{-}s}$ (nc) (mg/kg-day)**	**Dermal Reference Dose for Soil RfD_D (mg/kg-day)**	**Hazard Index from Dermal Contact with Soil $HI_{derm\text{-}s}$ (unitless)**
Polycyclic Aromatic Hydrocarbons (PAHs)											
Benzo(a)anthracene	**Yes**	38.7	1	3.9E+01	0.13	3.9E-05	1.0E-01	3.9E-06	8.2E-05	---	---
Benzo(a)pyrene	**Yes**	33.2	1	3.3E+01	0.13	3.4E-05	1.0E+00	3.4E-05	7.0E-05	3.0E-04	2.3E-01
Benzo(b)fluoranthene	**Yes**	43.4	1	4.3E+01	0.13	4.4E-05	1.0E-01	4.4E-06	9.2E-05	---	---
Benzo(k)fluoranthene	**Yes**	5.7	1	5.7E+00	0.13	5.8E-06	1.0E-02	5.8E-08	1.2E-05	---	---
Dibenzo(a,h)anthracene	**Yes**	1.5	1	1.5E+00	0.13	1.5E-06	1.0E+00	1.5E-06	3.2E-06	---	---
Indeno(1,2,3-cd)pyrene	**Yes**	6.2	1	6.2E+00	0.13	6.3E-06	1.0E-01	6.3E-07	1.3E-05	---	---
Metals											
Antimony	No	28.9	1	2.9E+01	0	0.0E+00	---	---	0.0E+00	6.0E-05	---
Arsenic	No	188.6	1	1.9E+02	0.03	1.1E-05	1.5E+00	1.7E-05	9.2E-05	3.0E-04	3.1E-01
Iron	No	59,016	1	5.9E+04	0	0.0E+00	---	---	0.0E+00	7.0E-01	---
Polychlorinated Biphenyls (PCBs)											
Aroclor-1254	No	0.35	1	3.5E-01	0.14	9.9E-08	2.0E+00	2.0E-07	8.0E-07	2.0E-05	4.0E-02

Notes:

Shaded cells utilize mutagenic equations.

Total Risk for Pathway = **6E-05**

Total HI for Pathway = **6E-01**

Table 8-4
Calculation of Risks and Hazard Indices for On-Site Recreational User
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

		Inhalation of Chemicals Volatilized to Outdoor Air from Soil									
						Calculation of Risk			Calculation of Hazard Index		
Constituent of Concern	**Mutagenic Constituent? (Yes or No)**	**Source Concentration for Soil CS_{src} (µg/kg)**	**Soil Saturation Limit C_{sat} (µg/kg)**	**Transfer Factor $TF_{a\text{-}vol}$ (kg/m^3)**	**Outdoor Air Concentration CA_a ($µg/m^3$)**	**Exposure Concentration (Cancer) EC_c ($µg/m^3$)**	**Inhalation Unit Risk Factor IUR $(µg/m^3)^{-1}$**	**Risk from Inhal. of Chem. Vol. from Soil $Risk_{inhal\text{-}v}$ (unitless)**	**Exposure Concentration (Noncancer) EC_{nc} ($µg/m^3$)**	**Reference Concentration RfC (mg/m^3)**	**Hazard Index from Inhal. of Chem. Vol. from Soil $HI_{inhal\text{-}v}$ (unitless)**
Polycyclic Aromatic Hydrocarbons (PAHs)											
Benzo(a)anthracene	**Yes**	38,662	---	1.7E-07	6.6E-03	1.2E-04	6.0E-05	7.2E-09	1.2E-04	---	---
Benzo(a)pyrene	**Yes**	---	---	---	---	---	---	---	---	---	---
Benzo(b)fluoranthene	**Yes**	---	---	---	---	---	---	---	---	---	---
Benzo(k)fluoranthene	**Yes**	---	---	---	---	---	---	---	---	---	---
Dibenzo(a,h)anthracene	**Yes**	---	---	---	---	---	---	---	---	---	---
Indeno(1,2,3-cd)pyrene	**Yes**	---	---	---	---	---	---	---	---	---	---
Metals											
Antimony	No	---	---	---	---	---	---	---	---	---	---
Arsenic	No	---	---	---	---	---	---	---	---	---	---
Iron	No	---	---	---	---	---	---	---	---	---	---
Polychlorinated Biphenyls (PCBs)											
Aroclor-1254	No	350	---	8.9E-07	3.1E-04	2.1E-06	5.7E-04	1.2E-09	5.5E-06	---	---

Notes:

Note: CA_a is calculated using minimum of $CS_{src} * TF_{a\text{-}vol}$ or $C_{sat} * TF_{a\text{-}vol}$

Shaded cells utilize mutagenic equations.

Total Risk for Pathway = **8E-09**

Total HI for Pathway = **0E+00**

Table 8-4
Calculation of Risks and Hazard Indices for On-Site Recreational User
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

		Inhalation of Particulates Emitted to Outdoor Air from Soil								
					Calculation of Risk			Calculation of Hazard Index		
Constituent of Concern	**Mutagenic Constituent? (Yes or No)**	**Source Concentration for Soil CS_{src} (µg/kg)**	**Transfer Factor $TF_{a\text{-}part}$ (kg/m^3)**	**Outdoor Air Concentration CA_a (µg/m^3)**	**Exposure Concentration (Cancer) EC_c (µg/m^3)**	**Inhalation Unit Risk Factor IUR (µg/m^3)$^{-1}$**	**Risk from Inhal. of Part. Em. from Soil $Risk_{inhal\text{-}p}$ (unitless)**	**Exposure Concentration (Noncancer) EC_{nc} (µg/m^3)**	**Reference Concentration RfC (mg/m^3)**	**Hazard Index from Inhal. of Part. Em. from Soil $HI_{inhal\text{-}p}$ (unitless)**
Polycyclic Aromatic Hydrocarbons (PAHs)										
Benzo(a)anthracene	**Yes**	---	---	---	---	---	---	---	---	---
Benzo(a)pyrene	**Yes**	33,232	7.4E-10	2.4E-05	4.5E-07	6.0E-04	2.7E-10	4.3E-07	2.0E-06	2.2E-04
Benzo(b)fluoranthene	**Yes**	43,441	7.4E-10	3.2E-05	5.8E-07	6.0E-05	3.5E-11	5.7E-07	---	---
Benzo(k)fluoranthene	**Yes**	5,743	7.4E-10	4.2E-06	7.7E-08	6.0E-06	4.6E-13	7.5E-08	---	---
Dibenzo(a,h)anthracene	**Yes**	1,516	7.4E-10	1.1E-06	2.0E-08	6.0E-04	1.2E-11	2.0E-08	---	---
Indeno(1,2,3-cd)pyrene	**Yes**	6,233	7.4E-10	4.6E-06	8.4E-08	6.0E-05	5.0E-12	8.2E-08	---	---
Metals										
Antimony	No	28,920	7.4E-10	2.1E-05	1.4E-07	---	---	3.8E-07	3.0E-04	1.3E-06
Arsenic	No	188,600	7.4E-10	1.4E-04	9.2E-07	4.3E-03	3.9E-09	2.5E-06	1.5E-05	1.6E-04
Iron	No	59,016,000	7.4E-10	4.3E-02	2.9E-04	---	---	7.7E-04	---	---
Polychlorinated Biphenyls (PCBs)										
Aroclor-1254	No	---	---	---	---	---	---	---	---	---

Notes:

Shaded cells utilize mutagenic equations.

Total Risk for Pathway = **4E-09**

Total HI for Pathway = **4E-04**

Table 8-5
Calculation of Risks and Hazard Indices for Trespasser
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

		Ingestion of Soil									
						Calculation of Risk			Calculation of Hazard Index		
Constituent of Concern	**Mutagenic Constituent? (Yes or No)**	**Source Concentration for Soil CS_{src} (mg/kg)**	**Transfer Factor TF_s (unitless)**	**Exposure Point Concentration for Soil EPC_s (mg/kg)**	**Absorption Adjustment Factor for Ingestion AAF_{ing-s} (mg/mg)**	**Ingestion Intake (Cancer) I_{ing-s} (c) (mg/kg-day)**	**Oral Cancer Slope Factor for Soil CSF_O $(mg/kg\text{-}day)^{-1}$**	**Risk from Ingestion of Soil $Risk_{ing-s}$ (unitless)**	**Ingestion Intake (Noncancer) I_{ing-s} (nc) (mg/kg-day)**	**Oral Reference Dose for Soil RfD_O (mg/kg-day)**	**Hazard Index from Ingestion of Soil HI_{ing-s} (unitless)**
Polycyclic Aromatic Hydrocarbons (PAHs)											
Benzo(a)anthracene	**Yes**	---	---	---	---	---	---	---	---	---	---
Benzo(a)pyrene	**Yes**	33.2	1	3.3E+01	1	1.6E-06	1.0E+00	1.6E-06	5.9E-06	3.0E-04	2.0E-02
Benzo(b)fluoranthene	**Yes**	---	---	---	---	---	---	---	---	---	---
Benzo(k)fluoranthene	**Yes**	---	---	---	---	---	---	---	---	---	---
Dibenzo(a,h)anthracene	**Yes**	---	---	---	---	---	---	---	---	---	---
Indeno(1,2,3-cd)pyrene	**Yes**	---	---	---	---	---	---	---	---	---	---
Metals											
Antimony	No	---	---	---	---	---	---	---	---	---	---
Arsenic	No	188.6	1	1.9E+02	0.6	3.7E-06	1.5E+00	5.6E-06	2.0E-05	3.0E-04	6.7E-02
Iron	No	---	---	---	---	---	---	---	---	---	---
Polychlorinated Biphenyls (PCBs)											
Aroclor-1254	No	---	---	---	---	---	---	---	---	---	---

Notes:

Shaded cells utilize mutagenic equations.

Total Risk for Pathway = **7E-06**

Total HI for Pathway = **9E-02**

Table 8-5
Calculation of Risks and Hazard Indices for Trespasser
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

		Dermal Contact with Soil									
						Calculation of Risk			Calculation of Hazard Index		
Constituent of Concern	**Mutagenic Constituent? (Yes or No)**	**Source Concentration for Soil CS_{src} (mg/kg)**	**Transfer Factor TF_s (unitless)**	**Exposure Point Concentration for Soil EPC_s (mg/kg)**	**Absorption Adjustment Factor for Dermal Contact $AAF_{derm\text{-}s}$ (mg/mg)**	**Dermal Absorbed Dose (Cancer) $I_{derm\text{-}s}$ (c) (mg/kg-day)**	**Dermal Cancer Slope Factor for Soil CSF_D $(mg/kg\text{-}day)^{-1}$**	**Risk from Dermal Contact with Soil $Risk_{derm\text{-}s}$ (unitless)**	**Dermal Absorbed Dose (Noncancer) $I_{derm\text{-}s}$ (nc) (mg/kg-day)**	**Dermal Reference Dose for Soil RfD_D (mg/kg-day)**	**Hazard Index from Dermal Contact with Soil $HI_{derm\text{-}s}$ (unitless)**
Polycyclic Aromatic Hydrocarbons (PAHs)											
Benzo(a)anthracene	**Yes**	---	---	---	---	---	---	---	---	---	---
Benzo(a)pyrene	**Yes**	33.2	1	3.3E+01	0.13	8.8E-07	1.0E+00	8.8E-07	3.2E-06	3.0E-04	1.1E-02
Benzo(b)fluoranthene	**Yes**	---	---	---	---	---	---	---	---	---	---
Benzo(k)fluoranthene	**Yes**	---	---	---	---	---	---	---	---	---	---
Dibenzo(a,h)anthracene	**Yes**	---	---	---	---	---	---	---	---	---	---
Indeno(1,2,3-cd)pyrene	**Yes**	---	---	---	---	---	---	---	---	---	---
Metals											
Antimony	No	---	---	---	---	---	---	---	---	---	---
Arsenic	No	188.6	1	1.9E+02	0.03	7.9E-07	1.5E+00	1.2E-06	4.3E-06	3.0E-04	1.4E-02
Iron	No	---	---	---	---	---	---	---	---	---	---
Polychlorinated Biphenyls (PCBs)											
Aroclor-1254	No	---	---	---	---	---	---	---	---	---	---

Notes:

Shaded cells utilize mutagenic equations.

Total Risk for Pathway = **2E-06**

Total HI for Pathway = **3E-02**

Table 8-5
Calculation of Risks and Hazard Indices for Trespasser
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

		Inhalation of Particulates Emitted to Outdoor Air from Soil								
					Calculation of Risk			Calculation of Hazard Index		
Constituent of Concern	**Mutagenic Constituent? (Yes or No)**	**Source Concentration for Soil CS_{src} (µg/kg)**	**Transfer Factor $TF_{a\text{-}part}$ (kg/m^3)**	**Outdoor Air Concentration CA_a (µg/m^3)**	**Exposure Concentration (Cancer) EC_c (µg/m^3)**	**Inhalation Unit Risk Factor IUR (µg/m^3)$^{-1}$**	**Risk from Inhal. of Part. Em. from Soil $Risk_{inhal\text{-}p}$ (unitless)**	**Exposure Concentration (Noncancer) EC_{nc} (µg/m^3)**	**Reference Concentration RfC (mg/m^3)**	**Hazard Index from Inhal. of Part. Em. from Soil $HI_{inhal\text{-}p}$ (unitless)**
Polycyclic Aromatic Hydrocarbons (PAHs)										
Benzo(a)anthracene	**Yes**	---	---	---	---	---	---	---	---	---
Benzo(a)pyrene	**Yes**	33,232	7.4E-10	2.4E-05	7.9E-08	6.0E-04	4.7E-11	2.9E-07	2.0E-06	1.4E-04
Benzo(b)fluoranthene	**Yes**	---	---	---	---	---	---	---	---	---
Benzo(k)fluoranthene	**Yes**	---	---	---	---	---	---	---	---	---
Dibenzo(a,h)anthracene	**Yes**	---	---	---	---	---	---	---	---	---
Indeno(1,2,3-cd)pyrene	**Yes**	---	---	---	---	---	---	---	---	---
Metals										
Antimony	No	---	---	---	---	---	---	---	---	---
Arsenic	No	188,600	7.4E-10	1.4E-04	3.1E-07	4.3E-03	1.3E-09	1.6E-06	1.5E-05	1.1E-04
Iron	No	---	---	---	---	---	---	---	---	---
Polychlorinated Biphenyls (PCBs)										
Aroclor-1254	No	---	---	---	---	---	---	---	---	---

Notes:

Shaded cells utilize mutagenic equations.

Total Risk for Pathway = **1E-09**

Total HI for Pathway = **3E-04**

Table 8-6
Summary of Risks and Hazard Indices for All Receptors
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

Risks

Receptor	Direct Contact					Total Risk
	Soil					
	Incidental Ingestion	Dermal Contact	Inhalation of Volatiles (Ambient/ Trench Air)	Inhalation of Particulates (Ambient/ Trench Air)	Total Soil	
On-Site						
Maintenance Worker	**2E-05**	5E-06	---	7E-09	**2E-05**	**2E-05**
Outdoor Worker	**6E-05**	**2E-05**	---	5E-08	**8E-05**	**8E-05**
Construction Worker	1E-06	2E-07	---	2E-10	1E-06	1E-06
Recreational User	8E-05	6E-05	8E-09	4E-09	1E-04	1E-04
Trespasser	7E-06	2E-06	---	1E-09	9E-06	9E-06

Hazard Indices

Receptor	Direct Contact					Total Hazard Index
	Soil					
	Incidental Ingestion	Dermal Contact	Inhalation of Volatiles (Ambient/ Trench Air)	Inhalation of Particulates (Ambient/ Trench Air)	Total Soil	
On-Site						
Maintenance Worker	1E-01	3E-02	---	7E-04	2E-01	2E-01
Outdoor Worker	4E-01	1E-01	---	5E-03	5E-01	5E-01
Construction Worker	2E-01	4E-02	---	6E-04	2E-01	2E-01
Recreational User	1E+00	6E-01	---[1]	4E-04	2E+00	2E+00
Trespasser	9E-02	3E-02	---	3E-04	1E-01	1E-01

Notes:

Shaded values indicate an exceedance of the WVDEP risk benchmark of $1x10^{-6}$ or the hazard index benchmark of 1.0 for residential receptors.

Bolded values indicate an exceedance of the WVDEP risk benchmark of $1x10^{-5}$ or the hazard index benchmark of 1.0 for commercial/industrial receptors.

"---" indicates exposure pathway was not retained for this receptor.

[1] There are no chronic reference concentrations available for the retained COC for the inhalation of volatiles exposure pathway. Therefore, a hazard quotient was not calculated.

On-Site Maintenance Worker

Direct Contact COC	Calculated Risks and HQs for Soil Exposure Pathways in Quantitative Risk Assessment						
	Surface Soil Source Concentration (mg/kg)	Risk - Incidental Ingestion	Risk - Dermal Contact	Risk - Inhalation of Particulates	HQ - Incidental Ingestion	HQ - Dermal Contact	HQ - Inhalation of Particulates
Benzo(a)pyrene	33.2	2.9E-06	1.6E-06	1.7E-10	2.7E-02	1.5E-02	4.0E-04
Arsenic	188.6	1.5E-05	3.2E-06	7.0E-09	9.3E-02	2.0E-02	3.0E-04
Total Risk/HI per pathway		**1.8E-05**	**4.8E-06**	**7.2E-09**	**1.2E-01**	**3.5E-02**	**7.1E-04**

Total Risk =	**2E-05**	**Total HI =**	**2E-01**

Direct Contact COC	Ratioed Risks and HQs for Soil Exposure Pathways						
	Surface Soil Source Concentration (mg/kg)	Risk - Incidental Ingestion	Risk - Dermal Contact	Risk - Inhalation of Particulates	HQ - Incidental Ingestion	HQ - Dermal Contact	HQ - Inhalation of Particulates
Benzo(a)pyrene	2.407	2.1E-07	1.2E-07	1.2E-11	2.0E-03	1.1E-03	2.9E-05
Arsenic	23.92	1.9E-06	4.0E-07	8.9E-10	1.2E-02	2.5E-03	3.9E-05
Total Risk/HI per pathway		**2.1E-06**	**5.2E-07**	**9.0E-10**	**1.4E-02**	**3.6E-03**	**6.8E-05**

Total Risk =	**3E-06**	**Total HI =**	**2E-02**

Notes:
COC - constituent of concern
HI - hazard index
HQ - hazard quotient
Shaded values indicate an exceedance of the WVDEP risk benchmark of $1x10^{-5}$ or the hazard index benchmark of 1.0 for commercial/industrial receptors.

On-Site Outdoor Worker

Direct Contact COC	Calculated Risks and HQs for Soil Exposure Pathways in Quantitative Risk Assessment						
	Surface Soil Source Concentration (mg/kg)	Risk - Incidental Ingestion	Risk - Dermal Contact	Risk - Inhalation of Particulates	HQ - Incidental Ingestion	HQ - Dermal Contact	HQ - Inhalation of Particulates
Benzo(a)pyrene	33.2	1.0E-05	5.6E-06	1.2E-09	9.5E-02	5.2E-02	2.8E-03
Arsenic	188.6	5.2E-05	1.1E-05	4.9E-08	3.2E-01	6.8E-02	2.1E-03
Total Risk/HI per pathway		**6.2E-05**	**1.7E-05**	**5.0E-08**	**4.2E-01**	**1.2E-01**	**4.9E-03**

Total Risk =	**8E-05**	**Total HI =**	**5E-01**

Direct Contact COC	Ratioed Risks and HQs for Soil Exposure Pathways						
	Surface Soil Source Concentration (mg/kg)	Risk - Incidental Ingestion	Risk - Dermal Contact	Risk - Inhalation of Particulates	HQ - Incidental Ingestion	HQ - Dermal Contact	HQ - Inhalation of Particulates
Benzo(a)pyrene	2.407	7.4E-07	4.0E-07	8.7E-11	6.9E-03	3.8E-03	2.0E-04
Arsenic	23.92	6.6E-06	1.4E-06	6.2E-09	4.1E-02	8.7E-03	2.7E-04
Total Risk/HI per pathway		**7.3E-06**	**1.8E-06**	**6.3E-09**	**4.8E-02**	**1.2E-02**	**4.7E-04**

Total Risk =	**9E-06**	**Total HI =**	**6E-02**

Notes:
COC - constituent of concern
HI - hazard index
HQ - hazard quotient
Shaded values indicate an exceedance of the WVDEP risk benchmark of $1x10^{-5}$ or the hazard index benchmark of 1.0 for commercial/industrial receptors.

Trespasser

Direct Contact COC	Calculated Risks and HQs for Soil Exposure Pathways in Quantitative Risk Assessment						
	Surface Soil Source Concentration (mg/kg)	Risk - Incidental Ingestion	Risk - Dermal Contact	Risk - Inhalation of Particulates	HQ - Incidental Ingestion	HQ - Dermal Contact	HQ - Inhalation of Particulates
Benzo(a)pyrene	33.2	1.6E-06	8.8E-07	4.7E-11	2.0E-02	1.1E-02	1.4E-04
Arsenic	188.6	5.6E-06	1.2E-06	1.3E-09	6.7E-02	1.4E-02	1.1E-04
Total Risk/HI per pathway		**7.2E-06**	**2.1E-06**	**1.4E-09**	**8.7E-02**	**2.5E-02**	**2.5E-04**

Total Risk =	**9E-06**	**Total HI =**	**1E-01**

Direct Contact COC	Ratioed Risks and HQs for Soil Exposure Pathways						
	Surface Soil Source Concentration (mg/kg)	Risk - Incidental Ingestion	Risk - Dermal Contact	Risk - Inhalation of Particulates	HQ - Incidental Ingestion	HQ - Dermal Contact	HQ - Inhalation of Particulates
Benzo(a)pyrene	2.407	1.2E-07	6.4E-08	3.4E-12	1.4E-03	7.8E-04	1.1E-05
Arsenic	23.92	7.1E-07	1.5E-07	1.7E-10	8.5E-03	1.8E-03	1.4E-05
Total Risk/HI per pathway		**8.3E-07**	**2.1E-07**	**1.7E-10**	**9.9E-03**	**2.6E-03**	**2.4E-05**

Total Risk =	**1E-06**	**Total HI =**	**1E-02**

Notes:
COC - constituent of concern
HI - hazard index
HQ - hazard quotient
Shaded values indicate an exceedance of the WVDEP risk benchmark of $1x10^{-6}$ or the hazard index benchmark of 1.0 for residential receptors.

On-Site Recreational User

Direct Contact COC	Calculated Risks and HQs for Soil Exposure Pathways in Quantitative Risk Assessment								
	Surface Soil Source Concentration (mg/kg)	Risk - Incidental Ingestion	Risk - Dermal Contact	Risk - Inhalation of Volatiles	Risk - Inhalation of Particulates	HQ - Incidental Ingestion	HQ - Dermal Contact	HQ - Inhalation of Volatiles	HQ - Inhalation of Particulates
Benzo(a)anthracene	38.7	3.8E-06	3.9E-06	7.2E-09	---	---	---	---	---
Benzo(a)pyrene	33.2	3.2E-05	3.4E-05	---	2.7E-10	2.3E-01	2.3E-01	---	2.2E-04
Benzo(b)fluoranthene	43.4	4.2E-06	4.4E-06	---	3.5E-11	---	---	---	---
Benzo(k)fluoranthene	5.7	5.6E-08	5.8E-08	---	4.6E-13	---	---	---	---
Dibenzo(a,h)anthracene	1.5	1.5E-06	1.5E-06	---	1.2E-11	---	---	---	---
Indeno(1,2,3-cd)pyrene	6.2	6.0E-07	6.3E-07	---	5.0E-12	---	---	---	---
Antimony	28.9	---	---	---	---	1.5E-01	---	---	1.3E-06
Arsenic	188.6	3.6E-05	1.7E-05	---	3.9E-09	7.8E-01	3.1E-01	---	1.6E-04
Iron	59,016	---	---	---	---	1.8E-01	---	---	---
Aroclor-1254	0.35	1.5E-07	2.0E-07	1.2E-09	---	3.6E-02	4.0E-02	---	---
Total Risk/HI per pathway		**7.9E-05**	**6.2E-05**	**8.4E-09**	**4.3E-09**	**1.4E+00**	**5.8E-01**	**---**	**3.8E-04**

Total Risk = 1E-04 **Total HI = 2E+00**

Direct Contact COC	Ratioed Risks and HQs for Soil Exposure Pathways								
	Surface Soil Source Concentration (mg/kg)	Risk - Incidental Ingestion	Risk - Dermal Contact	Risk - Inhalation of Volatiles	Risk - Inhalation of Particulates	HQ - Incidental Ingestion	HQ - Dermal Contact	HQ - Inhalation of Volatiles	HQ - Inhalation of Particulates
Benzo(a)anthracene	2.3	2.3E-07	2.4E-07	4.3E-10	---	---	---	---	---
Benzo(a)pyrene	2.4	2.3E-06	2.4E-06	---	1.9E-11	1.7E-02	1.7E-02	---	1.6E-05
Benzo(b)fluoranthene	3.5	3.4E-07	3.6E-07	---	2.8E-12	---	---	---	---
Benzo(k)fluoranthene	1.1	1.1E-08	1.1E-08	---	9.1E-14	---	---	---	---
Dibenzo(a,h)anthracene	0.3	3.4E-07	3.5E-07	---	2.8E-12	---	---	---	---
Indeno(1,2,3-cd)pyrene	1.5	1.5E-07	1.5E-07	---	1.2E-12	---	---	---	---
Antimony	11.7	---	---	---	---	6.1E-02	---	---	5.1E-07
Arsenic	23.9	4.6E-06	2.2E-06	---	5.0E-10	9.9E-02	3.9E-02	---	2.1E-05
Iron	34,863	---	---	---	---	1.0E-01	---	---	---
Aroclor-1254	0.35	1.5E-07	2.0E-07	1.2E-09	---	3.6E-02	4.0E-02	---	---
Total Risk/HI per pathway		**8.1E-06**	**5.9E-06**	**1.6E-09**	**5.3E-10**	**3.2E-01**	**9.6E-02**	**---**	**3.7E-05**

Total Risk = 1E-05 **Total HI = 4E-01**

Notes:
COC - constituent of concern
HI - hazard index
HQ - hazard quotient
Shaded values indicate an exceedance of the WVDEP risk benchmark of $1x10^{-6}$ or the hazard index benchmark of 1.0 for residential receptors.

Appendix A – Adult Lead Model

Calculations of Preliminary Remediation Goals (PRGs) for Soil in Nonresidential Areas

U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee

Version date 06/14/2017

EDIT RED CELLS

Variable	Description of Variable	Units	GSDi and PbBo from Analysis of NHANES 2009-2014	GSDi and PbBo from Analysis of NHANES 2007-2010	GSDi and PbBo from Analysis of NHANES 1999-2004	GSDi and PbBo from Analysis of NHANES III (Phases 1&2)
$PbB_{fetal,\ 0.95}$	Target PbB in fetus (e.g., 2-8 µg/dL)	µg/dL	3.5	3.5	3.5	3.5
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9	0.9	0.9	0.9
BKSF	Biokinetic Slope Factor	µg/dL per µg/day	0.4	0.4	0.4	0.4
GSD_i	Geometric standard deviation PbB	--	1.8	1.7	1.8	2.1
PbB_0	Baseline PbB	µg/dL	0.6	0.7	1.0	1.5
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.100	0.100	0.100	0.100
$AF_{S,\ D}$	Absorption fraction (same for soil and dust)	--	0.12	0.12	0.12	0.12
$EF_{S,\ D}$	Exposure frequency (same for soil and dust)	days/yr	270	270	270	270
$AT_{S,\ D}$	Averaging time (same for soil and dust)	days/yr	365	365	365	365
PRG in Soil for no more than 5% probability that fetal PbB exceeds target PbB		**ppm**	**247**	**260**	**135**	**-99**

selected standard

Appendix B – Ecological Checklist

ATTACHMENT 2

Checklist to Determine Applicable Remediation Standards
Part 1: Ecological Standards

STEP 1: Determine Whether a De Minimis Ecological Screening Evaluation is Appropriate for the Site		
1.1	Are there any undeveloped terrestrial areas on or adjacent to the site (e.g., areas that are not under intensive landscape or agricultural control)?	☐ Yes ☒ No
1.2	Are there any potential wetlands (including vernal pools) on or adjacent to the site?	☐ Yes ☒ No
1.3	Are there any surface water bodies (i.e., lotic or lentic habitat) on or adjacent to the site?	☐ Yes ☒ No
1.4	Are there any terrestrial, wetland, or aquatic habitats off-site, but situated downstream, downwind, or downgradient from the site that may be affected by site-related stressors?	☐ Yes ☒ No
1.5	Are there any projected land uses for the site that would result in undeveloped areas, wetland habitat, lotic habitat, or lentic habitat?	☐ Yes ☒ No
If "Yes" to any: A complete exposure pathway may exist for potential ecological receptors of concern. Proceed to Step 2. *If "No" to all: No further ecological evaluation is required. File this completed form with the Site Assessment Report.*		

STEP 2: Identify any Readily Apparent Harm or Exceedances of Surface Water Quality Standards		
2.1	Have there been any incidents where harm to wildlife attributable to contaminants originating from the site has been readily apparent?	☐ Yes ☐ No
	If "Yes": Proceed to Question 2.2. *If "No": Skip to Question 2.3.*	
2.2	Has the cause of such harm been eliminated?	☐ Yes ☐ No
	If "Yes": Briefly describe the action taken and complete the rest of the checklist. *If "No": Proceed directly to the remedy evaluation or, alternately, proceed with a determination of a Uniform or Site-Specific Ecological Standard, as described in the VRP Guidance Manual, prior to implementation of the remedy. File this form with the Site Assessment Report.*	
	Action Taken:	
2.3	Is the site contributing to exceedances of surface water quality standards established for the protection of aquatic life (see W. Va. Legislative Rule 47CSR2)?	☐ Yes ☐ No ☐ Unknown
	If "Yes": Proceed directly to the remedy evaluation or, alternately, proceed with a determination of a Uniform or Site-Specific Ecological Standard, as described in the VRP Guidance Manual, prior to implementation of the remedy. *If "No" or "Unknown": Proceed to Step 3.*	

ATTACHMENT 2

STEP 3: Identify Contamination Associated with Ecological Habitats		
3.1	Have the environmental media (e.g., soil, surface water, sediment, biota) associated with the ecological habitat(s) identified in Questions 1.2 through 1.5 been sampled and analyzed with regard to potential site-related contaminants of concern?	☐ Yes ☐ No
	If "Yes": Proceed to Question 3.2. *If "No": Skip to Step 4.*	
	Comments (e.g., some media sampled but others not, limitations of data):	
3.2	Have any site-related contaminants been detected above natural background concentrations in environmental media collected from terrestrial habitat?	☐ Yes ☐ No ☐ Unknown ☐ n/a
	Comments (e.g., type of contaminants):	
3.3	Have any site-related contaminants been detected above natural background concentrations in environmental media collected from wetland or aquatic habitats (lotic or lentic habitats)?	☐ Yes ☐ No ☐ Unknown ☐ n/a
	If "Yes" or "Unknown" to 3.2 and/or 3.3: Proceed to Question 3.4. *If "No" or "n/a" to both 3.2 and 3.3: Skip to Question 3.6.*	
	Comments (e.g., wetland or aquatic, lotic or lentic, limitations of data):	
3.4	Are site-related contaminants presenting an ecological risk over and above "local" condition?	☐ Yes ☐ No ☐ Unknown
	If "Yes": Skip to Step 4. *If "No" or "Unknown": Proceed to Question 3.5.*	
	Comments (e.g., evidence of local condition and/or ecological risk):	
3.5	Have site-related releases of contaminants been stopped?	☐ Yes ☐ No
	If "Yes": Proceed to Question 3.6. *If "No": Skip to Part 4.*	
	Comments (e.g., how were releases stopped):	
3.6	Are site-related contaminants currently or likely to be migrating to aquatic habitat (e.g., lotic, lentic, or wetland habitat)?	☐ Yes ☐ No ☐ Unknown ☐ n/a
	If "Yes" or "Unknown": Proceed to Step 4. *If "No" or "n/a": No further ecological evaluation is required. File this completed form with the Site Assessment Report.*	

ATTACHMENT 2

STEP 4: Characterize the Potential Ecological Habitat		
4.1	Describe the general land use in the immediate vicinity of the site.	
	☐ Commercial/Industrial ☐ Residential ☐ Rural/Agricultural ☐ Rural/Undeveloped ☐ Urban ☐ Other:	
4.2	For all affected areas that fulfill the descriptions in Step 1, answer the following and attach a site map identifying the potential ecological habitat.	
	4.2.1 Outline characteristics for potential terrestrial habitats.	
	Location:	
	Contiguous Area:	
	General Topography:	
	Primary Soil Type:	
	Predominant Vegetation Species:	
	4.2.2 Outline characteristics for potential wetland habitats (e.g., vernal pools, marshes, etc.).	
	Location:	
	Contiguous Area:	
	General Topography:	
	Primary Soil Type:	
	Predominant Vegetation Species:	
	4.2.3 Outline characteristics for potential lotic habitats (flowing water).	
	Location:	
	Typical Width and Depth:	
	Typical Flow Rate:	
	Typical Gradient (m/km):	
	Type of River/Creek Bottom:	
	Types of Aquatic Vegetation Present:	
	Topography of the Riparian Zone:	
	Predominant Riparian Vegetation:	
	Human Utilization of Lotic Habitat:	
	Local Conditions:	
	4.2.4 Outline characteristics for potential lentic habitats (standing water).	
	Location:	
	Is the lentic habitat…?	☐ Natural ☐ Man-made
	Area of Lentic Habitat	
	Typical and Maximum Depth:	
	Description of Sources & Drainage:	
	Predominant Aquatic Vegetation:	
	Topography of Littoral Zone:	
	Predominant Littoral Zone Vegetation:	
	Human Utilization of Lentic Habitat:	
	Local Conditions:	

4.3	Indicate if the site contains or is adjacent to any of the following types of valued terrestrial habitats:	
	☐ Climax Community (e.g., old growth forest) ☐ Federal Wilderness Area (designated or administratively proposed) ☐ National or State Forest ☐ National or State Park ☐ National or State Wildlife Refuge ☐ National Preserve Area ☐ State designated natural area ☐ Federal land designated for protection of natural ecosystems ☐ Federal or State land designated for wildlife or game management ☐ Area utilized for breeding by large or dense aggregations of wildlife ☐ Feeding, breeding, nesting, cover, or wintering habitat for migratory birds ☐ Area important to the maintenance of unique biotic communities (e.g., high proportion of endemic species) *Threatened or Endangered Species* ☐ Critical habitat for federally designated threatened or endangered species ☐ Habitat known to be used or potentially used by Federal or State designated threatened or endangered species, or species in the State Wildlife Action Plan	
4.4	Indicate if the site contains or is adjacent to any of the following types of valued wetlands:	
	☐ Area important to the maintenance of unique biotic communities (e.g., high proportion of endemic species) ☐ Area utilized for breeding by large or dense aggregations of wildlife ☐ Spawning or nursery areas critical to the maintenance of fish/shellfish species ☐ Feeding, breeding, nesting, cover, or wintering habitat for migratory waterfowl or other aquatic birds ☐ Area important to the maintenance of unique biotic communities (e.g., high proportion of endemic species) *Threatened or Endangered Species* ☐ Critical habitat for federally designated threatened or endangered species ☐ Habitat known to be used or potentially used by Federal or State designated threatened or endangered species, or species in the State Wildlife Action Plan	
4.5	Indicate if the site is within or adjacent to any of the following valued aquatic habitats:	
	☐ Federal or State Fish Hatchery ☐ Federal or State designated Scenic or Wild River ☐ National River Reach designated as recreational ☐ Critical areas identified under the Clean Lakes Program ☐ Trout-stocked streams or wild trout streams with verified trout production ☐ Spawning or nursery areas critical to the maintenance of fish/shellfish species ☐ Feeding, breeding, nesting, cover, or wintering habitat for migratory waterfowl or other aquatic birds ☐ Area important to the maintenance of unique biotic communities (e.g., high proportion of endemic species) *Threatened or Endangered Species* ☐ Critical habitat for federally designated threatened or endangered species ☐ Habitat known to be used or potentially used by Federal or State designated threatened or endangered species, or species in the State Wildlife Action Plan	
4.6	Have valued terrestrial, wetland, or aquatic habitats been identified within or adjacent to this site? *(A list of agencies that can provide information that should assist in determining whether the site is located within or adjacent to the areas listed in 4.3, 4.4, and 4.5 is provided at the end of this checklist.)*	☐ Yes ☐ No

ATTACHMENT 2

STEP 5: Identify Any Potential Ecological Receptors of Concern		
5.1	Threatened and Endangered Species Were any habitats within or adjacent to the site identified as critical habitat for, or areas known to be used by, federally threatened or endangered species listed in 50CFS17.95 or 17.96?	☐ Yes ☐ No

If "Yes", indicate which species*:

Amphibians
- ☐ Cheat Mountain salamander (*Plethodon nettingi*)

Clams & Mussels
- ☐ Clubshell (*Pleurobema clava*)
- ☐ Fanshell (*Cyprogenia stegaria*)
- ☐ James spinymussel (*Pleurobema collina*)
- ☐ Longsolid (*Fusconaia subrotunda*)
- ☐ Northern riffleshell (*Epioblasma torulosa rangiana*)
- ☐ Pink mucket pearlymussel (*Lampsilis abrupta*)
- ☐ Purple cat's paw pearlymussel (*Epioblasma obliquata obliquata*)
- ☐ Rayed bean (*Villosa fabalis*)
- ☐ Round hickorynut (*Obovaria subrotunda*)
- ☐ Sheepnose (*Plethobasus cyphyus*)
- ☐ Snuffbox (*Epioblasma triquetra*)
- ☐ Spectablecase (*Cumberlandia monodonta*)
- ☐ Tubercled blossom pearlymussel (*Epioblasma torulosa torulosa*)

Fish
- ☐ Candy darter (*Etheostoma osburni*)
- ☐ Diamond darter (*Crystallaria cincotta*)

Flowering Plants
- ☐ Harperella (*Ptilimnium nodosum*)
- ☐ Northeastern bulrush (*Scirpus ancistrochaetus*)
- ☐ Running buffalo cover (*Trifolium stoloniferum*)
- ☐ Shale barren rock cress (*Arabis perstellata*)
- ☐ Small whorled pogonia (*Isotria medeoloides*)
- ☐ Virginia spiraea (*Spiraea virginiana*)

Mammals
- ☐ Gray bat (*Myotis grisescens*)
- ☐ Indiana bat (*Myotis sodalis*)
- ☐ Northern long-eared bat (*Myotis septentrionalis*)
- ☐ Tricolored bat (*Perimyotis subflavus*) – Proposed Species as of 2022
- ☐ Virginia big-eared bat (*Corynorhinus towsendii virginianus*)
- ☐ Virginia northern flying squirrel (*Glaucomys sabrinus fuscus*)

Snails & Invertebrates
- ☐ Big Sandy crayfish (*Cambarus callainus*)
- ☐ Flat-spired three-toothed land snail (*Triodopsis platysayoides*)
- ☐ Guyandotte River crayfish (*Cambarus veteranus*)
- ☐ Madison cave isopod (*Antrolana lira*)
- ☐ Monarch butterfly (*Danaus plexippus*) – Candidate Species as of 2020
- ☐ Rusty-patched bumble bee (*Bombus affinis*)

5.2	Local Populations Providing Important Natural or Economic Resources, Functions, and Values Were any valued terrestrial, wetland, or aquatic habitats listed in 4.3, 4.4, or 4.5 identified within or adjacent to the site?	☐ Yes ☐ No
If "Yes" to 5.1 and/or 5.2 and/or surface water bodies are not in compliance with applicable water quality standards: The site does not pass the De Minimis ecological risk screening, since a complete exposure pathway may exist for potential ecological receptors of concern. Further evaluation of the site is required using either the Uniform Ecological Standard or the Site-Specific Ecological Standard. *If "No" to 5.1 and 5.2 and surface water bodies are in compliance with applicable water quality standards: No further ecological evaluation is required. File this completed form with the Site Assessment Report.*		

*The list contains those federally designated threatened and endangered species that are indigenous to WV. WVDNR, Wildlife Resources Section should be consulted to ensure the list is correct. WV has not established a list of state designated threatened or endangered species; however, the WVDNR has developed a "Species of Greatest Conservation Need" list in the State Wildlife Action Plan. Species listed in the State Wildlife Action Plan should also be considered in any Ecological Risk Assessment.

ATTACHMENT 2

Federal and State Agencies for Ecological Review Consultation

U.S. Department of Agricultural – Natural Resources and Conservation Service
1550 Earl L. Core Road, Suite 200
Morgantown, WV 26505
304-284-7540
https://www.nrcs.usda.gov/wps/portal/nrcs/site/wv/home

U.S. Fish and Wildlife Service – WV Field Office
Ecological Services
6263 Appalachian Highway
Davis, WV 26260
304-866-3858
https://www.fws.gov/office/west-virginia-ecological-services

WV Division of Forestry
7 Players Club Drive
Charleston, WV 25311
304-558-2788
https://wvforestry.com/

WV Division of Natural Resources
Building 74
324 Fourth Avenue
South Charleston, WV 25303
304-558-2754
http://www.wvdnr.gov/

WV Division of Natural Resources – Wildlife Resources Section
Building 74
324 Fourth Avenue
South Charleston, WV 25303
304-558-2771
http://www.wvdnr.gov/

Appendix C – Derivation of Source Concentrations

Sample Name	Sample Depth	Aroclor-1254	d_Aroclor-1254	Antimony	d_Antimony	Arsenic	d_Arsenic	Iron	d_Iron	Lead	d_Lead
		µg/kg		mg/kg		mg/kg		mg/kg		mg/kg	
SS-01*	0-0.5	75	0	2.8	1	7.6	1	32000	1	350	1
SS-02	0-0.5	73	0	2.8	1	13	1	23000	1	240	1
SS-03	0-0.5	72	0	4.5	0	5.8	1	27000	1	170	1
SS-04	0-0.5	86	0	49	1	400	1	120000	1	3500	1
SS-05	0-0.5	81	0	24	1	52	1	61000	1	1400	1
SS-06	0-0.5	76	0	10	1	33	1	33000	1	610	1
SS-07*	0-0.5	350	1	1.8	1	6.1	1	19000	1	110	1
SS-08	0-0.5	71	0	3.3	1	20	1	29000	1	740	1
SS-09	0-0.5	77	0	1.4	1	10	1	13000	1	130	1
SS-10	0-0.5	NA		NA		NA		NA		NA	
SS-11	0-0.5	73	0	3.7	0	4.4	1	8000	1	9.3	1
SS-12	0-0.5	180	1	2.7	1	7.6	1	19000	1	180	1
SS-15*	0-2	230	0	NA		16	1	NA		370	1

Notes

For surface soil samples SS-01, SS-07, and SS-15, the concentration utilized in the dataset was the greater of the parent and associated field duplicate sample results.

NA - not analyzed

Sample Name	Sample Depth	Benzo(a)anthracene	d_Benzo(a)anthracene	Benzo(a)pyrene	d_Benzo(a)pyrene	Benzo(b)fluoranthene	d_Benzo(b)fluoranthene
		µg/kg		µg/kg		µg/kg	
SS-01*	0-0.5	730	1	890	1	1400	1
SS-02	0-0.5	130	1	130	1	240	1
SS-03	0-0.5	640	1	800	1	1400	1
SS-04	0-0.5	42000	1	36000	1	47000	1
SS-05	0-0.5	2000	1	2300	1	3800	1
SS-06	0-0.5	3700	1	4000	1	5600	1
SS-07*	0-0.5	760	1	870	1	1500	1
SS-08	0-0.5	3400	1	3700	1	4900	1
SS-09	0-0.5	2100	1	2400	1	3200	1
SS-10	0-0.5	NA		NA		NA	
SS-11	0-0.5	19	1	23	1	51	1
SS-12	0-0.5	1100	1	1200	1	2200	1
SS-15*	0-2	3100	1	2100	1	3400	1

Notes

For surface soil samples SS-01, SS-07, and SS-15, the concentration utilized in the dataset was the greater of the parent and associated field duplicate sample results.

NA - not analyzed

Sample Name	Sample Depth	Benzo(k)fluoranthene	d_Benzo(k)fluoranthene	Dibenzo(a,h)anthracene	d_Dibenzo(a,h)anthracene	Indeno(1,2,3-cd)pyrene	d_Indeno(1,2,3-cd)pyrene
		µg/kg		µg/kg		µg/kg	
SS-01*	0-0.5	490	1	140	1	720	1
SS-02	0-0.5	66	1	29	1	120	1
SS-03	0-0.5	500	1	150	1	760	1
SS-04	0-0.5	16000	1	4100	1	17000	1
SS-05	0-0.5	920	1	370	1	1500	1
SS-06	0-0.5	2100	1	610	1	2500	1
SS-07*	0-0.5	530	1	110	1	650	1
SS-08	0-0.5	1400	1	520	1	2100	1
SS-09	0-0.5	1100	1	320	1	1500	1
SS-10	0-0.5	NA		NA		NA	
SS-11	0-0.5	16	1	4.7	1	24	1
SS-12	0-0.5	790	1	210	1	920	1
SS-15*	0-2	830	1	210	1	1100	1

Notes
For surface soil samples SS-01, SS-07, and SS-15, the concentration utilized in the dataset was the greater of the parent and associated field duplicate sample results.

NA - not analyzed

Sample Name	Sample Depth	Aroclor-1254	d_Aroclor-1254	Antimony	d_Antimony	Arsenic	d_Arsenic	Iron	d_Iron	Lead	d_Lead
		µg/kg		mg/kg		mg/kg		mg/kg		mg/kg	
SS-01*	0-0.5	75	0	2.8	1	7.6	1	32000	1	350	1
SS-02	0-0.5	73	0	2.8	1	13	1	23000	1	240	1
SS-03	0-0.5	72	0	4.5	0	5.8	1	27000	1	170	1
SS-05	0-0.5	81	0	24	1	52	1	61000	1	1400	1
SS-06	0-0.5	76	0	10	1	33	1	33000	1	610	1
SS-07*	0-0.5	350	1	1.8	1	6.1	1	19000	1	110	1
SS-08	0-0.5	71	0	3.3	1	20	1	29000	1	740	1
SS-09	0-0.5	77	0	1.4	1	10	1	13000	1	130	1
SS-10	0-0.5	NA		NA		NA		NA		NA	
SS-11	0-0.5	73	0	3.7	0	4.4	1	8000	1	9.3	1
SS-12	0-0.5	180	1	2.7	1	7.6	1	19000	1	180	1
SS-15*	0-2	230	0	NA		16	1	NA		370	1

Notes

For surface soil samples SS-01, SS-07, and SS-15, the concentration utilized in the dataset was the greater of the parent and associated field duplicate sample results.

NA - not analyzed

Sample Name	Sample Depth	Benzo(a)anthracene	d_Benzo(a)anthracene	Benzo(a)pyrene	d_Benzo(a)pyrene	Benzo(b)fluoranthene	d_Benzo(b)fluoranthene
		µg/kg		µg/kg		µg/kg	
SS-01*	0-0.5	730	1	890	1	1400	1
SS-02	0-0.5	130	1	130	1	240	1
SS-03	0-0.5	640	1	800	1	1400	1
SS-05	0-0.5	2000	1	2300	1	3800	1
SS-06	0-0.5	3700	1	4000	1	5600	1
SS-07*	0-0.5	760	1	870	1	1500	1
SS-08	0-0.5	3400	1	3700	1	4900	1
SS-09	0-0.5	2100	1	2400	1	3200	1
SS-10	0-0.5	NA		NA		NA	
SS-11	0-0.5	19	1	23	1	51	1
SS-12	0-0.5	1100	1	1200	1	2200	1
SS-15*	0-2	3100	1	2100	1	3400	1

Notes

For surface soil samples SS-01, SS-07, and SS-15, the concentration utilized in the dataset was the greater of the parent and associated field duplicate sample results.

NA - not analyzed

Sample Name	Sample Depth	Benzo(k)fluoranthene	d_Benzo(k)fluoranthene	Dibenzo(a,h)anthracene	d_Dibenzo(a,h)anthracene	Indeno(1,2,3-cd)pyrene	d_Indeno(1,2,3-cd)pyrene
		µg/kg		µg/kg		µg/kg	
SS-01*	0-0.5	490	1	140	1	720	1
SS-02	0-0.5	66	1	29	1	120	1
SS-03	0-0.5	500	1	150	1	760	1
SS-05	0-0.5	920	1	370	1	1500	1
SS-06	0-0.5	2100	1	610	1	2500	1
SS-07*	0-0.5	530	1	110	1	650	1
SS-08	0-0.5	1400	1	520	1	2100	1
SS-09	0-0.5	1100	1	320	1	1500	1
SS-10	0-0.5	NA		NA		NA	
SS-11	0-0.5	16	1	4.7	1	24	1
SS-12	0-0.5	790	1	210	1	920	1
SS-15*	0-2	830	1	210	1	1100	1

Notes

For surface soil samples SS-01, SS-07, and SS-15, the concentration utilized in the dataset was the greater of the parent and associated field duplicate sample results.

NA - not analyzed

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.14/1/2024 11:04:19 AM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Aroclor-1254

General Statistics

Total Number of Observations	12	Number of Distinct Observations	11
		Number of Missing Observations	2
Number of Detects	2	Number of Non-Detects	10
Number of Distinct Detects	2	Number of Distinct Non-Detects	9
Minimum Detect	180	Minimum Non-Detect	71
Maximum Detect	350	Maximum Non-Detect	230
Variance Detects	14450	Percent Non-Detects	83.33%
Mean Detects	265	SD Detects	120.2
Median Detects	265	CV Detects	0.454
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	5.525	SD of Logged Detects	0.47

Warning: Data set has only 2 Detected Values.

This is not enough to compute meaningful or reliable statistics and estimates.

Normal GOF Test on Detects Only

Not Enough Data to Perform GOF Test

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	104.2	KM Standard Error of Mean	33.09
KM SD	80.44	95% KM (BCA) UCL	N/A
95% KM (t) UCL	163.7	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	158.7	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	203.5	95% KM Chebyshev UCL	248.5
97.5% KM Chebyshev UCL	310.9	99% KM Chebyshev UCL	433.5

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	9.374	k star (bias corrected MLE)	N/A
Theta hat (MLE)	28.27	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	37.5	nu star (bias corrected)	N/A
Mean (detects)	265		

Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	104.2	SD (KM)	80.44
Variance (KM)	6471	SE of Mean (KM)	33.09
k hat (KM)	1.679	k star (KM)	1.315
nu hat (KM)	40.3	nu star (KM)	31.56
theta hat (KM)	62.08	theta star (KM)	79.27
80% gamma percentile (KM)	163.6	90% gamma percentile (KM)	224.3
95% gamma percentile (KM)	283.9	99% gamma percentile (KM)	419.6
Gamma Kaplan-Meier (KM) Statistics			
		Adjusted Level of Significance (β)	0.029
Approximate Chi Square Value (31.56, α)	19.72	Adjusted Chi Square Value (31.56, β)	18.31
95% Gamma Approximate KM-UCL (use when n>=50)	166.8	95% Gamma Adjusted KM-UCL (use when n<50)	179.7
Lognormal GOF Test on Detected Observations Only			
Not Enough Data to Perform GOF Test			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	78.71	Mean in Log Scale	4.011
SD in Original Scale	94.53	SD in Log Scale	0.742
95% t UCL (assumes normality of ROS data)	127.7	95% Percentile Bootstrap UCL	128.3
95% BCA Bootstrap UCL	154.5	95% Bootstrap t UCL	531.3
95% H-UCL (Log ROS)	126.6		
Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
KM Mean (logged)	4.481	KM Geo Mean	88.31
KM SD (logged)	0.494	95% Critical H Value (KM-Log)	2.133
KM Standard Error of Mean (logged)	0.205	95% H-UCL (KM -Log)	137.1
KM SD (logged)	0.494	95% Critical H Value (KM-Log)	2.133
KM Standard Error of Mean (logged)	0.205		
DL/2 Statistics			
DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	82.25	Mean in Log Scale	4.043
SD in Original Scale	95.34	SD in Log Scale	0.776
95% t UCL (Assumes normality)	131.7	95% H-Stat UCL	139.4
DL/2 is not a recommended method, provided for comparisons and historical reasons			
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution at 5% Significance Level			
Suggested UCL to Use			
95% KM (t) UCL	163.7	KM H-UCL	137.1
95% KM (BCA) UCL	N/A		
Warning: One or more Recommended UCL(s) not available!			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			

Arsenic

General Statistics			
Total Number of Observations	12	Number of Distinct Observations	11
		Number of Missing Observations	2
Minimum	4.4	Mean	47.96
Maximum	400	Median	11.5
SD	111.7	Std. Error of Mean	32.25
Coefficient of Variation	2.33	Skewness	3.372
Normal GOF Test			
Shapiro Wilk Test Statistic	0.423	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.859	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.402	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.243	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	105.9	95% Adjusted-CLT UCL (Chen-1995)	134.6
		95% Modified-t UCL (Johnson-1978)	111.1
Gamma GOF Test			
A-D Test Statistic	1.622	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.78	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.293	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.258	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.564	k star (bias corrected MLE)	0.479
Theta hat (MLE)	85.01	Theta star (bias corrected MLE)	100.2
nu hat (MLE)	13.54	nu star (bias corrected)	11.49
MLE Mean (bias corrected)	47.96	MLE Sd (bias corrected)	69.32
		Approximate Chi Square Value (0.05)	4.891
Adjusted Level of Significance	0.029	Adjusted Chi Square Value	4.253
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	112.6	95% Adjusted Gamma UCL (use when n<50)	129.5
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.844	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.859	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.177	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.243	Data appear Lognormal at 5% Significance Level	
Data appear Approximate Lognormal at 5% Significance Level			

Lognormal Statistics			
Minimum of Logged Data	1.482	Mean of logged Data	2.765
Maximum of Logged Data	5.991	SD of logged Data	1.255
Assuming Lognormal Distribution			
95% H-UCL	126.2	90% Chebyshev (MVUE) UCL	68.78
95% Chebyshev (MVUE) UCL	85.65	97.5% Chebyshev (MVUE) UCL	109.1
99% Chebyshev (MVUE) UCL	155.1		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	101	95% Jackknife UCL	105.9
95% Standard Bootstrap UCL	99.26	95% Bootstrap-t UCL	545.2
95% Hall's Bootstrap UCL	349.5	95% Percentile Bootstrap UCL	111.3
95% BCA Bootstrap UCL	143.5		
90% Chebyshev(Mean, Sd) UCL	144.7	95% Chebyshev(Mean, Sd) UCL	188.6
97.5% Chebyshev(Mean, Sd) UCL	249.4	99% Chebyshev(Mean, Sd) UCL	368.9
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	188.6		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			

Iron

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	10
		Number of Missing Observations	2
Minimum	8000	Mean	34909
Maximum	120000	Median	27000
SD	31437	Std. Error of Mean	9479
Coefficient of Variation	0.901	Skewness	2.334
Normal GOF Test			
Shapiro Wilk Test Statistic	0.715	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.85	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.342	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.251	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	52089	95% Adjusted-CLT UCL (Chen-1995)	57628
		95% Modified-t UCL (Johnson-1978)	53201
Gamma GOF Test			
A-D Test Statistic	0.529	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.739	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.256	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.258	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.056	k star (bias corrected MLE)	1.556
Theta hat (MLE)	16981	Theta star (bias corrected MLE)	22440
nu hat (MLE)	45.23	nu star (bias corrected)	34.22
MLE Mean (bias corrected)	34909	MLE Sd (bias corrected)	27988
		Approximate Chi Square Value (0.05)	21.84
Adjusted Level of Significance	0.0278	Adjusted Chi Square Value	20.24
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50)	54695	95% Adjusted Gamma UCL (use when n<50)	59016
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.96	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.85	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.206	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.251	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			

Lognormal Statistics			
Minimum of Logged Data	8.987	Mean of logged Data	10.2
Maximum of Logged Data	11.7	SD of logged Data	0.725

Assuming Lognormal Distribution			
95% H-UCL	61977	90% Chebyshev (MVUE) UCL	57031
95% Chebyshev (MVUE) UCL	67495	97.5% Chebyshev (MVUE) UCL	82018
99% Chebyshev (MVUE) UCL	110546		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs			
95% CLT UCL	50500	95% Jackknife UCL	52089
95% Standard Bootstrap UCL	49883	95% Bootstrap-t UCL	85510
95% Hall's Bootstrap UCL	134895	95% Percentile Bootstrap UCL	51000
95% BCA Bootstrap UCL	58636		
90% Chebyshev(Mean, Sd) UCL	63345	95% Chebyshev(Mean, Sd) UCL	76226
97.5% Chebyshev(Mean, Sd) UCL	94103	99% Chebyshev(Mean, Sd) UCL	129220

Suggested UCL to Use			
95% Adjusted Gamma UCL	59016		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Lead

General Statistics			
Total Number of Observations	12	Number of Distinct Observations	12
		Number of Missing Observations	2
Minimum	9.3	Mean	650.8
Maximum	3500	Median	295
SD	974.9	Std. Error of Mean	281.4
Coefficient of Variation	1.498	Skewness	2.667
Normal GOF Test			
Shapiro Wilk Test Statistic	0.634	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.859	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.297	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.243	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	1156	95% Adjusted-CLT UCL (Chen-1995)	1345
		95% Modified-t UCL (Johnson-1978)	1192
Gamma GOF Test			
A-D Test Statistic	0.414	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.767	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.179	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.255	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.726	k star (bias corrected MLE)	0.6
Theta hat (MLE)	896	Theta star (bias corrected MLE)	1084
nu hat (MLE)	17.43	nu star (bias corrected)	14.41
MLE Mean (bias corrected)	650.8	MLE Sd (bias corrected)	840
		Approximate Chi Square Value (0.05)	6.851
Adjusted Level of Significance	0.029	Adjusted Chi Square Value	6.072
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50)	1369	95% Adjusted Gamma UCL (use when n<50)	1544
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.946	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.859	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.177	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.243	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			

Lognormal Statistics			
Minimum of Logged Data	2.23	Mean of logged Data	5.65
Maximum of Logged Data	8.161	SD of logged Data	1.482
Assuming Lognormal Distribution			
95% H-UCL	4786	90% Chebyshev (MVUE) UCL	1752
95% Chebyshev (MVUE) UCL	2216	97.5% Chebyshev (MVUE) UCL	2859
99% Chebyshev (MVUE) UCL	4123		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	1114	95% Jackknife UCL	1156
95% Standard Bootstrap UCL	1086	95% Bootstrap-t UCL	2364
95% Hall's Bootstrap UCL	3035	95% Percentile Bootstrap UCL	1172
95% BCA Bootstrap UCL	1432		
90% Chebyshev(Mean, Sd) UCL	1495	95% Chebyshev(Mean, Sd) UCL	1878
97.5% Chebyshev(Mean, Sd) UCL	2408	99% Chebyshev(Mean, Sd) UCL	3451
Suggested UCL to Use			
95% Adjusted Gamma UCL	1544		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			

Benzo(a)anthracene

General Statistics			
Total Number of Observations	12	Number of Distinct Observations	12
		Number of Missing Observations	2
Minimum	19	Mean	4973
Maximum	42000	Median	1550
SD	11729	Std. Error of Mean	3386
Coefficient of Variation	2.358	Skewness	3.392
Normal GOF Test			
Shapiro Wilk Test Statistic	0.425	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.859	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.46	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.243	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	11054	95% Adjusted-CLT UCL (Chen-1995)	14085
		95% Modified-t UCL (Johnson-1978)	11606
Gamma GOF Test			
A-D Test Statistic	0.871	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.795	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.291	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.26	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.447	k star (bias corrected MLE)	0.391
Theta hat (MLE)	11127	Theta star (bias corrected MLE)	12727
nu hat (MLE)	10.73	nu star (bias corrected)	9.379
MLE Mean (bias corrected)	4973	MLE Sd (bias corrected)	7956
		Approximate Chi Square Value (0.05)	3.557
Adjusted Level of Significance	0.029	Adjusted Chi Square Value	3.031
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	13112	95% Adjusted Gamma UCL (use when n<50)	15389
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.932	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.859	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.208	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.243	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			

Lognormal Statistics			
Minimum of Logged Data	2.944	Mean of logged Data	7.065
Maximum of Logged Data	10.65	SD of logged Data	1.894

Assuming Lognormal Distribution			
95% H-UCL	104755	90% Chebyshev (MVUE) UCL	14332
95% Chebyshev (MVUE) UCL	18494	97.5% Chebyshev (MVUE) UCL	24270
99% Chebyshev (MVUE) UCL	35615		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs			
95% CLT UCL	10542	95% Jackknife UCL	11054
95% Standard Bootstrap UCL	10361	95% Bootstrap-t UCL	44984
95% Hall's Bootstrap UCL	35920	95% Percentile Bootstrap UCL	11624
95% BCA Bootstrap UCL	14900		
90% Chebyshev(Mean, Sd) UCL	15131	95% Chebyshev(Mean, Sd) UCL	19732
97.5% Chebyshev(Mean, Sd) UCL	26118	99% Chebyshev(Mean, Sd) UCL	38662

Suggested UCL to Use			
99% Chebyshev (Mean, Sd) UCL	38662		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Benzo(a)pyrene

General Statistics

Total Number of Observations	12	Number of Distinct Observations	12
		Number of Missing Observations	2
Minimum	23	Mean	4534
Maximum	36000	Median	1650
SD	9991	Std. Error of Mean	2884
Coefficient of Variation	2.203	Skewness	3.364

Normal GOF Test

Shapiro Wilk Test Statistic	0.443	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.859	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.438	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.243	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	9714	95% Adjusted-CLT UCL (Chen-1995)	12271
		95% Modified-t UCL (Johnson-1978)	10181

Gamma GOF Test

A-D Test Statistic	0.82	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.786	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.263	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.259	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.492	k star (bias corrected MLE)	0.425
Theta hat (MLE)	9211	Theta star (bias corrected MLE)	10675
nu hat (MLE)	11.81	nu star (bias corrected)	10.19
MLE Mean (bias corrected)	4534	MLE Sd (bias corrected)	6957
		Approximate Chi Square Value (0.05)	4.064
Adjusted Level of Significance	0.029	Adjusted Chi Square Value	3.493

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	11376	95% Adjusted Gamma UCL (use when n<50)	13234

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.921	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.859	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.237	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.243	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics			
Minimum of Logged Data	3.135	Mean of logged Data	7.126
Maximum of Logged Data	10.49	SD of logged Data	1.82
Assuming Lognormal Distribution			
95% H-UCL	79977	90% Chebyshev (MVUE) UCL	13402
95% Chebyshev (MVUE) UCL	17241	97.5% Chebyshev (MVUE) UCL	22570
99% Chebyshev (MVUE) UCL	33038		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	9279	95% Jackknife UCL	9714
95% Standard Bootstrap UCL	9114	95% Bootstrap-t UCL	35249
95% Hall's Bootstrap UCL	29555	95% Percentile Bootstrap UCL	10196
95% BCA Bootstrap UCL	13027		
90% Chebyshev(Mean, Sd) UCL	13187	95% Chebyshev(Mean, Sd) UCL	17106
97.5% Chebyshev(Mean, Sd) UCL	22546	99% Chebyshev(Mean, Sd) UCL	33232
Suggested UCL to Use			
99% Chebyshev (Mean, Sd) UCL	33232		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			

Benzo(b)fluoranthene

General Statistics			
Total Number of Observations	12	Number of Distinct Observations	11
		Number of Missing Observations	2
Minimum	51	Mean	6224
Maximum	47000	Median	2700
SD	12957	Std. Error of Mean	3740
Coefficient of Variation	2.082	Skewness	3.354
Normal GOF Test			
Shapiro Wilk Test Statistic	0.452	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.859	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.436	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.243	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	12942	95% Adjusted-CLT UCL (Chen-1995)	16247
		95% Modified-t UCL (Johnson-1978)	13545
Gamma GOF Test			
A-D Test Statistic	0.849	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.781	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.269	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.258	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.552	k star (bias corrected MLE)	0.47
Theta hat (MLE)	11271	Theta star (bias corrected MLE)	13250
nu hat (MLE)	13.25	nu star (bias corrected)	11.27
MLE Mean (bias corrected)	6224	MLE Sd (bias corrected)	9082
		Approximate Chi Square Value (0.05)	4.753
Adjusted Level of Significance	0.029	Adjusted Chi Square Value	4.126
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	14765	95% Adjusted Gamma UCL (use when n<50)	17009
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.913	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.859	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.249	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.243	Data Not Lognormal at 5% Significance Level	
Data appear Approximate Lognormal at 5% Significance Level			

Lognormal Statistics			
Minimum of Logged Data	3.932	Mean of logged Data	7.603
Maximum of Logged Data	10.76	SD of logged Data	1.68

Assuming Lognormal Distribution			
95% H-UCL	71620	90% Chebyshev (MVUE) UCL	17059
95% Chebyshev (MVUE) UCL	21807	97.5% Chebyshev (MVUE) UCL	28398
99% Chebyshev (MVUE) UCL	41343		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs			
95% CLT UCL	12377	95% Jackknife UCL	12942
95% Standard Bootstrap UCL	12143	95% Bootstrap-t UCL	42461
95% Hall's Bootstrap UCL	39881	95% Percentile Bootstrap UCL	13488
95% BCA Bootstrap UCL	17188		
90% Chebyshev(Mean, Sd) UCL	17446	95% Chebyshev(Mean, Sd) UCL	22528
97.5% Chebyshev(Mean, Sd) UCL	29583	99% Chebyshev(Mean, Sd) UCL	43441

Suggested UCL to Use			
99% Chebyshev (Mean, Sd) UCL	43441		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Benzo(k)fluoranthene

General Statistics			
Total Number of Observations	12	Number of Distinct Observations	12
		Number of Missing Observations	2
Minimum	16	Mean	2062
Maximum	16000	Median	810
SD	4426	Std. Error of Mean	1278
Coefficient of Variation	2.147	Skewness	3.363
Normal GOF Test			
Shapiro Wilk Test Statistic	0.443	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.859	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.413	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.243	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	4356	95% Adjusted-CLT UCL (Chen-1995)	5489
		95% Modified-t UCL (Johnson-1978)	4563
Gamma GOF Test			
A-D Test Statistic	0.965	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.782	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.252	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.258	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data follow Appr. Gamma Distribution at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.534	k star (bias corrected MLE)	0.456
Theta hat (MLE)	3863	Theta star (bias corrected MLE)	4523
nu hat (MLE)	12.81	nu star (bias corrected)	10.94
MLE Mean (bias corrected)	2062	MLE Sd (bias corrected)	3054
		Approximate Chi Square Value (0.05)	4.538
Adjusted Level of Significance	0.029	Adjusted Chi Square Value	3.928
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50)	4971	95% Adjusted Gamma UCL (use when n<50)	5743
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.901	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.859	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.273	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.243	Data Not Lognormal at 5% Significance Level	
Data appear Approximate Lognormal at 5% Significance Level			

Lognormal Statistics			
Minimum of Logged Data	2.773	Mean of logged Data	6.453
Maximum of Logged Data	9.68	SD of logged Data	1.702
Assuming Lognormal Distribution			
95% H-UCL	24777	90% Chebyshev (MVUE) UCL	5601
95% Chebyshev (MVUE) UCL	7168	97.5% Chebyshev (MVUE) UCL	9342
99% Chebyshev (MVUE) UCL	13613		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	4164	95% Jackknife UCL	4356
95% Standard Bootstrap UCL	4104	95% Bootstrap-t UCL	17475
95% Hall's Bootstrap UCL	14708	95% Percentile Bootstrap UCL	4529
95% BCA Bootstrap UCL	5873		
90% Chebyshev(Mean, Sd) UCL	5895	95% Chebyshev(Mean, Sd) UCL	7631
97.5% Chebyshev(Mean, Sd) UCL	10041	99% Chebyshev(Mean, Sd) UCL	14775
Suggested UCL to Use			
95% Adjusted Gamma UCL	5743		
When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test			
When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			

Dibenzo(a,h)anthracene

General Statistics

Total Number of Observations	12	Number of Distinct Observations	11
		Number of Missing Observations	2
Minimum	4.7	Mean	564.5
Maximum	4100	Median	210
SD	1129	Std. Error of Mean	325.8
Coefficient of Variation	1.999	Skewness	3.302

Normal GOF Test

Shapiro Wilk Test Statistic	0.476	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.859	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.401	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.243	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	1150	95% Adjusted-CLT UCL (Chen-1995)	1432
		95% Modified-t UCL (Johnson-1978)	1201

Gamma GOF Test

A-D Test Statistic	0.705	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.78	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.224	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.258	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.57	k star (bias corrected MLE)	0.483
Theta hat (MLE)	989.9	Theta star (bias corrected MLE)	1168
nu hat (MLE)	13.69	nu star (bias corrected)	11.6
MLE Mean (bias corrected)	564.5	MLE Sd (bias corrected)	812
		Approximate Chi Square Value (0.05)	4.963
Adjusted Level of Significance	0.029	Adjusted Chi Square Value	4.32

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	1319	95% Adjusted Gamma UCL (use when n<50)	1516

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.933	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.859	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.205	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.243	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics			
Minimum of Logged Data	1.548	Mean of logged Data	5.244
Maximum of Logged Data	8.319	SD of logged Data	1.657
Assuming Lognormal Distribution			
95% H-UCL	6177	90% Chebyshev (MVUE) UCL	1552
95% Chebyshev (MVUE) UCL	1982	97.5% Chebyshev (MVUE) UCL	2578
99% Chebyshev (MVUE) UCL	3750		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	1100	95% Jackknife UCL	1150
95% Standard Bootstrap UCL	1088	95% Bootstrap-t UCL	3356
95% Hall's Bootstrap UCL	3226	95% Percentile Bootstrap UCL	1200
95% BCA Bootstrap UCL	1557		
90% Chebyshev(Mean, Sd) UCL	1542	95% Chebyshev(Mean, Sd) UCL	1985
97.5% Chebyshev(Mean, Sd) UCL	2599	99% Chebyshev(Mean, Sd) UCL	3806
Suggested UCL to Use			
95% Adjusted Gamma UCL	1516		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			

Indeno(1,2,3-cd)pyrene

General Statistics			
Total Number of Observations	12	Number of Distinct Observations	11
		Number of Missing Observations	2
Minimum	24	Mean	2408
Maximum	17000	Median	1010
SD	4653	Std. Error of Mean	1343
Coefficient of Variation	1.933	Skewness	3.313
Normal GOF Test			
Shapiro Wilk Test Statistic	0.474	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.859	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.409	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.243	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	4820	95% Adjusted-CLT UCL (Chen-1995)	5990
		95% Modified-t UCL (Johnson-1978)	5034
Gamma GOF Test			
A-D Test Statistic	0.812	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.776	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.24	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.257	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data follow Appr. Gamma Distribution at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.61	k star (bias corrected MLE)	0.513
Theta hat (MLE)	3944	Theta star (bias corrected MLE)	4690
nu hat (MLE)	14.65	nu star (bias corrected)	12.32
MLE Mean (bias corrected)	2408	MLE Sd (bias corrected)	3360
		Approximate Chi Square Value (0.05)	5.44
Adjusted Level of Significance	0.029	Adjusted Chi Square Value	4.76
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50)	5454	95% Adjusted Gamma UCL (use when n<50)	6233
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.905	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.859	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.259	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.243	Data Not Lognormal at 5% Significance Level	
Data appear Approximate Lognormal at 5% Significance Level			

Lognormal Statistics			
Minimum of Logged Data	3.178	Mean of logged Data	6.777
Maximum of Logged Data	9.741	SD of logged Data	1.605
Assuming Lognormal Distribution			
95% H-UCL	23287	90% Chebyshev (MVUE) UCL	6592
95% Chebyshev (MVUE) UCL	8395	97.5% Chebyshev (MVUE) UCL	10897
99% Chebyshev (MVUE) UCL	15811		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	4617	95% Jackknife UCL	4820
95% Standard Bootstrap UCL	4483	95% Bootstrap-t UCL	14161
95% Hall's Bootstrap UCL	14076	95% Percentile Bootstrap UCL	4885
95% BCA Bootstrap UCL	6508		
90% Chebyshev(Mean, Sd) UCL	6438	95% Chebyshev(Mean, Sd) UCL	8263
97.5% Chebyshev(Mean, Sd) UCL	10797	99% Chebyshev(Mean, Sd) UCL	15773
Suggested UCL to Use			
95% Adjusted Gamma UCL	6233		
When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test			
When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.13/28/2024 11:28:19 AM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Antimony

General Statistics

Total Number of Observations	11	Number of Distinct Observations	10
Number of Detects	9	Number of Non-Detects	2
Number of Distinct Detects	8	Number of Distinct Non-Detects	2
Minimum Detect	1.4	Minimum Non-Detect	3.7
Maximum Detect	49	Maximum Non-Detect	4.5
Variance Detects	256.7	Percent Non-Detects	18.18%
Mean Detects	10.87	SD Detects	16.02
Median Detects	2.8	CV Detects	1.474
Skewness Detects	2.114	Kurtosis Detects	4.274
Mean of Logged Detects	1.616	SD of Logged Detects	1.227

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.657	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.829	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.348	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.274	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	9.339	KM Standard Error of Mean	4.493
KM SD	14.04	95% KM (BCA) UCL	17.76
95% KM (t) UCL	17.48	95% KM (Percentile Bootstrap) UCL	17.6
95% KM (z) UCL	16.73	95% KM Bootstrap t UCL	47.75
90% KM Chebyshev UCL	22.82	95% KM Chebyshev UCL	28.92
97.5% KM Chebyshev UCL	37.4	99% KM Chebyshev UCL	54.04

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.944	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.751	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.348	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.289	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.774	k star (bias corrected MLE)	0.59
Theta hat (MLE)	14.03	Theta star (bias corrected MLE)	18.41
nu hat (MLE)	13.94	nu star (bias corrected)	10.63
Mean (detects)	10.87		

Gamma ROS Statistics using Imputed Non-Detects			
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)			
For such situations, GROS method may yield incorrect values of UCLs and BTVs			
This is especially true when the sample size is small.			
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
Minimum	1.041	Mean	9.08
Maximum	49	Median	2.8
SD	14.87	CV	1.638
k hat (MLE)	0.691	k star (bias corrected MLE)	0.563
Theta hat (MLE)	13.15	Theta star (bias corrected MLE)	16.13
nu hat (MLE)	15.2	nu star (bias corrected)	12.38
Adjusted Level of Significance (β)	0.0278		
Approximate Chi Square Value (12.38, α)	5.481	Adjusted Chi Square Value (12.38, β)	4.754
95% Gamma Approximate UCL (use when n>=50)	20.52	95% Gamma Adjusted UCL (use when n<50)	23.66
Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	9.339	SD (KM)	14.04
Variance (KM)	197.2	SE of Mean (KM)	4.493
k hat (KM)	0.442	k star (KM)	0.382
nu hat (KM)	9.729	nu star (KM)	8.409
theta hat (KM)	21.12	theta star (KM)	24.43
80% gamma percentile (KM)	14.99	90% gamma percentile (KM)	26.59
95% gamma percentile (KM)	39.42	99% gamma percentile (KM)	71.83
Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (8.41, α)	2.974	Adjusted Chi Square Value (8.41, β)	2.472
95% Gamma Approximate KM-UCL (use when n>=50)	26.41	95% Gamma Adjusted KM-UCL (use when n<50)	31.76
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.855	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.829	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.301	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.274	Detected Data Not Lognormal at 5% Significance Level	
Detected Data appear Approximate Lognormal at 5% Significance Level			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	9.402	Mean in Log Scale	1.51
SD in Original Scale	14.69	SD in Log Scale	1.122
95% t UCL (assumes normality of ROS data)	17.43	95% Percentile Bootstrap UCL	17.1
95% BCA Bootstrap UCL	19.59	95% Bootstrap t UCL	48.6
95% H-UCL (Log ROS)	26.81		
Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
KM Mean (logged)	1.479	KM Geo Mean	4.388
KM SD (logged)	1.093	95% Critical H Value (KM-Log)	3.18
KM Standard Error of Mean (logged)	0.353	95% H-UCL (KM -Log)	23.95
KM SD (logged)	1.093	95% Critical H Value (KM-Log)	3.18
KM Standard Error of Mean (logged)	0.353		

DL/2 Statistics			
DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	9.264	Mean in Log Scale	1.452
SD in Original Scale	14.77	SD in Log Scale	1.157
95% t UCL (Assumes normality)	17.33	95% H-Stat UCL	28
DL/2 is not a recommended method, provided for comparisons and historical reasons			
Nonparametric Distribution Free UCL Statistics			
Detected Data appear Approximate Lognormal Distributed at 5% Significance Level			
Suggested UCL to Use			
95% KM (Chebyshev) UCL	28.92		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.14/1/2024 11:08:59 AM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Aroclor-1254

General Statistics

Total Number of Observations	11	Number of Distinct Observations	10
		Number of Missing Observations	3
Number of Detects	2	Number of Non-Detects	9
Number of Distinct Detects	2	Number of Distinct Non-Detects	8
Minimum Detect	180	Minimum Non-Detect	71
Maximum Detect	350	Maximum Non-Detect	230
Variance Detects	14450	Percent Non-Detects	81.82%
Mean Detects	265	SD Detects	120.2
Median Detects	265	CV Detects	0.454
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	5.525	SD of Logged Detects	0.47

Warning: Data set has only 2 Detected Values.

This is not enough to compute meaningful or reliable statistics and estimates.

Normal GOF Test on Detects Only

Not Enough Data to Perform GOF Test

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	107.4	KM Standard Error of Mean	35.86
KM SD	83.39	95% KM (BCA) UCL	N/A
95% KM (t) UCL	172.4	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	166.4	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	214.9	95% KM Chebyshev UCL	263.7
97.5% KM Chebyshev UCL	331.3	99% KM Chebyshev UCL	464.2

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	9.374	k star (bias corrected MLE)	N/A
Theta hat (MLE)	28.27	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	37.5	nu star (bias corrected)	N/A
Mean (detects)	265		

Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	107.4	SD (KM)	83.39
Variance (KM)	6954	SE of Mean (KM)	35.86
k hat (KM)	1.658	k star (KM)	1.266
nu hat (KM)	36.48	nu star (KM)	27.86
theta hat (KM)	64.76	theta star (KM)	84.78
80% gamma percentile (KM)	169.1	90% gamma percentile (KM)	233.2
95% gamma percentile (KM)	296.2	99% gamma percentile (KM)	440.1
Gamma Kaplan-Meier (KM) Statistics			
		Adjusted Level of Significance (β)	0.0278
Approximate Chi Square Value (27.86, α)	16.82	Adjusted Chi Square Value (27.86, β)	15.44
95% Gamma Approximate KM-UCL (use when n>=50)	177.9	95% Gamma Adjusted KM-UCL (use when n<50)	193.8
Lognormal GOF Test on Detected Observations Only			
Not Enough Data to Perform GOF Test			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	84.81	Mean in Log Scale	4.101
SD in Original Scale	97.17	SD in Log Scale	0.741
95% t UCL (assumes normality of ROS data)	137.9	95% Percentile Bootstrap UCL	137.5
95% BCA Bootstrap UCL	168.4	95% Bootstrap t UCL	586.6
95% H-UCL (Log ROS)	143.9		
Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
KM Mean (logged)	4.502	KM Geo Mean	90.17
KM SD (logged)	0.512	95% Critical H Value (KM-Log)	2.191
KM Standard Error of Mean (logged)	0.222	95% H-UCL (KM -Log)	146.5
KM SD (logged)	0.512	95% Critical H Value (KM-Log)	2.191
KM Standard Error of Mean (logged)	0.222		
DL/2 Statistics			
DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	85.82	Mean in Log Scale	4.069
SD in Original Scale	99.15	SD in Log Scale	0.809
95% t UCL (Assumes normality)	140	95% H-Stat UCL	159.7
DL/2 is not a recommended method, provided for comparisons and historical reasons			
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution at 5% Significance Level			
Suggested UCL to Use			
95% KM (t) UCL	172.4	KM H-UCL	146.5
95% KM (BCA) UCL	N/A		
Warning: One or more Recommended UCL(s) not available!			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			

Arsenic

General Statistics

Total Number of Observations	11	Number of Distinct Observations	10
		Number of Missing Observations	3
Minimum	4.4	Mean	15.95
Maximum	52	Median	10
SD	14.57	Std. Error of Mean	4.394
Coefficient of Variation	0.913	Skewness	1.852

Normal GOF Test

Shapiro Wilk Test Statistic	0.768	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.85	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.226	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.251	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	23.92	95% Adjusted-CLT UCL (Chen-1995)	25.8
		95% Modified-t UCL (Johnson-1978)	24.33

Gamma GOF Test

A-D Test Statistic	0.499	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.74	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.191	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.259	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.826	k star (bias corrected MLE)	1.389
Theta hat (MLE)	8.737	Theta star (bias corrected MLE)	11.49
nu hat (MLE)	40.17	nu star (bias corrected)	30.55
MLE Mean (bias corrected)	15.95	MLE Sd (bias corrected)	13.54
		Approximate Chi Square Value (0.05)	18.93
Adjusted Level of Significance	0.0278	Adjusted Chi Square Value	17.45

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	25.75	95% Adjusted Gamma UCL (use when n<50)	27.94

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.943	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.85	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.172	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.251	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.482	Mean of logged Data	2.472
Maximum of Logged Data	3.951	SD of logged Data	0.772

Assuming Lognormal Distribution			
95% H-UCL	30	90% Chebyshev (MVUE) UCL	26.69
95% Chebyshev (MVUE) UCL	31.78	97.5% Chebyshev (MVUE) UCL	38.85
99% Chebyshev (MVUE) UCL	52.74		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	23.18	95% Jackknife UCL	23.92
95% Standard Bootstrap UCL	22.97	95% Bootstrap-t UCL	34.8
95% Hall's Bootstrap UCL	57.66	95% Percentile Bootstrap UCL	23.6
95% BCA Bootstrap UCL	25.83		
90% Chebyshev(Mean, Sd) UCL	29.14	95% Chebyshev(Mean, Sd) UCL	35.11
97.5% Chebyshev(Mean, Sd) UCL	43.39	99% Chebyshev(Mean, Sd) UCL	59.67
Suggested UCL to Use			
95% Student's-t UCL	23.92		
When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test			
When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			

Iron

General Statistics			
Total Number of Observations	10	Number of Distinct Observations	9
		Number of Missing Observations	3
Minimum	8000	Mean	26400
Maximum	61000	Median	25000
SD	14600	Std. Error of Mean	4617
Coefficient of Variation	0.553	Skewness	1.447
Normal GOF Test			
Shapiro Wilk Test Statistic	0.883	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.226	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	34863	95% Adjusted-CLT UCL (Chen-1995)	36251
		95% Modified-t UCL (Johnson-1978)	35215
Gamma GOF Test			
A-D Test Statistic	0.241	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.73	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.166	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.268	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	3.922	k star (bias corrected MLE)	2.812
Theta hat (MLE)	6731	Theta star (bias corrected MLE)	9388
nu hat (MLE)	78.44	nu star (bias corrected)	56.24
MLE Mean (bias corrected)	26400	MLE Sd (bias corrected)	15743
		Approximate Chi Square Value (0.05)	40.01
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	37.64
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	37114	95% Adjusted Gamma UCL (use when n<50)	39450

Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.969	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.162	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	8.987	Mean of logged Data	10.05
Maximum of Logged Data	11.02	SD of logged Data	0.556
Assuming Lognormal Distribution			
95% H-UCL	41335	90% Chebyshev (MVUE) UCL	40816
95% Chebyshev (MVUE) UCL	47290	97.5% Chebyshev (MVUE) UCL	56277
99% Chebyshev (MVUE) UCL	73929		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	33994	95% Jackknife UCL	34863
95% Standard Bootstrap UCL	33702	95% Bootstrap-t UCL	37973
95% Hall's Bootstrap UCL	71818	95% Percentile Bootstrap UCL	34600
95% BCA Bootstrap UCL	36200		
90% Chebyshev(Mean, Sd) UCL	40251	95% Chebyshev(Mean, Sd) UCL	46525
97.5% Chebyshev(Mean, Sd) UCL	55232	99% Chebyshev(Mean, Sd) UCL	72337
Suggested UCL to Use			
95% Student's-t UCL	34863		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			

Lead

General Statistics

Total Number of Observations	11	Number of Distinct Observations	11
		Number of Missing Observations	3
Minimum	9.3	Mean	391.8
Maximum	1400	Median	240
SD	399.9	Std. Error of Mean	120.6
Coefficient of Variation	1.021	Skewness	1.83

Normal GOF Test

Shapiro Wilk Test Statistic	0.808	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.85	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.249	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.251	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	610.3	95% Adjusted-CLT UCL (Chen-1995)	661.1
		95% Modified-t UCL (Johnson-1978)	621.4

Gamma GOF Test

A-D Test Statistic	0.228	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.751	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.144	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.262	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.047	k star (bias corrected MLE)	0.822
Theta hat (MLE)	374.3	Theta star (bias corrected MLE)	476.7
nu hat (MLE)	23.03	nu star (bias corrected)	18.08
MLE Mean (bias corrected)	391.8	MLE Sd (bias corrected)	432.1
		Approximate Chi Square Value (0.05)	9.45
Adjusted Level of Significance	0.0278	Adjusted Chi Square Value	8.45

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	749.6	95% Adjusted Gamma UCL (use when n<50)	838.3

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.901	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.85	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.201	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.251	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics			
Minimum of Logged Data	2.23	Mean of logged Data	5.422
Maximum of Logged Data	7.244	SD of logged Data	1.315
Assuming Lognormal Distribution			
95% H-UCL	2437	90% Chebyshev (MVUE) UCL	1082
95% Chebyshev (MVUE) UCL	1357	97.5% Chebyshev (MVUE) UCL	1739
99% Chebyshev (MVUE) UCL	2488		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	590.1	95% Jackknife UCL	610.3
95% Standard Bootstrap UCL	577.2	95% Bootstrap-t UCL	776.5
95% Hall's Bootstrap UCL	1434	95% Percentile Bootstrap UCL	587.2
95% BCA Bootstrap UCL	657.3		
90% Chebyshev(Mean, Sd) UCL	753.4	95% Chebyshev(Mean, Sd) UCL	917.3
97.5% Chebyshev(Mean, Sd) UCL	1145	99% Chebyshev(Mean, Sd) UCL	1591
Suggested UCL to Use			
95% Student's-t UCL	610.3		
When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test			
When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			

Benzo(a)anthracene

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	11
		Number of Missing Observations	3
Minimum	19	Mean	1607
Maximum	3700	Median	1100
SD	1327	Std. Error of Mean	400
Coefficient of Variation	0.826	Skewness	0.465
Normal GOF Test			
Shapiro Wilk Test Statistic	0.901	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.85	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.194	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.251	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	2332	95% Adjusted-CLT UCL (Chen-1995)	2325
		95% Modified-t UCL (Johnson-1978)	2342
Gamma GOF Test			
A-D Test Statistic	0.385	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.756	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.168	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.263	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.909	k star (bias corrected MLE)	0.722
Theta hat (MLE)	1768	Theta star (bias corrected MLE)	2227
nu hat (MLE)	20	nu star (bias corrected)	15.88
MLE Mean (bias corrected)	1607	MLE Sd (bias corrected)	1892
		Approximate Chi Square Value (0.05)	7.878
Adjusted Level of Significance	0.0278	Adjusted Chi Square Value	6.978
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	3240	95% Adjusted Gamma UCL (use when n<50)	3658

Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.834	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.85	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.249	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.251	Data appear Lognormal at 5% Significance Level	
Data appear Approximate Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	2.944	Mean of logged Data	6.74
Maximum of Logged Data	8.216	SD of logged Data	1.596
Assuming Lognormal Distribution			
95% H-UCL	25697	90% Chebyshev (MVUE) UCL	6263
95% Chebyshev (MVUE) UCL	7988	97.5% Chebyshev (MVUE) UCL	10383
99% Chebyshev (MVUE) UCL	15087		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	2265	95% Jackknife UCL	2332
95% Standard Bootstrap UCL	2246	95% Bootstrap-t UCL	2396
95% Hall's Bootstrap UCL	2227	95% Percentile Bootstrap UCL	2247
95% BCA Bootstrap UCL	2265		
90% Chebyshev(Mean, Sd) UCL	2807	95% Chebyshev(Mean, Sd) UCL	3351
97.5% Chebyshev(Mean, Sd) UCL	4105	99% Chebyshev(Mean, Sd) UCL	5588
Suggested UCL to Use			
95% Student's-t UCL	2332		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			

Benzo(a)pyrene

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	11
		Number of Missing Observations	3
Minimum	23	Mean	1674
Maximum	4000	Median	1200
SD	1341	Std. Error of Mean	404.2
Coefficient of Variation	0.801	Skewness	0.591
Normal GOF Test			
Shapiro Wilk Test Statistic	0.918	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.85	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.184	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.251	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	2407	95% Adjusted-CLT UCL (Chen-1995)	2416
		95% Modified-t UCL (Johnson-1978)	2419
Gamma GOF Test			
A-D Test Statistic	0.432	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.753	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.206	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.263	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.962	k star (bias corrected MLE)	0.76
Theta hat (MLE)	1740	Theta star (bias corrected MLE)	2202
nu hat (MLE)	21.16	nu star (bias corrected)	16.72
MLE Mean (bias corrected)	1674	MLE Sd (bias corrected)	1920
		Approximate Chi Square Value (0.05)	8.476
Adjusted Level of Significance	0.0278	Adjusted Chi Square Value	7.537
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	3303	95% Adjusted Gamma UCL (use when n<50)	3714
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.821	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.85	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.283	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.251	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			

Lognormal Statistics			
Minimum of Logged Data	3.135	Mean of logged Data	6.82
Maximum of Logged Data	8.294	SD of logged Data	1.551
Assuming Lognormal Distribution			
95% H-UCL	23321	90% Chebyshev (MVUE) UCL	6319
95% Chebyshev (MVUE) UCL	8042	97.5% Chebyshev (MVUE) UCL	10432
99% Chebyshev (MVUE) UCL	15127		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	2339	95% Jackknife UCL	2407
95% Standard Bootstrap UCL	2299	95% Bootstrap-t UCL	2519
95% Hall's Bootstrap UCL	2550	95% Percentile Bootstrap UCL	2310
95% BCA Bootstrap UCL	2378		
90% Chebyshev(Mean, Sd) UCL	2887	95% Chebyshev(Mean, Sd) UCL	3436
97.5% Chebyshev(Mean, Sd) UCL	4198	99% Chebyshev(Mean, Sd) UCL	5696
Suggested UCL to Use			
95% Student's-t UCL	2407		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			

Benzo(b)fluoranthene

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	10
		Number of Missing Observations	3
Minimum	51	Mean	2517
Maximum	5600	Median	2200
SD	1816	Std. Error of Mean	547.5
Coefficient of Variation	0.721	Skewness	0.311
Normal GOF Test			
Shapiro Wilk Test Statistic	0.951	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.85	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.167	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.251	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	3510	95% Adjusted-CLT UCL (Chen-1995)	3473
		95% Modified-t UCL (Johnson-1978)	3518
Gamma GOF Test			
A-D Test Statistic	0.503	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.75	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.227	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.262	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.109	k star (bias corrected MLE)	0.867
Theta hat (MLE)	2270	Theta star (bias corrected MLE)	2903
nu hat (MLE)	24.4	nu star (bias corrected)	19.08
MLE Mean (bias corrected)	2517	MLE Sd (bias corrected)	2703
		Approximate Chi Square Value (0.05)	10.18
Adjusted Level of Significance	0.0278	Adjusted Chi Square Value	9.133
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	4720	95% Adjusted Gamma UCL (use when n<50)	5259

Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.807	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.85	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.298	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.251	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	3.932	Mean of logged Data	7.317
Maximum of Logged Data	8.631	SD of logged Data	1.421
Assuming Lognormal Distribution			
95% H-UCL	23420	90% Chebyshev (MVUE) UCL	8459
95% Chebyshev (MVUE) UCL	10683	97.5% Chebyshev (MVUE) UCL	13770
99% Chebyshev (MVUE) UCL	19834		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	3418	95% Jackknife UCL	3510
95% Standard Bootstrap UCL	3373	95% Bootstrap-t UCL	3621
95% Hall's Bootstrap UCL	3490	95% Percentile Bootstrap UCL	3364
95% BCA Bootstrap UCL	3414		
90% Chebyshev(Mean, Sd) UCL	4160	95% Chebyshev(Mean, Sd) UCL	4904
97.5% Chebyshev(Mean, Sd) UCL	5936	99% Chebyshev(Mean, Sd) UCL	7965
Suggested UCL to Use			
95% Student's-t UCL	3510		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			

Benzo(k)fluoranthene

General Statistics

Total Number of Observations	11	Number of Distinct Observations	11
		Number of Missing Observations	3
Minimum	16	Mean	794.7
Maximum	2100	Median	790
SD	597.3	Std. Error of Mean	180.1
Coefficient of Variation	0.752	Skewness	0.886

Normal GOF Test

Shapiro Wilk Test Statistic	0.937	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.85	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.144	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.251	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	1121	95% Adjusted-CLT UCL (Chen-1995)	1142
		95% Modified-t UCL (Johnson-1978)	1129

Gamma GOF Test

A-D Test Statistic	0.569	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.75	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.263	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.262	Data Not Gamma Distributed at 5% Significance Level	

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.102	k star (bias corrected MLE)	0.862
Theta hat (MLE)	721.3	Theta star (bias corrected MLE)	922
nu hat (MLE)	24.24	nu star (bias corrected)	18.96
MLE Mean (bias corrected)	794.7	MLE Sd (bias corrected)	856
		Approximate Chi Square Value (0.05)	10.09
Adjusted Level of Significance	0.0278	Adjusted Chi Square Value	9.053

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	1494	95% Adjusted Gamma UCL (use when n<50)	1665

Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.798	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.85	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.328	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.251	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	2.773	Mean of logged Data	6.16
Maximum of Logged Data	7.65	SD of logged Data	1.432
Assuming Lognormal Distribution			
95% H-UCL	7657	90% Chebyshev (MVUE) UCL	2705
95% Chebyshev (MVUE) UCL	3418	97.5% Chebyshev (MVUE) UCL	4409
99% Chebyshev (MVUE) UCL	6354		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	1091	95% Jackknife UCL	1121
95% Standard Bootstrap UCL	1078	95% Bootstrap-t UCL	1197
95% Hall's Bootstrap UCL	1358	95% Percentile Bootstrap UCL	1095
95% BCA Bootstrap UCL	1145		
90% Chebyshev(Mean, Sd) UCL	1335	95% Chebyshev(Mean, Sd) UCL	1580
97.5% Chebyshev(Mean, Sd) UCL	1919	99% Chebyshev(Mean, Sd) UCL	2587
Suggested UCL to Use			
95% Student's-t UCL	1121		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			

Dibenzo(a,h)anthracene

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	10
		Number of Missing Observations	3
Minimum	4.7	Mean	243.1
Maximum	610	Median	210
SD	193.7	Std. Error of Mean	58.4
Coefficient of Variation	0.797	Skewness	0.765
Normal GOF Test			
Shapiro Wilk Test Statistic	0.929	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.85	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.204	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.251	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	348.9	95% Adjusted-CLT UCL (Chen-1995)	353.5
		95% Modified-t UCL (Johnson-1978)	351.2
Gamma GOF Test			
A-D Test Statistic	0.308	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.75	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.167	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.262	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.082	k star (bias corrected MLE)	0.847
Theta hat (MLE)	224.7	Theta star (bias corrected MLE)	286.8
nu hat (MLE)	23.8	nu star (bias corrected)	18.64
MLE Mean (bias corrected)	243.1	MLE Sd (bias corrected)	264
		Approximate Chi Square Value (0.05)	9.858
Adjusted Level of Significance	0.0278	Adjusted Chi Square Value	8.834
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	459.7	95% Adjusted Gamma UCL (use when n<50)	513

Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.844	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.85	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.244	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.251	Data appear Lognormal at 5% Significance Level	
Data appear Approximate Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.548	Mean of logged Data	4.965
Maximum of Logged Data	6.413	SD of logged Data	1.411
Assuming Lognormal Distribution			
95% H-UCL	2148	90% Chebyshev (MVUE) UCL	792.3
95% Chebyshev (MVUE) UCL	1000	97.5% Chebyshev (MVUE) UCL	1288
99% Chebyshev (MVUE) UCL	1855		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	339.1	95% Jackknife UCL	348.9
95% Standard Bootstrap UCL	333.2	95% Bootstrap-t UCL	383.5
95% Hall's Bootstrap UCL	382.4	95% Percentile Bootstrap UCL	338.1
95% BCA Bootstrap UCL	345.9		
90% Chebyshev(Mean, Sd) UCL	418.3	95% Chebyshev(Mean, Sd) UCL	497.6
97.5% Chebyshev(Mean, Sd) UCL	607.8	99% Chebyshev(Mean, Sd) UCL	824.2
Suggested UCL to Use			
95% Student's-t UCL	348.9		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			

Indeno(1,2,3-cd)pyrene

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	10
		Number of Missing Observations	3
Minimum	24	Mean	1081
Maximum	2500	Median	920
SD	767.4	Std. Error of Mean	231.4
Coefficient of Variation	0.71	Skewness	0.494
Normal GOF Test			
Shapiro Wilk Test Statistic	0.954	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.85	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.129	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.251	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	1501	95% Adjusted-CLT UCL (Chen-1995)	1499
		95% Modified-t UCL (Johnson-1978)	1506
Gamma GOF Test			
A-D Test Statistic	0.519	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.748	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.243	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.261	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.184	k star (bias corrected MLE)	0.922
Theta hat (MLE)	913.2	Theta star (bias corrected MLE)	1173
nu hat (MLE)	26.05	nu star (bias corrected)	20.28
MLE Mean (bias corrected)	1081	MLE Sd (bias corrected)	1126
		Approximate Chi Square Value (0.05)	11.06
Adjusted Level of Significance	0.0278	Adjusted Chi Square Value	9.963
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	1983	95% Adjusted Gamma UCL (use when n<50)	2201
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.799	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.85	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.309	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.251	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			

Lognormal Statistics			
Minimum of Logged Data	3.178	Mean of logged Data	6.508
Maximum of Logged Data	7.824	SD of logged Data	1.369
Assuming Lognormal Distribution			
95% H-UCL	8680	90% Chebyshev (MVUE) UCL	3478
95% Chebyshev (MVUE) UCL	4378	97.5% Chebyshev (MVUE) UCL	5627
99% Chebyshev (MVUE) UCL	8080		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	1462	95% Jackknife UCL	1501
95% Standard Bootstrap UCL	1451	95% Bootstrap-t UCL	1560
95% Hall's Bootstrap UCL	1544	95% Percentile Bootstrap UCL	1450
95% BCA Bootstrap UCL	1493		
90% Chebyshev(Mean, Sd) UCL	1775	95% Chebyshev(Mean, Sd) UCL	2090
97.5% Chebyshev(Mean, Sd) UCL	2526	99% Chebyshev(Mean, Sd) UCL	3384
Suggested UCL to Use			
95% Student's-t UCL	1501		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.14/1/2024 9:16:24 PM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

antimony

General Statistics

Total Number of Observations	10	Number of Distinct Observations	9
		Number of Missing Observations	1
Minimum	1.4	Mean	5.7
Maximum	24	Median	3.05
SD	6.865	Std. Error of Mean	2.171
Coefficient of Variation	1.204	Skewness	2.563

Normal GOF Test

Shapiro Wilk Test Statistic	0.618	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.369	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	9.679	95% Adjusted-CLT UCL (Chen-1995)	11.15
		95% Modified-t UCL (Johnson-1978)	9.973

Gamma GOF Test

A-D Test Statistic	0.966	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.741	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.293	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.272	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.412	k star (bias corrected MLE)	1.055
Theta hat (MLE)	4.036	Theta star (bias corrected MLE)	5.402
nu hat (MLE)	28.24	nu star (bias corrected)	21.1
MLE Mean (bias corrected)	5.7	MLE Sd (bias corrected)	5.549
		Approximate Chi Square Value (0.05)	11.67
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	10.47

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	10.31	95% Adjusted Gamma UCL (use when n<50)	11.49

Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.881	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.225	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.336	Mean of logged Data	1.346
Maximum of Logged Data	3.178	SD of logged Data	0.833
Assuming Lognormal Distribution			
95% H-UCL	11.73	90% Chebyshev (MVUE) UCL	9.483
95% Chebyshev (MVUE) UCL	11.42	97.5% Chebyshev (MVUE) UCL	14.11
99% Chebyshev (MVUE) UCL	19.39		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	9.271	95% Jackknife UCL	9.679
95% Standard Bootstrap UCL	9.132	95% Bootstrap-t UCL	27.7
95% Hall's Bootstrap UCL	28.22	95% Percentile Bootstrap UCL	9.47
95% BCA Bootstrap UCL	11.18		
90% Chebyshev(Mean, Sd) UCL	12.21	95% Chebyshev(Mean, Sd) UCL	15.16
97.5% Chebyshev(Mean, Sd) UCL	19.26	99% Chebyshev(Mean, Sd) UCL	27.3
Suggested UCL to Use			
95% H-UCL	11.73		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
ProUCL computes and outputs H-statistic based UCLs for historical reasons only.			
H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.			
It is therefore recommended to avoid the use of H-statistic based 95% UCLs.			
Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.			

Appendix D - Constituent Volatilization Transfer Factor Calculations

Appendix D – Constituent Volatilization Transfer Factor Calculations

Former Hinton Ice House

508 Commercial Avenue
Hinton, Summers County, West Virginia
VRP Project #21037

Disclaimer

Any questions concerning the information or its interpretation should be directed to L. Poppelreiter or T. Todoruk.

Table of Contents

List of Tables

1. Introduction

This attachment presents the mathematical models used in the quantitative risk assessment to estimate the concentrations of constituents in ambient air due to volatilization from soil for the on-Site recreational user.

A soil volatilization model referenced in the United States Environmental Protection Agency (USEPA) Soil Screening Guidance (USEPA 1996) and the Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites (USEPA 2002) was used to estimate concentrations of constituents in ambient air due to the volatilization from soil. This model may be used for intrusive activities or for non-intrusive activities for Site receptors.

2. Estimating Ambient Air Concentrations from Volatile Emissions from Soil

2.1 USEPA Model

Ambient concentrations of constituents of concern in air resulting from volatile emissions from soil may be estimated as follows:

$$CA_a = C_{src} * TF_{a-v}$$

where:

CA_a	=	concentration of constituent in air (µg/m^3)
$TF_{a\text{-}vol}$	=	transport factor that translates a soil concentration to an air concentration via volatile emissions (kg/m^3)
C_{src}	=	initial concentration of constituent in soil (µg/kg)

The soil saturation limit (C_{sat}) is the constituent concentration at which soil pore air and pore water space are saturated with the constituent and the adsorptive limits of the soil particles have been reached. Above this concentration, the constituent may be present in free phase. When soil concentrations are above C_{sat}, the volatilization model is no longer applicable because the model utilizes Henry's Law, which does not apply when constituents are in free phase. Thus, C_{sat} represents an upper bound on the applicability of the volatilization model. If the initial constituent soil concentration (C_{src}) is greater than the C_{sat}, then C_{sat} is utilized as the soil source concentration. If C_{src} is less than C_{sat}, then C_{src} is utilized as the soil source concentration.

C_{sat} can be estimated by the following equation:

$$C_{sat} = \frac{S}{\rho_b}(K_d * \rho_b + n_w + H' * n_a)$$

where:

C_{sat}	=	soil saturation limit (mg/kg)
S	=	solubility in water (mg/L)
ρ_b	=	dry soil bulk density (kg/L or g/cm^3)
K_d	=	soil-water partition coefficient (cm^3/g or L/kg)
n_w	=	water-filled soil porosity (cm^3-water/cm^3-total or L-water/L-total)
H'	=	dimensionless Henry's Law constant (if calculated from *H*, equal to 41**H*)
H	=	Henry's Law Constant (atm-m^3/mol)

n_a = air-filled porosity (cm^3-air/cm^3-total or L-air/L-total)

Note that if the units g/cm^3 and cm^3/g are used for the variables above, the C_{sat} must be multiplied by the conversion factors 1 L/1000 cm^3 and 1000 g/1 kg. According to the USEPA Regional Screening Level User's Guide (USEPA 2024), C_{sat} is not calculated for chemicals that are solid at ambient soil temperatures. USEPA developed the following decision criterion: if the melting point of a chemical is less than 20°C, the chemical is a liquid; if the melting point is above 20°C, the chemical is a solid. This criterion was used to decide whether to limit C_{src} by C_{sat}.

The transport factor (TF_{vol}) describes the relationship between the concentration in air to the concentration in soil and is given by the following expression:

$$TF_{a-vol} = DF * VF_{on}$$

where:

$TF_{a\text{-}vol}$ = transport factor that translates a soil concentration to an air concentration via volatile emissions (kg/m^3)

DF = dilution factor which translates on-Site air concentrations to off-Site air concentrations (dimensionless) (*DF* equals 1 if on-Site concentrations are required)

VF_{on} = volatilization factor for on-Site air concentrations (kg/m^3)

The value for *DF* can be determined from on-Site measurements or from use of an air dispersion model. In this risk assessment, the *DF* was conservatively assumed to be 1 for Site receptors.

The volatilization factor describes the relationship between concentrations in air to concentrations in soil and is based on a volatilization model provided in the Soil Screening Guidance (USEPA 1996). The volatilization factor is given by the following equation:

$$VF_{on} = (\frac{1}{Q/C}) * (FF)$$

where:

VF_{on} = volatilization factor for on-Site air concentrations (kg/m^3)

Q/C = inverse dispersion factor [(g/m^2-sec)/(kg/m^3)]

FF = flux factor (g/m^2-sec)

The flux factor (*FF*), when multiplied by the soil concentration, gives the average flux of chemical out of the soil surface over a specified period of time. This flux is translated into an on-Site air concentration by use of a dispersion factor [1/(*Q/C*)], which represents the median air concentration for volatiles at the center of a square area based on analysis presented in the Soil Screening Guidance (USEPA 1996). It should be noted that the volatilization factor (VF_{on}) defined by the Soil Screening Guidance (USEPA 1996) equals $1/VF_{on}$; the equations presented in this attachment were re-arranged to solve for VF_{on}.

The following equation, derived from the Soil Screening Guidance (USEPA 1996), is used to calculate the average flux factor assuming volatilization is not limited by the available mass of a constituent in soil:

$$FF_a = \frac{2 * \rho_b * D_A * CF}{(\pi * D_A * T)^{0.5}}$$

where:

FF_a	=	average flux factor (g/m^2-sec)
ρ_b	=	dry bulk density (g/cm^3)
D_A	=	apparent diffusivity (cm^2/sec)
CF	=	conversion factor (1.0x10^4 cm^2/m^2)
T	=	exposure period (sec)

The following equation is used to calculate the maximum flux factor assuming volatilization is limited by the mass of a constituent in soil:

$$FF_m = \frac{\rho_b * d * CF}{T}$$

where:

FF_m	=	maximum flux factor (g/m^2-sec)
d	=	thickness of affected soil (m)
CF	=	conversion factor (1.0x10^6 cm^3/m^3)
ρ_b	=	dry bulk density (g/cm^3)
T	=	exposure period (sec)

In this evaluation, the flux factor (*FF*) is set to the minimum of the average flux factor (FF_a) and the maximum flux factor (FF_m).

The apparent diffusivity (D_A) is given by the following equation:

$$D_A = \frac{\left(n_a^{\frac{10}{3}} * D_v * H' + n_w^{\frac{10}{3}} * D_w\right)/n^2}{\rho_b * K_d + n_w + n_a * H'}$$

where:

D_A	=	apparent diffusivity (cm^2/sec)
n_a	=	air filled porosity (cm^3-air/cm^3-total)
n_w	=	water filled soil porosity (cm^3-water/cm^3-total)

n = total soil porosity (cm^3-pore/cm^3-total) [equal to 1-(ρ_b/ρ_s)]

ρ_b = dry bulk density (g/cm^3)

H' = dimensionless Henry's Law constant (if calculated from *H*, equal to 41**H*)

H = Henry's Law constant (atm-m^3/mol)

D_v = diffusivity in air (cm^2/sec)

D_w = diffusivity in water (cm^2/sec)

K_d = soil water partition coefficient (cm^3/g) (equal to f_{oc}*K_{oc})

f_{oc} = fraction of organic carbon in soil (g-oc/g-soil)

K_{oc} = organic carbon to water partition coefficient (cm^3/g)

The inverse dispersion factor (*Q/C*) for exposure to volatile emissions from soil was calculated using the following equation (USEPA 2002):

$$Q/C = \mathrm{A} * \exp[\frac{(\ln(A_c) - B)^2}{C}]$$

where:

Q/C = inverse dispersion factor (g/m^2-s per kg/m^3)

A = constant [11.6831 for a resident, applied to a recreational user (default from Equation E-30 of USEPA 2002)]

B = constant [23.4910 for a resident, applied to a recreational user (default from Equation E-30 of USEPA 2002)]

C = constant [287.9969 for a resident, applied to a recreational user (default from Equation E-30 of USEPA 2002)]

A_c = areal extent of contamination (acres)

The results of running the model for the on-Site recreational user are presented in Table 1. Individual constants used in the equations for each receptor are also presented and referenced in Table 1.

3. References

USEPA 1996. Soil Screening Guidance: User's Guide. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, EPA/540/R-96/018, OSWER 9355.4-23, April 1996.

USEPA 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, OSWER 9355.4-24, December 2002.

USEPA 2024. Regional Screening Levels (RSLs) - User's Guide. U.S. Environmental Protection Agency. https://www.epa.gov/risk/regional-screening-levels-rsls-users-guide. May 2024.

Tables

Table 1
Calculation of Soil Volatilization Transfer Factors for an On-Site Recreational User
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

System Parameters

Variable Name	Value	Units	Description
DF	1	unitless	dilution factor
Q/C control	1		0 indicates input value; 1 indicates calculate from area using SSG formula
Q/C (if Q/C control = 0)		$(g/m^2\text{-sec}) / (kg/m^3)$	
A_{site}	0.437	acres	areal extent of contaminated area at the site, assumed whole site is contaminated based on measured soil exceedances.
A	11.6831	not specified	constant; default for resident (USEPA 2002, Equation E-30)
B	23.491	not specified	constant; default for resident (USEPA 2002, Equation E-30)
C	287.9969	not specified	constant; default for resident (USEPA 2002, Equation E-30)
Q/C	91.1	$(g/m^2\text{-sec}) / (kg/m^3)$	
r_b	1.5	g/cm^3 or kg/L	dry bulk density; default value from SSG (USEPA 1996; p. 26)
r_s	2.65	g/cm^3	soil particle density; default value from SSG (USEPA 1996; p. 26)
d	0.61	m	unsaturated thickness of affected soil; 2 ft based on residential soil de minimis standard exceedances in surface soil (0-2 ft-bgs)
n	0.43	cm^3-pore/cm^3-total or L-pore/L-total	total soil porosity; equal to $1-(r_b/r_s)$
n_w	0.15	cm^3-water/cm^3-total or L-water/L-total	water filled soil porosity; default value from SSG (USEPA 1996; p. 26)
n_a	0.28	cm^3-air/cm^3-total or L-air/L-total	air filled soil porosity; equal to $n-n_w$
f_{oc}	0.006	g-oc/g-soil	fraction organic carbon in soil; default value from SSG (USEPA 1996; p. 26)
T	26	yr	exposure period; set equal to the exposure duration for the receptor
	8.20E+08	sec	
CF1	1.0E+04	cm^2/m^2	conversion factor
CF2	1.0E+06	cm^3/m^3	conversion factor
CF3	41	mol/atm-m^3	conversion factor
Csat Decision Criterion	20	deg C	decision criterion for establishing soil saturation limit (Csat) (USEPA 2024; Section 5.12)
Volatilization Control	1	0 indicates no limits on volatilization	
		1 indicates volatile if Hen law const. ≥ limit or if vapor pressure ≥ limit	
		2 indicates volatile if boiling point < limit OR if Hen law const. ≥ limit and molecular weight is < limit	
Henry's law limit	1.0E-05	atm-m^3/mol	
vapor pressure limit	1	mm Hg	
molecular weight limit	200	g/mol	
boiling point limit	200	deg C	

Notes: USEPA soil volatilization model (USEPA 2002)

References:

USEPA 1996. Soil Screening Guidance: User's Guide. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, EPA/540/R-96/018, OSWER 9355.4-23, April 1996.

USEPA 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, OSWER 9355.4-24, December 2002.

USEPA 2024. Regional Screening Table User's Guide. U.S. Environmental Protection Agency. https://www.epa.gov/risk/regional-screening-levels-rsls-users-guide, May 2024.

Table 1
Calculation of Soil Volatilization Transfer Factors for an On-Site Recreational User
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

Chemical-Specific Variables

Chemical	Chemical Properties									
	Vapor Pressure VP (mm Hg)	Molecular Weight MW_i (g/mol)	Melting Point MP (°C)	Boiling Point BP (°C)	Solubility S (mg/L)	Organic Carbon Part. Coef. Koc (mg/kg / mg/L)	Henry's Law Constant H (atm-m³/mol)	Dim. Henry's Law Constant H' (unitless)	Vapor Phase Diffusivity D_V (cm²/s)	Water Phase Diffusivity D_W (cm²/s)
Polycyclic Aromatic Hydrocarbons (PAHs)										
Benzo(a)anthracene	2.1E-07	2.3E+02	8.4E+01	4.4E+02	9.4E-03	1.8E+05	1.2E-05	4.9E-04	2.6E-02	6.7E-06
Benzo(a)pyrene	5.5E-09	2.5E+02	1.8E+02	5.0E+02	1.6E-03	5.9E+05	4.6E-07	1.9E-05	2.5E-02	6.6E-06
Benzo(b)fluoranthene	5.0E-07	2.5E+02	1.7E+02	4.4E+02	1.5E-03	6.0E+05	6.6E-07	2.7E-05	2.5E-02	6.4E-06
Benzo(k)fluoranthene	9.7E-10	2.5E+02	2.2E+02	4.8E+02	8.0E-04	5.9E+05	5.8E-07	2.4E-05	2.5E-02	6.4E-06
Dibenzo(a,h)anthracene	9.6E-10	2.8E+02	2.7E+02	5.2E+02	2.5E-03	1.9E+06	1.4E-07	5.8E-06	2.4E-02	6.0E-06
Indeno(1,2,3-cd)pyrene	1.3E-10	2.8E+02	1.6E+02	5.4E+02	1.9E-04	2.0E+06	3.5E-07	1.4E-05	2.5E-02	6.4E-06
Metals										
Antimony	NA	1.2E+02	6.3E+02	1.6E+03	NA	NA	NA	NA	NA	NA
Arsenic	NA	7.5E+01	2.7E+02	6.2E+02	NA	NA	NA	NA	NA	NA
Iron	NA	5.6E+01	1.5E+03	3.0E+03	NA	NA	NA	NA	NA	NA
Polychlorinated Biphenyls (PCBs)										
Aroclor-1254	7.7E-05	3.3E+02	1.3E+02	3.8E+02	4.3E-02	1.3E+05	2.8E-04	1.2E-02	2.4E-02	6.1E-06

Notes:
NA - not available

Table 1
Calculation of Soil Volatilization Transfer Factors for an On-Site Recreational User
Human Health and Ecological Risk Assessment
Former Hinton Ice House
Hinton, West Virginia

Chemical-Specific Variables

	Calculated Parameters								
Chemical	**Soil-Water Part. Coeff. K_d (cm^3/g) or (L/kg)**	**Apparent Diffusivity D_A (cm^2/sec)**	**Average Flux Factor FFa (g/m^2-sec)**	**Maximum Flux Factor FFm (g/m^2-sec)**	**Volatilization Factor VFon (kg/m^3)**	**Volatilization Control [1] (unitless)**	**Transport Factor TFvol (kg/m^3)**	**Calculated Soil Sat. Limit Csat (mg/kg)**	**Use Soil Csat Limit? Yes / No Csat Decision Criterion [2]**
Polycyclic Aromatic Hydrocarbons (PAHs)									
Benzo(a)anthracene	1.1E+03	6.8E-10	1.5E-05	1.1E-03	1.7E-07	1	1.7E-07	1.0E+01	No
Benzo(a)pyrene	3.5E+03	1.9E-11	2.6E-06	1.1E-03	2.8E-08	0	---	5.7E+00	No
Benzo(b)fluoranthene	3.6E+03	2.1E-11	2.7E-06	1.1E-03	3.0E-08	0	---	5.4E+00	No
Benzo(k)fluoranthene	3.5E+03	2.1E-11	2.7E-06	1.1E-03	2.9E-08	0	---	2.8E+00	No
Dibenzo(a,h)anthracene	1.1E+04	4.0E-12	1.2E-06	1.1E-03	1.3E-08	0	---	2.9E+01	No
Indeno(1,2,3-cd)pyrene	1.2E+04	5.1E-12	1.3E-06	1.1E-03	1.5E-08	0	---	2.2E+00	No
Metals									
Antimony	NA	NA	NA	1.1E-03	0.0E+00	0	---	NA	No
Arsenic	NA	NA	NA	1.1E-03	0.0E+00	0	---	NA	No
Iron	NA	NA	NA	1.1E-03	0.0E+00	0	---	NA	No
Polychlorinated Biphenyls (PCBs)									
Aroclor-1254	7.8E+02	1.9E-08	8.1E-05	1.1E-03	8.9E-07	1	8.9E-07	3.4E+01	No

Notes:
[1] For the volatilization control column: "1" means the constituent is a volatile and a "0" means the constituent is not a volatile based on the selected definition of a volatile on page 1 of this table.
[2] Calculated C_{sat} is utilized to compare the soil source concentration (i.e. C_{src}).

Heather Gretka, M.Sc., R.P.Bio., P.Biol.

Senior Toxicologist

Summary

Heather Gretka is a risk assessor with 12 years of experience in environmental consulting. Her practice focuses on risk assessment, risk management, remedial options and sustainability decisions in the context of human, terrestrial and aquatic receptor health. She is practiced in the analysis and interpretation of surface water, sediment, soil, and toxicological data. Heather has completed screening, intermediate, and detailed level HHERAs under federal and provincial regulatory frameworks using various lines of evidence such as toxicity tests, bioaccumulation factors, food chain modeling, and biological assessments. Heather is proficient at using R and ProUCL statistical software.

Education

2018	Pg. Dip, Environmental Toxicology and Pollution Monitoring, Ulster University
2015	M.Sc., University of Victoria
2008	B.Sc., University of Western Ontario

Relevant Experience

2022 **Risk Assessor, Liquid Sulphur Pipeline Release Report, Pieridae Energy**

In support of meeting the AER's release reporting requirements, prepared a report to address a release from a steamline encapsulating a liquid sulphur pipeline (LSPL). A weight-of-evidence risk assessment approach was taken to address potential impacts to the local environment, which involved analysis of surface water and soil chemistry data, soil leachability testing, multi-concentration acute lethality testing of the source solution, and a fish habitat assessment.

2022 **Risk Assessor, Hart Road DDT HHERA, PSPC**

Completed a weight-of-evidence HHERA addressing dichloro-diphenyl-trichloroethane (DDT) and its metabolites in site soil due to historical agricultural uses on behalf of Public Services and Procurement Canada (PSPC). The HHERA was prepared in accordance with FCSAP and CCME guidance documents and involved integrating newly collected data with previously established datasets for soil, invertebrate tissue, and plant tissue chemistry data and evaluating whether unacceptable risks to human and ecological receptors were to be expected at the site following a proposed remedial excavation of several hot spot areas.

2021 **Risk Assessor, Nanaimo Rifle Range HHERA, PSPC**

Prepared an HHERA for PSPC on behalf of the Department of National Defense to support planned site upgrades and the reuse of soil at the Nanaimo Rifle Range. Munitions-related contamination (e.g., copper, lead, and nickel) was identified in on-site soil, sediment, and surface water and evaluated to determine potential risks caused to human and ecological receptors. Food web modeling was completed for birds and mammals.

Memberships and affiliations

- Registered Professional Biologist (R.P.Bio) with the College of Applied Biologists, Current
- Science Advisory Board for Contaminated Sites (SABCS) in BC, Current
- Alberta Society of Professional Biologists, Current

Work History

2022-Present	Advisian, Senior Risk Assessor
2020-Present	SLR, Risk Assessor
2014-2020	AECOM, Environmental Scientist

Lisa Poppelreiter

Associate Technical Consultant, Environmental Scientist, Risk Assessor

Summary

Lisa has over 13 years of environmental consulting experience. Areas of expertise include human health and ecological risk assessments (including third-party reviews of risk assessments), derivation of clean-up numbers, conceptual site model development, vapor intrusion assessments, and statistical evaluations of analytical data. She has focused on the technical requirements under Pennsylvania's Land Recycling and Environmental Remediation Standards Act (Act 2) and the West Virginia Voluntary Remediation and Redevelopment Act (VRRA) program, as well as clean-up programs in Ohio, Massachusetts, and Louisiana. Lisa has taken the lead as project manager on a voluminous number of risk assessment projects and has experience training entry level employees on the risk assessment process. She has assisted in the development of site investigation reports, baseline and residual risk assessments, clean-up/remedial action plans, and final reports.

Areas of Expertise

- Human Health and Ecological Risk Assessments
- Derivation of Cleanup Numbers
- Conceptual Site Model Development
- Vapor Intrusion Assessment
- Statistical Evaluation of Analytical Data / Data Management

Education

2009 B.S. Environmental Science, California University of Pennsylvania

Relevant Experience

Risk Assessment Third-Party Reviews

Lisa has also completed third-party reviews of human health and ecological risk assessment reports under West Virginia's voluntary remediation program. She is exceptionally knowledgeable about the West Virginia VRRA rules and regulations and has commented on a multitude of site assessment reports and risk assessment reports to provide constructive feedback on properly following the VRP guidance. Lisa has worked closely with WVDEP project managers in regards to writing and resolving technical comments. She has also participated in various site visits in support of completing site characterization activities that fulfill the WVDEP requirements to prepare a human health and ecological risk assessment.

WVDEP LUST/LAST Program

Lisa has assisted with the re-development of WVDEP's Leaking Underground Storage Tank (LUST) and Leaking Aboveground Storage Tank (LAST) program in regards to development of soil screening standards. The purpose was to develop updated soil screening standards that will allow efficient screening of sites

through the LUST/LAST program, but still be health protective. The proposed soil screening standards were developed primarily based on risk-based methods that are protective of both direct contact and vapor intrusion exposure pathways. She had prepared a conceptual flow chart of steps that guides a remediator through the soil screening process and identified what limiting factors prevent the use of the proposed soil screening standards.

WVDEP Regulatory Screening Value Spreadsheets

Lisa has also assisted WVDEP with updating technical spreadsheets that were utilized to derive WVDEP regulatory screening values. The primary task was to correct errors in the Excel formulas and return and error-free, fully-functioning spreadsheet capable of deriving screening values for over 350 chemicals.

Petroleum UST/AST Sites

Lisa has worked as the lead risk assessor on numerous petroleum underground storage tank and above ground storage tank sites located in both Pennsylvania and West Virginia under their respective voluntary programs. These assessments focus the use of risk assessment on addressing environmental impacts in order to place these sites back into use. A solid conceptual site model is crucial in determining the areas of the site and types of receptors that could create the most significant risk. Most of the site conceptual models addressed nonresidential use; however, several of the sites needed to address future residential use and recreational use as part of the risk assessment.

Derivation of Cleanup Values

Lisa has developed property-specific cleanup values for a future recreational land use scenario (i.e., walking trail through a natural area) for a site in Ohio. The cleanup values were developed for several polycyclic aromatic hydrocarbons (PAHs) and metals, including lead, for surface soil. Exposure parameters related specifically to this recreational land were utilized to calculate the cleanup values. For lead, a time-weighted exposure approach was used in accordance with USEPA guidance to derive a cleanup value that is specific to a recreator rather than a resident. On a separate project in Pennsylvania (PA), Lisa has derived site-specific cleanup values for a different type of future recreational land use scenario (i.e., community park including playground, event lawn, pavilions, walking trails, and water access to adjacent river). The exposure parameters varied slightly from the Ohio site due to the presence of amenities on the property. Cleanup values for the PA site were derived for PAHs and arsenic in surface soil.

Vapor Intrusion Assessment

Lisa completed an assessment of vapor intrusion for a site in PA. An underground storm sewer system was suspected as acting as a preferential pathway for vapors from the site release of gasoline. It was determined that the product was not expected to migrate preferentially through the sewer system as the release occurred in product lines that were deeper than the shallower sewer lines. Based on a multiple line of evidence approach, it was determined that vapor sources in soil and groundwater were not in proximity distance to the sewer line system and as a result preferential migration of vapors through the sewer system was unlikely. Off-site indoor air and ambient air samples were also utilized to evaluate off-site residences. The analysis concluded that the few detections of volatile constituents in indoor air samples were likely attributed to other anthropogenic sources.

Surface Water Risk Assessment

Lisa has participated in a complex risk assessment for a site in which a catch basin served as a preferential pathway and discharged into a culvert, which then discharged into an adjacent stream. Assessment of a recreational user of the stream and the stream itself was strategically evaluated in two parts. One part was the direct discharge from the culvert and the other part was diffuse discharge of groundwater upstream of the culvert discharge point. A site-specific surface water concentration was back-calculated for the recreational user under several scenarios (varying dermal exposure) in order to determine an appropriate surface water concentration that would be below an acceptable risk benchmark.

Right-of-Way Segmentation and Target Hazard Quotient Analyses

Lisa has worked on many sites where she has developed a variety of strategic approaches for site closure utilizing unique aspect and tools of quantitative risk assessment. She has utilized site-specific data evaluation methods and procedures that reduced the need for further remediation. For example, Lisa has employed

various quantitative methods for deriving exposure point concentrations for the construction/utility worker scenarios in un-deeded right-of-ways, including segmentation of the utility corridors. This entailed apportioning the time these receptors would spend in each segment and relating each segment to a different exposure point concentration. In addition, she has performed target hazard quotient analyses on several projects to demonstrate whether or not the total hazard index for each target organ was above the regulatory benchmark.

Residual Risk Assessment

Lisa has assisted in a residual risk assessment for a former manufactured gas plant (MGP) site. A residual risk assessment was conducted in order to derive remedial goals that would reduce the overall hazard index and cancer risk to acceptable levels for each receptor at the site. This required each receptor and exposure pathway to be evaluated in order to determine which pathway(s) contributed the most risk and as a result was chosen as the basis of the remedial action goals that were calculated. These remedial goals were calculated to be protective of all receptors evaluated at the site.

Statistical Background Analyses

Lisa has performed statistical analyses on quarterly groundwater data under a National Pollutant Discharge Elimination System (NPDES) Permit. This analysis utilized the tolerance interval procedure to calculate tolerance limits based on the background well data and compared data from four compliance monitoring wells in order to determine if there is a statistically significant increase in concentration over the background well. On a separate project, Lisa has performed a statistical background analysis on vanadium in soil. The Mann-Wilcoxon Rank Sum Test and Quantile Test were used to perform the statistical analyses in order to demonstrate that vanadium soil concentrations within the release area are not statistically different from vanadium soil concentration from samples collected outside of the release area. Also, she has assisted with plume stability analyses utilizing statistical programs such as the Mann Kendall model spreadsheets.

Data Gap Analyses

Lisa has provided technical input in support of data gap analyses for several clients. The data gap analysis was completed to identify any additional sampling or investigative activities that needed to be completed in order to satisfy site characterization requirements. This included, for example, additional soil and groundwater sampling locations, additional rounds of groundwater sampling to meet the minimum number of samples required to complete a risk assessment, speciating analytical parameters to perform appropriate screening of applicable criteria, etc.

Fate & Transport Modeling

Lisa has utilized a number of various fate and transport models to estimate exposure point concentrations. These include the Johnson and Ettinger (J&E) model (to estimate indoor air concentrations), the Virginia Department of Environmental Quality (VA DEQ) trench model (to estimate trench air concentrations from groundwater), and groundwater transport models such as BIOSCREEN, Quick Domenico, and SWLOAD/Toxics Management Spreadsheet.

Trench Model Alternatives

Lisa has performed research on alternative methods for estimating trench air concentrations for a construction worker/utility worker scenario. This included site-specific modifications to existing trench air models (e.g., VADEQ model) based on USEPA Region 8 documents. Modifications to the trench dimensions and air exchange rate play a significant role in estimating trench air concentrations. This evaluation also included utilization of soil gas data and utilization of direct air measurements collected within a trench via Summa canisters. Alternative methods based on Andelman studies were also considered during this evaluation.

Massachusetts Risk Assessment

Lisa has prepared a Method 3 Risk Characterization Report following regulatory requirements and guidelines for the Massachusetts Contingency Plan. The Method 3 Risk Characterization Report assessed the conditions of a petroleum retail facility and potential exposures in order to determine that no significant risk of harm to human health, public welfare, safety, or environmental exist at the site.

Ohio Risk Assessment

Lisa has prepared a property-specific risk assessment report for a former dry cleaner facility under the Ohio VAP. The risk assessment originally evaluated the site under a commercial scenario when the former dry cleaner was a vacant space. However, the vacant former dry cleaner was then converted into a child day-care facility. The change in use of the property required a re-evaluation of the use of the facility (i.e., residential use) and a re-evaluation of potential receptors (e.g., children, parents, day care workers, etc.) that may be exposed to chlorinated vapors beneath the building.

Louisiana Cleanup Standard

Lisa has developed Louisiana cleanup standards (e.g., MO-2 remediation standards) following technical guidance from the Louisiana Department of Environmental Quality (LDEQ). The standards were developed under the LDEQ Risk Evaluation/Corrective Action Program (RECAP) guidance. Lisa utilized LDEQ's spreadsheets to derive the cleanup standards while updating various elements of the spreadsheets as needed to ensure the most recent methods and procedures for deriving risk-based cleanup standards were followed. This included updating toxicity values, modifying the method to utilize inhalation toxicity criteria in the applicable equations, and adding in constituents to the spreadsheets along with all applicable chemical property inputs that were not already included in the spreadsheets.

International Risk Assessment

Lisa has prepared a risk assessment for a petroleum refinery and chemical storage terminal located outside of the United States. Extensive research on local bye-laws and environmental protection acts was conducted to build the regulatory framework under which to prepare the risk assessment. Regulations from USEPA, Florida, Hawaii, and Puerto Rico were also considered. The risk assessment was completed to support the facility's long-term vision for remediation of historical releases of crude oil and petroleum products beneath the terminal.

International Outdoor Air Risk Evaluation

Lisa has conducted a risk evaluation for a chemical facility located outside of the United States which underwent thermal treatment remediation activities. Soil vapor samples were collected and screened against USEPA screening values to evaluate risks for exposure to chlorobenzene compounds for commercial/industrial workers at the facility via the inhalation of volatiles migrating from the subsurface to outdoor air. An outdoor air attenuation factor was applied to the USEPA air screening values to derive soil vapor screening values which could then be compared to the soil vapor analytical results.

Field Monitoring and Sampling

Lisa has also had experience in the field participating in perimeter air monitoring during an interim response action excavation and assisting in collecting wastewater disposal samples. She is familiar with the use of air monitoring equipment such as photoionization detector (PID) devices. She has also had experience in the field collecting samples as part of an on-going annual PCB (polychlorinated biphenyls) sampling program in which liquid samples were collected from accumulation in components from natural gas distribution pipeline systems across western Pennsylvania and tested for PCBs. Lisa has worked closely with analytical laboratories to have samples from various media analyzed, starting from development of the analytical scope of work to management of the final lab results.

COAs/Annual Plan Preparation

Lisa has also been responsible for developing and updating generic work plan documents for a multi-site consent order and agreement (COA) in the state of Pennsylvania. She also was responsible for several annual plans under various COAs that summarize activities completed from the ending year and projected activities for the following year. Points are accrued for each activity as a means of tracking financial spending on the sites under the COA, which is reported to PADEP each year. Lisa has attended annual meetings with entities under the COAs, including PADEP project managers. Lisa has also prepared monthly and quarterly cost models to track and updated projected cost-to-closure activities and spending.

Training Entry Level Employees

Lisa has experience training entry level employees on the risk assessment process, including following appropriate regulatory guidance procedures, understanding the screening process for selection of constituents of interest, evaluation of applicable receptors and exposure pathways, and calculating quantitative risks.

Environmental Covenants/Land Use Covenants

Lisa has experience preparing environmental covenants/land use covenants for dozens of properties based on the institutional and/or engineering controls required for the property. This includes researching the property's tax parcel information, preparing a description of contamination and remedy, and summarizing activity and use limitations. She has also assisted with preparing associated figures and tax parcel maps indicating the coordinates of the area of the property that pertain to the activity and use limitations and as well as indicating remaining sample locations in which constituent concentrations exceed regulatory screening criteria.

Presentations

- Poppelreiter, Lisa, 2024. COC or Not a COC: That Is The Question. Presented at the 2024 West Virginia Brownfields Conference. September 10, 2024.
- Poppelreiter, Lisa, 2023. Navigating the Roadblocks of Vapor Intrusion. Presented at the 2023 West Virginia Brownfields Conference. September 12, 2023.
- Shamory, Brett, L. Smith, 2015. Evaluation of Virginia DEQ Trench Model for Construction/Utility Worker Exposure Pathway Risk Assessment. Presented at the 2015 Pennsylvania Brownfields Conference. Co-authored by John J. Mahfood and Chad Hunter.
- Shaw, Bruce, L. Smith, and J. J. Mahfood, 2014. Risk Assessment to Support Multi-Phase Brownfields Redevelopment. Presented at the 2014 West Virginia Brownfields Conference. September 11 and 12, 2014.
- Urbassik, Mark, L. Smith, 2012. A Different Paradigm for Brownfield Assessments/Remediation. Presented at the 2012 Pennsylvania Brownfields Conference. Co-authored by John J. Mahfood.

Work History

2023-Present	Associate Technical Consultant/Environmental Scientist/Risk Assessor, Worley Consulting
2020-2023	Sr. Risk Assessment Specialist, Strategic Risk Services, LLC
2010-2020	Environmental Risk Assessor, The Mahfood Group, LLC

Department of Administration
Purchasing Division
2019 Washington Street East
Post Office Box 50130
Charleston, WV 25305-0130

State of West Virginia
Centralized Request for Quote
Service - Prof

Proc Folder: 1468037 **Doc Description:** Environmental Risk Assessor **Proc Type:** Central Master Agreement			**Reason for Modification:**
Date Issued	**Solicitation Closes**	**Solicitation No**	**Version**
2024-09-04	2024-09-19 13:30	CRFQ 0313 DEP2500000004	1

BID RECEIVING LOCATION

BID CLERK
DEPARTMENT OF ADMINISTRATION
PURCHASING DIVISION
2019 WASHINGTON ST E
CHARLESTON WV 25305
US

VENDOR

Vendor Customer Code: VS0000046054

Vendor Name : Worley Group, Inc.

Address :

Street : 5995 Rogerdale Road

City : Houston

State : TX **Country :** USA **Zip :** 77072

Principal Contact : Lisa Poppelreiter

Vendor Contact Phone: 412-377-5089 **Extension:**

FOR INFORMATION CONTACT THE BUYER
Joseph E Hager III
(304) 558-2306
joseph.e.hageriii@wv.gov

Vendor Signature X **FEIN#** 94-2624994 **DATE** 19-Sept-2024

All offers subject to all terms and conditions contained in this solicitation

ADDITIONAL INFORMATION

The West Virginia Purchasing Division is soliciting bids on behalf of West Virginia Department of Environmental Protection to establish an open-end contract for an Environmental Risk Assessor to determine ecological and human health risks that may be associated with projects managed by the WVDEP per the attached specifications and terms and conditions.

INVOICE TO		SHIP TO	
ENVIRONMENTAL PROTECTION		ENVIRONMENTAL PROTECTION	
OFFICE OF ENVIRONMENTAL REMEDIATION		601 57TH ST	
601 57TH ST SE			
CHARLESTON	WV	CHARLESTON	WV
US		US	

Line	Comm Ln Desc	Qty	Unit Issue	Unit Price	Total Price
1	Risk or hazard assessment	700.00000	HOUR	$128/hr	$89,600

Comm Code	Manufacturer	Specification	Model #
77101501			

Extended Description:

Environmental Risk Assessor Open end contract for service, bid sheet represents an estimated number of hours for bidding purposes to establish a contracted set price per hour.

SCHEDULE OF EVENTS

Line	Event	Event Date

INSTRUCTIONS TO VENDORS SUBMITTING BIDS

1. REVIEW DOCUMENTS THOROUGHLY: The attached documents contain a solicitation for bids. Please read these instructions and all documents attached in their entirety. These instructions provide critical information about requirements that if overlooked could lead to disqualification of a Vendor's bid. All bids must be submitted in accordance with the provisions contained in these instructions and the Solicitation. Failure to do so may result in disqualification of Vendor's bid.

2. MANDATORY TERMS: The Solicitation may contain mandatory provisions identified by the use of the words "must," "will," and "shall." Failure to comply with a mandatory term in the Solicitation will result in bid disqualification.

3. PREBID MEETING: The item identified below shall apply to this Solicitation.

☑ A pre-bid meeting will not be held prior to bid opening

☐ A **MANDATORY PRE-BID** meeting will be held at the following place and time:

All Vendors submitting a bid must attend the mandatory pre-bid meeting. Failure to attend the mandatory pre-bid meeting shall result in disqualification of the Vendor's bid. No one individual is permitted to represent more than one vendor at the pre-bid meeting. Any individual that does attempt to represent two or more vendors will be required to select one vendor to which the individual's attendance will be attributed. The vendors not selected will be deemed to have not attended the pre-bid meeting unless another individual attended on their behalf.

An attendance sheet provided at the pre-bid meeting shall serve as the official document verifying attendance. Any person attending the pre-bid meeting on behalf of a Vendor must list on the attendance sheet his or her name and the name of the Vendor he or she is representing.

Additionally, the person attending the pre-bid meeting should include the Vendor's E-Mail address, phone number, and Fax number on the attendance sheet. It is the Vendor's responsibility to locate the attendance sheet and provide the required information. Failure to complete the attendance sheet as required may result in disqualification of Vendor's bid.

All Vendors should arrive prior to the starting time for the pre-bid. Vendors who arrive after the starting time but prior to the end of the pre-bid will be permitted to sign in but are charged with knowing all matters discussed at the pre-bid.

Questions submitted at least five business days prior to a scheduled pre-bid will be discussed at the pre-bid meeting if possible. Any discussions or answers to questions at the pre-bid meeting are preliminary in nature and are non-binding. Official and binding answers to questions will be published in a written addendum to the Solicitation prior to bid opening.

4. VENDOR QUESTION DEADLINE: Vendors may submit questions relating to this Solicitation to the Purchasing Division. Questions must be submitted in writing. All questions must be submitted on or before the date listed below and to the address listed below to be considered. A written response will be published in a Solicitation addendum if a response is possible and appropriate. Non-written discussions, conversations, or questions and answers regarding this Solicitation are preliminary in nature and are nonbinding.

Submitted emails should have the solicitation number in the subject line.

Question Submission Deadline: 9/11/2024 @ 4:00 PM ET

Submit Questions to: Josh Hager
2019 Washington Street, East
Charleston, WV 25305
Fax: (304) 558-3970
Email: Joseph.E.HagerIII@wv.gov

5. VERBAL COMMUNICATION: Any verbal communication between the Vendor and any State personnel is not binding, including verbal communication at the mandatory pre-bid conference. Only information issued in writing and added to the Solicitation by an official written addendum by the Purchasing Division is binding.

6. BID SUBMISSION: All bids must be submitted on or before the date and time of the bid opening listed in section 7 below. Vendors can submit bids electronically through *wv*OASIS, in paper form delivered to the Purchasing Division at the address listed below either in person or by courier, or in facsimile form by faxing to the Purchasing Division at the number listed below. Notwithstanding the foregoing, the Purchasing Division may prohibit the submission of bids electronically through *wv*OASIS at its sole discretion. Such a prohibition will be contained and communicated in the *wv*OASIS system resulting in the Vendor's inability to submit bids through *wv*OASIS. The Purchasing Division will not accept bids, modification of bids, or addendum acknowledgment forms via email. Bids submitted in paper or facsimile form must contain a signature. Bids submitted in *wv*OASIS are deemed to be electronically signed.

Any bid received by the Purchasing Division staff is considered to be in the possession of the Purchasing Division and will not be returned for any reason.

For Request for Proposal ("RFP") Responses Only: Submission of a response to a Request for Proposal is not permitted in *wv*OASIS. In the event that Vendor is responding to a request for proposal, the Vendor shall submit one original technical and one original cost proposal prior to the bid opening date and time identified in Section 7 below, plus _____convenience copies of each to the Purchasing Division at the address shown below. Additionally, the Vendor should clearly identify and segregate the cost proposal from the technical proposal in a separately sealed envelope.

Bid Delivery Address and Fax Number:
Department of Administration, Purchasing Division
2019 Washington Street East
Charleston, WV 25305-0130
Fax: 304-558-3970

A bid submitted in paper or facsimile form should contain the information listed below on the face of the submission envelope or fax cover sheet. Otherwise, the bid may be rejected by the Purchasing Division.

VENDOR NAME:
BUYER: Josh Hager
SOLICITATION NO.: CRFQ 0313 DEP2500000004
BID OPENING DATE: See section 7
BID OPENING TIME: See section 7
FAX NUMBER: 304-558-3970

7. BID OPENING: Bids submitted in response to this Solicitation will be opened at the location identified below on the date and time listed below. Delivery of a bid after the bid opening date and time will result in bid disqualification. For purposes of this Solicitation, a bid is considered delivered when confirmation of delivery is provided by *wv*OASIS (in the case of electronic submission) or when the bid is time stamped by the official Purchasing Division time clock (in the case of hand delivery).

Bid Opening Date and Time: 9/19/2024 @ 1:30 PM ET

Bid Opening Location: Department of Administration, Purchasing Division
2019 Washington Street East
Charleston, WV 25305-0130

8. ADDENDUM ACKNOWLEDGEMENT: Changes or revisions to this Solicitation will be made by an official written addendum issued by the Purchasing Division. Vendor should acknowledge receipt of all addenda issued with this Solicitation by completing an Addendum Acknowledgment Form, a copy of which is included herewith. Failure to acknowledge addenda may result in bid disqualification. The addendum acknowledgement should be submitted with the bid to expedite document processing.

9. BID FORMATTING: Vendor should type or electronically enter the information onto its bid to prevent errors in the evaluation. Failure to type or electronically enter the information may result in bid disqualification.

10. ALTERNATE MODEL OR BRAND: Unless the box below is checked, any model, brand, or specification listed in this Solicitation establishes the acceptable level of quality only and is not intended to reflect a preference for, or in any way favor, a particular brand or vendor. Vendors may bid alternates to a listed model or brand provided that the alternate is at least equal to the model or brand and complies with the required specifications. The equality of any alternate being bid shall be determined by the State at its sole discretion. Any Vendor bidding an alternate model or brand should clearly identify the alternate items in its bid and should include manufacturer's specifications, industry literature, and/or any other relevant documentation demonstrating the equality of the alternate items. Failure to provide information for alternate items may be grounds for rejection of a Vendor's bid.

☐ This Solicitation is based upon a standardized commodity established under W. Va. Code § 5A-3-61. Vendors are expected to bid the standardized commodity identified. Failure to bid the standardized commodity will result in your firm's bid being rejected.

11. EXCEPTIONS AND CLARIFICATIONS: The Solicitation contains the specifications that shall form the basis of a contractual agreement. Vendor shall clearly mark any exceptions, clarifications, or other proposed modifications in its bid. Exceptions to, clarifications of, or modifications of a requirement or term and condition of the Solicitation may result in bid disqualification.

12. COMMUNICATION LIMITATIONS: In accordance with West Virginia Code of State Rules §148-1-6.6, communication with the State of West Virginia or any of its employees regarding this Solicitation during the solicitation, bid, evaluation or award periods, except through the Purchasing Division, is strictly prohibited without prior Purchasing Division approval. Purchasing Division approval for such communication is implied for all agency delegated and exempt purchases.

13. REGISTRATION: Prior to Contract award, the apparent successful Vendor must be properly registered with the West Virginia Purchasing Division and must have paid the $125 fee, if applicable.

14. UNIT PRICE: Unit prices shall prevail in cases of a discrepancy in the Vendor's bid.

15. PREFERENCE: Vendor Preference may be requested in purchases of motor vehicles or construction and maintenance equipment and machinery used in highway and other infrastructure projects. Any request for preference must be submitted in writing with the bid, must specifically identify the preference requested with reference to the applicable subsection of West Virginia Code § 5A-3-37, and must include with the bid any information necessary to evaluate and confirm the applicability of the requested preference. A request form to help facilitate the request can be found at: www.state.wv.us/admin/purchase/vrc/Venpref.pdf.

15A. RECIPROCAL PREFERENCE: The State of West Virginia applies a reciprocal preference to all solicitations for commodities and printing in accordance with W. Va. Code § 5A-3-37(b). In effect, non-resident vendors receiving a preference in their home states, will see that same preference granted to West Virginia resident vendors bidding against them in West Virginia. Any request for reciprocal preference must include with the bid any information necessary to evaluate and confirm the applicability of the preference. A request form to help facilitate the request can be found at: www.state.wv.us/admin/purchase/vrc/Venpref.pdf.

16. SMALL, WOMEN-OWNED, OR MINORITY-OWNED BUSINESSES: For any solicitations publicly advertised for bid, in accordance with West Virginia Code §5A-3-37 and W. Va. CSR § 148-22-9, any non-resident vendor certified as a small, women- owned, or minority-owned business under W. Va. CSR § 148-22-9 shall be provided the same preference made available to any resident vendor. Any non-resident small, women-owned, or minority-owned business must identify itself as such in writing, must submit that writing to the Purchasing Division with its bid, and must be properly certified under W. Va. CSR § 148-22-9 prior to contract award to receive the preferences made available to resident vendors. Preference for a non-resident small, women-owned, or minority owned business shall be applied in accordance with W. Va. CSR § 148-22-9.

17. WAIVER OF MINOR IRREGULARITIES: The Director reserves the right to waive minor irregularities in bids or specifications in accordance with West Virginia Code of State Rules § 148-1-4.6.

18. ELECTRONIC FILE ACCESS RESTRICTIONS: Vendor must ensure that its submission in *wv*OASIS can be accessed and viewed by the Purchasing Division staff immediately upon bid opening. The Purchasing Division will consider any file that cannot be immediately accessed and viewed at the time of the bid opening (such as, encrypted files, password protected files, or incompatible files) to be blank or incomplete as context requires and are therefore unacceptable. A vendor will not be permitted to unencrypt files, remove password protections, or resubmit documents after bid opening to make a file viewable if those documents are required with the bid. A Vendor may be required to provide document passwords or remove access restrictions to allow the Purchasing Division to print or electronically save documents provided that those documents are viewable by the Purchasing Division prior to obtaining the password or removing the access restriction.

19. NON-RESPONSIBLE: The Purchasing Division Director reserves the right to reject the bid of any vendor as Non-Responsible in accordance with W. Va. Code of State Rules § 148-1-5.3, when the Director determines that the vendor submitting the bid does not have the capability to fully perform or lacks the integrity and reliability to assure good-faith performance."

20. ACCEPTANCE/REJECTION: The State may accept or reject any bid in whole, or in part in accordance with W. Va. Code of State Rules § 148-1-4.5. and § 148-1-6.4.b."

21. YOUR SUBMISSION IS A PUBLIC DOCUMENT: Vendor's entire response to the Solicitation and the resulting Contract are public documents. As public documents, they will be disclosed to the public following the bid/proposal opening or award of the contract, as required by the competitive bidding laws of West Virginia Code §§ 5A-3-1 et seq., 5-22-1 et seq., and 5G-1-1 et seq. and the Freedom of Information Act West Virginia Code §§ 29B-1-1 et seq.

DO NOT SUBMIT MATERIAL YOU CONSIDER TO BE CONFIDENTIAL, A TRADE SECRET, OR OTHERWISE NOT SUBJECT TO PUBLIC DISCLOSURE.

Submission of any bid, proposal, or other document to the Purchasing Division constitutes your explicit consent to the subsequent public disclosure of the bid, proposal, or document. The Purchasing Division will disclose any document labeled "confidential," "proprietary," "trade secret," "private," or labeled with any other claim against public disclosure of the documents, to include any "trade secrets" as defined by West Virginia Code § 47-22-1 et seq. All submissions are subject to public disclosure without notice.

22. WITH THE BID REQUIREMENTS: In instances where these specifications require documentation or other information with the bid, and a vendor fails to provide it with the bid, the Director of the Purchasing Division reserves the right to request those items after bid opening and prior to contract award pursuant to the authority to waive minor irregularities in bids or specifications under W. Va. CSR § 148-1-4.6. This authority does not apply to instances where state law mandates receipt with the bid.

23. EMAIL NOTIFICATION OF AWARD: The Purchasing Division will attempt to provide bidders with e-mail notification of contract award when a solicitation that the bidder participated in has been awarded. For notification purposes, bidders must provide the Purchasing Division with a valid email address in the bid response. Bidders may also monitor *wv*OASIS or the Purchasing Division's website to determine when a contract has been awarded.

24. ISRAEL BOYCOTT CERTIFICATION: Vendor's act of submitting a bid in response to this solicitation shall be deemed a certification from bidder to the State that bidder is not currently engaged in, and will not for the duration of the contract, engage in a boycott of Israel. This certification is required by W. Va. Code § 5A-3-63.

GENERAL TERMS AND CONDITIONS:

1. CONTRACTUAL AGREEMENT: Issuance of an Award Document signed by the Purchasing Division Director, or his designee, and approved as to form by the Attorney General's office constitutes acceptance by the State of this Contract made by and between the State of West Virginia and the Vendor. Vendor's signature on its bid, or on the Contract if the Contract is not the result of a bid solicitation, signifies Vendor's agreement to be bound by and accept the terms and conditions contained in this Contract.

2. DEFINITIONS: As used in this Solicitation/Contract, the following terms shall have the meanings attributed to them below. Additional definitions may be found in the specifications included with this Solicitation/Contract.

2.1. "Agency" or **"Agencies"** means the agency, board, commission, or other entity of the State of West Virginia that is identified on the first page of the Solicitation or any other public entity seeking to procure goods or services under this Contract.

2.2. "Bid" or **"Proposal"** means the vendors submitted response to this solicitation.

2.3. "Contract" means the binding agreement that is entered into between the State and the Vendor to provide the goods or services requested in the Solicitation.

2.4. "Director" means the Director of the West Virginia Department of Administration, Purchasing Division.

2.5. "Purchasing Division" means the West Virginia Department of Administration, Purchasing Division.

2.6. "Award Document" means the document signed by the Agency and the Purchasing Division, and approved as to form by the Attorney General, that identifies the Vendor as the contract holder.

2.7. "Solicitation" means the official notice of an opportunity to supply the State with goods or services that is published by the Purchasing Division.

2.8. "State" means the State of West Virginia and/or any of its agencies, commissions, boards, etc. as context requires.

2.9. "Vendor" or **"Vendors"** means any entity submitting a bid in response to the Solicitation, the entity that has been selected as the lowest responsible bidder, or the entity that has been awarded the Contract as context requires.

3. CONTRACT TERM; RENEWAL; EXTENSION: The term of this Contract shall be determined in accordance with the category that has been identified as applicable to this Contract below:

☑ **Term Contract**

Initial Contract Term: The Initial Contract Term will be for a period of one (1) year _____. The Initial Contract Term becomes effective on the effective start date listed on the first page of this Contract, identified as the State of West Virginia contract cover page containing the signatures of the Purchasing Division, Attorney General, and Encumbrance clerk (or another page identified as _____), and the Initial Contract Term ends on the effective end date also shown on the first page of this Contract.

Renewal Term: This Contract may be renewed upon the mutual written consent of the Agency, and the Vendor, with approval of the Purchasing Division and the Attorney General's office (Attorney General approval is as to form only). Any request for renewal should be delivered to the Agency and then submitted to the Purchasing Division thirty (30) days prior to the expiration date of the initial contract term or appropriate renewal term. A Contract renewal shall be in accordance with the terms and conditions of the original contract. Unless otherwise specified below, renewal of this Contract is limited to three (3) successive one (1) year periods or multiple renewal periods of less than one year, provided that the multiple renewal periods do not exceed the total number of months available in all renewal years combined. Automatic renewal of this Contract is prohibited. Renewals must be approved by the Vendor, Agency, Purchasing Division and Attorney General's office (Attorney General approval is as to form only)

☐ **Alternate Renewal Term** – This contract may be renewed for _____ successive _____ year periods or shorter periods provided that they do not exceed the total number of months contained in all available renewals. Automatic renewal of this Contract is prohibited. Renewals must be approved by the Vendor, Agency, Purchasing Division and Attorney General's office (Attorney General approval is as to form only)

Delivery Order Limitations: In the event that this contract permits delivery orders, a delivery order may only be issued during the time this Contract is in effect. Any delivery order issued within one year of the expiration of this Contract shall be effective for one year from the date the delivery order is issued. No delivery order may be extended beyond one year after this Contract has expired.

☐ **Fixed Period Contract:** This Contract becomes effective upon Vendor's receipt of the notice to proceed and must be completed within _____days.

☐ **Fixed Period Contract with Renewals:** This Contract becomes effective upon Vendor's receipt of the notice to proceed and part of the Contract more fully described in the attached specifications must be completed within _____ days. Upon completion of the work covered by the preceding sentence, the vendor agrees that:

☐ the contract will continue for _____ years;

☐ the contract may be renewed for _____ successive _____ year periods or shorter periods provided that they do not exceed the total number of months contained in all available renewals. Automatic renewal of this Contract is prohibited. Renewals must be approved by the Vendor, Agency, Purchasing Division and Attorney General's Office (Attorney General approval is as to form only).

☐ **One-Time Purchase:** The term of this Contract shall run from the issuance of the Award Document until all of the goods contracted for have been delivered, but in no event will this Contract extend for more than one fiscal year.

☐ **Construction/Project Oversight:** This Contract becomes effective on the effective start date listed on the first page of this Contract, identified as the State of West Virginia contract cover page containing the signatures of the Purchasing Division, Attorney General, and Encumbrance clerk (or another page identified as _____), and continues until the project for which the vendor is providing oversight is complete.

☐ **Other:** Contract Term specified in _____

4. AUTHORITY TO PROCEED: Vendor is authorized to begin performance of this contract on the date of encumbrance listed on the front page of the Award Document unless either the box for "Fixed Period Contract" or "Fixed Period Contract with Renewals" has been checked in Section 3 above. If either "Fixed Period Contract" or "Fixed Period Contract with Renewals" has been checked, Vendor must not begin work until it receives a separate notice to proceed from the State. The notice to proceed will then be incorporated into the Contract via change order to memorialize the official date that work commenced.

5. QUANTITIES: The quantities required under this Contract shall be determined in accordance with the category that has been identified as applicable to this Contract below.

☑ **Open End Contract:** Quantities listed in this Solicitation/Award Document are approximations only, based on estimates supplied by the Agency. It is understood and agreed that the Contract shall cover the quantities actually ordered for delivery during the term of the Contract, whether more or less than the quantities shown.

☐ **Service:** The scope of the service to be provided will be more clearly defined in the specifications included herewith.

☐ **Combined Service and Goods:** The scope of the service and deliverable goods to be provided will be more clearly defined in the specifications included herewith.

☐ **One-Time Purchase:** This Contract is for the purchase of a set quantity of goods that are identified in the specifications included herewith. Once those items have been delivered, no additional goods may be procured under this Contract without an appropriate change order approved by the Vendor, Agency, Purchasing Division, and Attorney General's office.

☐ **Construction:** This Contract is for construction activity more fully defined in the specifications.

6. EMERGENCY PURCHASES: The Purchasing Division Director may authorize the Agency to purchase goods or services in the open market that Vendor would otherwise provide under this Contract if those goods or services are for immediate or expedited delivery in an emergency. Emergencies shall include, but are not limited to, delays in transportation or an unanticipated increase in the volume of work. An emergency purchase in the open market, approved by the Purchasing Division Director, shall not constitute of breach of this Contract and shall not entitle the Vendor to any form of compensation or damages. This provision does not excuse the State from fulfilling its obligations under a One-Time Purchase contract.

7. REQUIRED DOCUMENTS: All of the items checked in this section must be provided to the Purchasing Division by the Vendor as specified:

☐ **LICENSE(S) / CERTIFICATIONS / PERMITS:** In addition to anything required under the Section of the General Terms and Conditions entitled Licensing, the apparent successful Vendor shall furnish proof of the following licenses, certifications, and/or permits upon request and in a form acceptable to the State. The request may be prior to or after contract award at the State's sole discretion.

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The apparent successful Vendor shall also furnish proof of any additional licenses or certifications contained in the specifications regardless of whether or not that requirement is listed above.

8. INSURANCE: The apparent successful Vendor shall furnish proof of the insurance identified by a checkmark below prior to Contract award. The insurance coverages identified below must be maintained throughout the life of this contract. Thirty (30) days prior to the expiration of the insurance policies, Vendor shall provide the Agency with proof that the insurance mandated herein has been continued. Vendor must also provide Agency with immediate notice of any changes in its insurance policies, including but not limited to, policy cancelation, policy reduction, or change in insurers. The apparent successful Vendor shall also furnish proof of any additional insurance requirements contained in the specifications prior to Contract award regardless of whether that insurance requirement is listed in this section.

Vendor must maintain:

☑ **Commercial General Liability Insurance** in at least an amount of: $1,000,000.00 per occurrence.

☐ **Automobile Liability Insurance** in at least an amount of: _____per occurrence.

☑ **Professional/Malpractice/Errors and Omission Insurance** in at least an amount of: $1,000,000.00 per occurrence. Notwithstanding the forgoing, Vendor's are not required to list the State as an additional insured for this type of policy.

☐ **Commercial Crime and Third Party Fidelity Insurance** in an amount of: _____ per occurrence.

☐ **Cyber Liability Insurance** in an amount of: _____ per occurrence.

☐ **Builders Risk Insurance** in an amount equal to 100% of the amount of the Contract.

☐ **Pollution Insurance** in an amount of: _____ per occurrence.

☐ **Aircraft Liability** in an amount of: _____ per occurrence.

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9. WORKERS' COMPENSATION INSURANCE: Vendor shall comply with laws relating to workers compensation, shall maintain workers' compensation insurance when required, and shall furnish proof of workers' compensation insurance upon request.

10. VENUE: All legal actions for damages brought by Vendor against the State shall be brought in the West Virginia Claims Commission. Other causes of action must be brought in the West Virginia court authorized by statute to exercise jurisdiction over it.

11. LIQUIDATED DAMAGES: This clause shall in no way be considered exclusive and shall not limit the State or Agency's right to pursue any other available remedy. Vendor shall pay liquidated damages in the amount specified below or as described in the specifications:

☐ _____ for _____.

☐ Liquidated Damages Contained in the Specifications.

☑ Liquidated Damages Are Not Included in this Contract.

12. ACCEPTANCE: Vendor's signature on its bid, or on the certification and signature page, constitutes an offer to the State that cannot be unilaterally withdrawn, signifies that the product or service proposed by vendor meets the mandatory requirements contained in the Solicitation for that product or service, unless otherwise indicated, and signifies acceptance of the terms and conditions contained in the Solicitation unless otherwise indicated.

13. PRICING: The pricing set forth herein is firm for the life of the Contract, unless specified elsewhere within this Solicitation/Contract by the State. A Vendor's inclusion of price adjustment provisions in its bid, without an express authorization from the State in the Solicitation to do so, may result in bid disqualification. Notwithstanding the foregoing, Vendor must extend any publicly advertised sale price to the State and invoice at the lower of the contract price or the publicly advertised sale price.

14. PAYMENT IN ARREARS: Payments for goods/services will be made in arrears only upon receipt of a proper invoice, detailing the goods/services provided or receipt of the goods/services, whichever is later. Notwithstanding the foregoing, payments for software maintenance, licenses, or subscriptions may be paid annually in advance.

15. PAYMENT METHODS: Vendor must accept payment by electronic funds transfer and P-Card. (The State of West Virginia's Purchasing Card program, administered under contract by a banking institution, processes payment for goods and services through state designated credit cards.)

16. TAXES: The Vendor shall pay any applicable sales, use, personal property or any other taxes arising out of this Contract and the transactions contemplated thereby. The State of West Virginia is exempt from federal and state taxes and will not pay or reimburse such taxes.

17. ADDITIONAL FEES: Vendor is not permitted to charge additional fees or assess additional charges that were not either expressly provided for in the solicitation published by the State of West Virginia, included in the Contract, or included in the unit price or lump sum bid amount that Vendor is required by the solicitation to provide. Including such fees or charges as notes to the solicitation may result in rejection of vendor's bid. Requesting such fees or charges be paid after the contract has been awarded may result in cancellation of the contract.

18. FUNDING: This Contract shall continue for the term stated herein, contingent upon funds being appropriated by the Legislature or otherwise being made available. In the event funds are not appropriated or otherwise made available, this Contract becomes void and of no effect beginning on July 1 of the fiscal year for which funding has not been appropriated or otherwise made available. If that occurs, the State may notify the Vendor that an alternative source of funding has been obtained and thereby avoid the automatic termination. Non-appropriation or non-funding shall not be considered an event of default.

19. CANCELLATION: The Purchasing Division Director reserves the right to cancel this Contract immediately upon written notice to the vendor if the materials or workmanship supplied do not conform to the specifications contained in the Contract. The Purchasing Division Director may also cancel any purchase or Contract upon 30 days written notice to the Vendor in accordance with West Virginia Code of State Rules § 148-1-5.2.b.

20. TIME: Time is of the essence regarding all matters of time and performance in this Contract.

21. APPLICABLE LAW: This Contract is governed by and interpreted under West Virginia law without giving effect to its choice of law principles. Any information provided in specification manuals, or any other source, verbal or written, which contradicts or violates the West Virginia Constitution, West Virginia Code, or West Virginia Code of State Rules is void and of no effect.

22. COMPLIANCE WITH LAWS: Vendor shall comply with all applicable federal, state, and local laws, regulations and ordinances. By submitting a bid, Vendor acknowledges that it has reviewed, understands, and will comply with all applicable laws, regulations, and ordinances.

> **SUBCONTRACTOR COMPLIANCE:** Vendor shall notify all subcontractors providing commodities or services related to this Contract that as subcontractors, they too are required to comply with all applicable laws, regulations, and ordinances. Notification under this provision must occur prior to the performance of any work under the contract by the subcontractor.

23. ARBITRATION: Any references made to arbitration contained in this Contract, Vendor's bid, or in any American Institute of Architects documents pertaining to this Contract are hereby deleted, void, and of no effect.

24. MODIFICATIONS: This writing is the parties' final expression of intent. Notwithstanding anything contained in this Contract to the contrary no modification of this Contract shall be binding without mutual written consent of the Agency, and the Vendor, with approval of the Purchasing Division and the Attorney General's office (Attorney General approval is as to form only). Any change to existing contracts that adds work or changes contract cost, and were not included in the original contract, must be approved by the Purchasing Division and the Attorney General's Office (as to form) prior to the implementation of the change or commencement of work affected by the change.

25. WAIVER: The failure of either party to insist upon a strict performance of any of the terms or provision of this Contract, or to exercise any option, right, or remedy herein contained, shall not be construed as a waiver or a relinquishment for the future of such term, provision, option, right, or remedy, but the same shall continue in full force and effect. Any waiver must be expressly stated in writing and signed by the waiving party.

26. SUBSEQUENT FORMS: The terms and conditions contained in this Contract shall supersede any and all subsequent terms and conditions which may appear on any form documents submitted by Vendor to the Agency or Purchasing Division such as price lists, order forms, invoices, sales agreements, or maintenance agreements, and includes internet websites or other electronic documents. Acceptance or use of Vendor's forms does not constitute acceptance of the terms and conditions contained thereon.

27. ASSIGNMENT: Neither this Contract nor any monies due, or to become due hereunder, may be assigned by the Vendor without the express written consent of the Agency, the Purchasing Division, the Attorney General's office (as to form only), and any other government agency or office that may be required to approve such assignments.

28. WARRANTY: The Vendor expressly warrants that the goods and/or services covered by this Contract will: (a) conform to the specifications, drawings, samples, or other description furnished or specified by the Agency; (b) be merchantable and fit for the purpose intended; and (c) be free from defect in material and workmanship.

29. STATE EMPLOYEES: State employees are not permitted to utilize this Contract for personal use and the Vendor is prohibited from permitting or facilitating the same.

30. PRIVACY, SECURITY, AND CONFIDENTIALITY: The Vendor agrees that it will not disclose to anyone, directly or indirectly, any such personally identifiable information or other confidential information gained from the Agency, unless the individual who is the subject of the information consents to the disclosure in writing or the disclosure is made pursuant to the Agency's policies, procedures, and rules. Vendor further agrees to comply with the Confidentiality Policies and Information Security Accountability Requirements, set forth in www.state.wv.us/admin/purchase/privacy.

31. YOUR SUBMISSION IS A PUBLIC DOCUMENT: Vendor's entire response to the Solicitation and the resulting Contract are public documents. As public documents, they will be disclosed to the public following the bid/proposal opening or award of the contract, as required by the competitive bidding laws of West Virginia Code §§ 5A-3-1 et seq., 5-22-1 et seq., and 5G-1-1 et seq. and the Freedom of Information Act West Virginia Code §§ 29B-1-1 et seq.

DO NOT SUBMIT MATERIAL YOU CONSIDER TO BE CONFIDENTIAL, A TRADE SECRET, OR OTHERWISE NOT SUBJECT TO PUBLIC DISCLOSURE.

Submission of any bid, proposal, or other document to the Purchasing Division constitutes your explicit consent to the subsequent public disclosure of the bid, proposal, or document. The Purchasing Division will disclose any document labeled "confidential," "proprietary," "trade secret," "private," or labeled with any other claim against public disclosure of the documents, to include any "trade secrets" as defined by West Virginia Code § 47-22-1 et seq. All submissions are subject to public disclosure without notice.

32. LICENSING: In accordance with West Virginia Code of State Rules § 148-1-6.1.e, Vendor must be licensed and in good standing in accordance with any and all state and local laws and requirements by any state or local agency of West Virginia, including, but not limited to, the West Virginia Secretary of State's Office, the West Virginia Tax Department, West Virginia Insurance Commission, or any other state agency or political subdivision. Obligations related to political subdivisions may include, but are not limited to, business licensing, business and occupation taxes, inspection compliance, permitting, etc. Upon request, the Vendor must provide all necessary releases to obtain information to enable the Purchasing Division Director or the Agency to verify that the Vendor is licensed and in good standing with the above entities.

SUBCONTRACTOR COMPLIANCE: Vendor shall notify all subcontractors providing commodities or services related to this Contract that as subcontractors, they too are required to be licensed, in good standing, and up-to-date on all state and local obligations as described in this section. Obligations related to political subdivisions may include, but are not limited to, business licensing, business and occupation taxes, inspection compliance, permitting, etc. Notification under this provision must occur prior to the performance of any work under the contract by the subcontractor.

33. ANTITRUST: In submitting a bid to, signing a contract with, or accepting a Award Document from any agency of the State of West Virginia, the Vendor agrees to convey, sell, assign, or transfer to the State of West Virginia all rights, title, and interest in and to all causes of action it may now or hereafter acquire under the antitrust laws of the United States and the State of West Virginia for price fixing and/or unreasonable restraints of trade relating to the particular commodities or services purchased or acquired by the State of West Virginia. Such assignment shall be made and become effective at the time the purchasing agency tenders the initial payment to Vendor.

34. VENDOR NON-CONFLICT: Neither Vendor nor its representatives are permitted to have any interest, nor shall they acquire any interest, direct or indirect, which would compromise the performance of its services hereunder. Any such interests shall be promptly presented in detail to the Agency.

35. VENDOR RELATIONSHIP: The relationship of the Vendor to the State shall be that of an independent contractor and no principal-agent relationship or employer-employee relationship is contemplated or created by this Contract. The Vendor as an independent contractor is solely liable for the acts and omissions of its employees and agents. Vendor shall be responsible for selecting, supervising, and compensating any and all individuals employed pursuant to the terms of this Solicitation and resulting contract. Neither the Vendor, nor any employees or subcontractors of the Vendor, shall be deemed to be employees of the State for any purpose whatsoever. Vendor shall be exclusively responsible for payment of employees and contractors for all wages and salaries, taxes, withholding payments, penalties, fees, fringe benefits, professional liability insurance premiums, contributions to insurance and pension, or other deferred compensation plans, including but not limited to, Workers' Compensation and Social Security obligations, licensing fees, etc. and the filing of all necessary documents, forms, and returns pertinent to all of the foregoing.

Vendor shall hold harmless the State, and shall provide the State and Agency with a defense against any and all claims including, but not limited to, the foregoing payments, withholdings, contributions, taxes, Social Security taxes, and employer income tax returns.

36. INDEMNIFICATION: The Vendor agrees to indemnify, defend, and hold harmless the State and the Agency, their officers, and employees from and against: (1) Any claims or losses for services rendered by any subcontractor, person, or firm performing or supplying services, materials, or supplies in connection with the performance of the Contract; (2) Any claims or losses resulting to any person or entity injured or damaged by the Vendor, its officers, employees, or subcontractors by the publication, translation, reproduction, delivery, performance, use, or disposition of any data used under the Contract in a manner not authorized by the Contract, or by Federal or State statutes or regulations; and (3) Any failure of the Vendor, its officers, employees, or subcontractors to observe State and Federal laws including, but not limited to, labor and wage and hour laws.

37. NO DEBT CERTIFICATION: In accordance with West Virginia Code §§ 5A-3-10a and 5-22-1(i), the State is prohibited from awarding a contract to any bidder that owes a debt to the State or a political subdivision of the State. By submitting a bid, or entering into a contract with the State, Vendor is affirming that (1) for construction contracts, the Vendor is not in default on any monetary obligation owed to the state or a political subdivision of the state, and (2) for all other contracts, neither the Vendor nor any related party owe a debt as defined above, and neither the Vendor nor any related party are in employer default as defined in the statute cited above unless the debt or employer default is permitted under the statute.

38. CONFLICT OF INTEREST: Vendor, its officers or members or employees, shall not presently have or acquire an interest, direct or indirect, which would conflict with or compromise the performance of its obligations hereunder. Vendor shall periodically inquire of its officers, members and employees to ensure that a conflict of interest does not arise. Any conflict of interest discovered shall be promptly presented in detail to the Agency.

39. REPORTS: Vendor shall provide the Agency and/or the Purchasing Division with the following reports identified by a checked box below:

☐ Such reports as the Agency and/or the Purchasing Division may request. Requested reports may include, but are not limited to, quantities purchased, agencies utilizing the contract, total contract expenditures by agency, etc.

☐ Quarterly reports detailing the total quantity of purchases in units and dollars, along with a listing of purchases by agency. Quarterly reports should be delivered to the Purchasing Division via email at purchasing.division@wv.gov.

40. BACKGROUND CHECK: In accordance with W. Va. Code § 15-2D-3, the State reserves the right to prohibit a service provider's employees from accessing sensitive or critical information or to be present at the Capitol complex based upon results addressed from a criminal background check. Service providers should contact the West Virginia Division of Protective Services by phone at (304) 558-9911 for more information.

41. PREFERENCE FOR USE OF DOMESTIC STEEL PRODUCTS: Except when authorized by the Director of the Purchasing Division pursuant to W. Va. Code § 5A-3-56, no contractor may use or supply steel products for a State Contract Project other than those steel products made in the United States. A contractor who uses steel products in violation of this section may be subject to civil penalties pursuant to W. Va. Code § 5A-3-56. As used in this section:

a. "State Contract Project" means any erection or construction of, or any addition to, alteration of or other improvement to any building or structure, including, but not limited to, roads or highways, or the installation of any heating or cooling or ventilating plants or other equipment, or the supply of and materials for such projects, pursuant to a contract with the State of West Virginia for which bids were solicited on or after June 6, 2001.

b. "Steel Products" means products rolled, formed, shaped, drawn, extruded, forged, cast, fabricated or otherwise similarly processed, or processed by a combination of two or more or such operations, from steel made by the open heath, basic oxygen, electric furnace, Bessemer or other steel making process.

c. The Purchasing Division Director may, in writing, authorize the use of foreign steel products if:

    1. The cost for each contract item used does not exceed one tenth of one percent (.1%) of the total contract cost or two thousand five hundred dollars ($2,500.00), whichever is greater. For the purposes of this section, the cost is the value of the steel product as delivered to the project; or

    2. The Director of the Purchasing Division determines that specified steel materials are not produced in the United States in sufficient quantity or otherwise are not reasonably available to meet contract requirements.

42. PREFERENCE FOR USE OF DOMESTIC ALUMINUM, GLASS, AND STEEL: In Accordance with W. Va. Code § 5-19-1 et seq., and W. Va. CSR § 148-10-1 et seq., for every contract or subcontract, subject to the limitations contained herein, for the construction, reconstruction, alteration, repair, improvement or maintenance of public works or for the purchase of any item of machinery or equipment to be used at sites of public works, only domestic aluminum, glass or steel products shall be supplied unless the spending officer determines, in writing, after the receipt of offers or bids, (1) that the cost of domestic aluminum, glass or steel products is unreasonable or inconsistent with the public interest of the State of West Virginia, (2) that domestic aluminum, glass or steel products are not produced in sufficient quantities to meet the contract requirements, or (3) the available domestic aluminum, glass, or steel do not meet the contract specifications. This provision only applies to public works contracts awarded in an amount more than fifty thousand dollars ($50,000) or public works contracts that require more than ten thousand pounds of steel products.

The cost of domestic aluminum, glass, or steel products may be unreasonable if the cost is more than twenty percent (20%) of the bid or offered price for foreign made aluminum, glass, or steel products. If the domestic aluminum, glass or steel products to be supplied or produced in a "substantial labor surplus area", as defined by the United States Department of Labor, the cost of domestic aluminum, glass, or steel products may be unreasonable if the cost is more than thirty percent (30%) of the bid or offered price for foreign made aluminum, glass, or steel products. This preference shall be applied to an item of machinery or equipment, as indicated above, when the item is a single unit of equipment or machinery manufactured primarily of aluminum, glass or steel, is part of a public works contract and has the sole purpose or of being a permanent part of a single public works project. This provision does not apply to equipment or machinery purchased by a spending unit for use by that spending unit and not as part of a single public works project.

All bids and offers including domestic aluminum, glass or steel products that exceed bid or offer prices including foreign aluminum, glass or steel products after application of the preferences provided in this provision may be reduced to a price equal to or lower than the lowest bid or offer price for foreign aluminum, glass or steel products plus the applicable preference. If the reduced bid or offer prices are made in writing and supersede the prior bid or offer prices, all bids or offers, including the reduced bid or offer prices, will be reevaluated in accordance with this rule.

43. INTERESTED PARTY SUPPLEMENTAL DISCLOSURE: W. Va. Code § 6D-1-2 requires that for contracts with an actual or estimated value of at least $1 million, the Vendor must submit to the Agency a disclosure of interested parties prior to beginning work under this Contract. Additionally, the Vendor must submit a supplemental disclosure of interested parties reflecting any new or differing interested parties to the contract, which were not included in the original pre-work interested party disclosure, within 30 days following the completion or termination of the contract. A copy of that form is included with this solicitation or can be obtained from the WV Ethics Commission. This requirement does not apply to publicly traded companies listed on a national or international stock exchange. A more detailed definition of interested parties can be obtained from the form referenced above.

44. PROHIBITION AGAINST USED OR REFURBISHED: Unless expressly permitted in the solicitation published by the State, Vendor must provide new, unused commodities, and is prohibited from supplying used or refurbished commodities, in fulfilling its responsibilities under this Contract.

45. VOID CONTRACT CLAUSES: This Contract is subject to the provisions of West Virginia Code § 5A-3-62, which automatically voids certain contract clauses that violate State law.

46. ISRAEL BOYCOTT: Bidder understands and agrees that, pursuant to W. Va. Code § 5A-3-63, it is prohibited from engaging in a boycott of Israel during the term of this contract.

DESIGNATED CONTACT: Vendor appoints the individual identified in this Section as the Contract Administrator and the initial point of contact for matters relating to this Contract.

(Printed Name and Title) Lisa Poppelreiter, Associate Technical Consultant/Env Scientist

(Address) 1 Meridian Blvd, Suite 2C02, Wyomissing, PA 19610

(Phone Number) / (Fax Number) 412-377-5089

(email address) lisa.poppelreiter@worley.com

CERTIFICATION AND SIGNATURE: By signing below, or submitting documentation through *wv*OASIS, I certify that: I have reviewed this Solicitation/Contract in its entirety; that I understand the requirements, terms and conditions, and other information contained herein; that this bid, offer or proposal constitutes an offer to the State that cannot be unilaterally withdrawn; that the product or service proposed meets the mandatory requirements contained in the Solicitation/Contract for that product or service, unless otherwise stated herein; that the Vendor accepts the terms and conditions contained in the Solicitation, unless otherwise stated herein; that I am submitting this bid, offer or proposal for review and consideration; that this bid or offer was made without prior understanding, agreement, or connection with any entity submitting a bid or offer for the same material, supplies, equipment or services; that this bid or offer is in all respects fair and without collusion or fraud; that this Contract is accepted or entered into without any prior understanding, agreement, or connection to any other entity that could be considered a violation of law; that I am authorized by the Vendor to execute and submit this bid, offer, or proposal, or any documents related thereto on Vendor's behalf; that I am authorized to bind the vendor in a contractual relationship; and that to the best of my knowledge, the vendor has properly registered with any State agency that may require registration.

By signing below, I further certify that I understand this Contract is subject to the provisions of West Virginia Code § 5A-3-62, which automatically voids certain contract clauses that violate State law; and that pursuant to W. Va. Code 5A-3-63, the entity entering into this contract is prohibited from engaging in a boycott against Israel.

Worley Group, Inc.
(Company)

(Signature of Authorized Representative)

Lisa Poppelreiter, Associate Technical Consultant/Env Scientist 19-Sept-2024
(Printed Name and Title of Authorized Representative) (Date)

412-377-5089
(Phone Number) (Fax Number)

lisa.poppelreiter@worley.com
(Email Address)

ADDENDUM ACKNOWLEDGEMENT FORM
SOLICITATION NO.:

Instructions: Please acknowledge receipt of all addenda issued with this solicitation by completing this addendum acknowledgment form. Check the box next to each addendum received and sign below. Failure to acknowledge addenda may result in bid disqualification.

Acknowledgment: I hereby acknowledge receipt of the following addenda and have made the necessary revisions to my proposal, plans and/or specification, etc.

Addendum Numbers Received:
(Check the box next to each addendum received)

☐ Addendum No. 1	☐ Addendum No. 6
☐ Addendum No. 2	☐ Addendum No. 7
☐ Addendum No. 3	☐ Addendum No. 8
☐ Addendum No. 4	☐ Addendum No. 9
☐ Addendum No. 5	☐ Addendum No. 10

I understand that failure to confirm the receipt of addenda may be cause for rejection of this bid. I further understand that any verbal representation made or assumed to be made during any oral discussion held between Vendor's representatives and any state personnel is not binding. Only the information issued in writing and added to the specifications by an official addendum is binding.

Worley Group, Inc.
Company

Authorized Signature

19-Sept-2024
Date

NOTE: This addendum acknowledgement should be submitted with the bid to expedite document processing.

SPECIFICATIONS

1. **PURPOSE AND SCOPE:** The West Virginia Purchasing Division is soliciting bids on behalf of West Virginia Department of Environmental Protection to establish an open-end contract for an Environmental Risk Assessor to determine ecological and human health risks that may be associated with projects managed by the WVDEP.

2. **DEFINITIONS:** The terms listed below shall have the meanings assigned to them below. Additional definitions can be found in section 2 of the General Terms and Conditions.

   2.1 **"Agency"** means West Virginia Department of Environmental Protection (WVDEP).

   2.2 **"Contract Item"** or **"Contract Items"** means the list of items identified in Section 3.1 below and on the Pricing Pages.

   2.3 **"Environmental Risk Assessor"** means a person who evaluates the exposure of human and ecological receptors to contaminants in environmental media (i.e. soil, groundwater, air, sediments, and surface water) and determines the likelihood that such exposure would results in an adverse impact to the health of the receptor. Risk assessments are dependent upon mathematical constructs of interactions between living organisms and contaminants in their environment. Risk assessors must possess knowledge of toxicology, statistics, biology, and chemistry as well as the ability to apply computer models simulating contaminant behavior in environmental media and/or contamination uptake and distribution within a biological system. Risk assessors must also be able to perform complex calculations using appropriate environmental data and Agency-approved exposure parameters and to present the information in tabular form and figures according to OER's Voluntary Remediation Program Guidance Manual.

   2.4 **"LRS"** means Licensed Remediation Specialist

   2.5 **"OER"** means the Office of Environmental Remediation

   2.6 **"Pricing Pages"** means the schedule of prices, estimated order quantity, and totals contained in wvOASIS and used to evaluate the Solicitation responses.

   2.7 **"Solicitation"** means the official notice of an opportunity to supply the State with goods or services that is published by the Purchasing Division.

   2.8 **"TCAU"** means the Tanks Corrective Action Unit.

   2.9 **"VRP"** means the Voluntary Remediation Program.

2.10 "WVDEP" means the West Virginia Department of Environmental Protection

3. GENERAL REQUIREMENTS:

3.1 Contract Items and Mandatory Requirements: Vendor shall provide Agency with the Contract Items listed below on an open-end and continuing basis. Contract Items must meet or exceed the mandatory requirements as shown below.

3.1.1 Background, Qualifications, Record Retention, Confidentiality, Testimony

3.1.1.1 Background: There are several sections within the WVDEP that use Risk Assessments within their Programs. The majority of the Risk Assessment work is related to the WVDEP Division of Land Restoration, Office of Environmental Remediation (OER), which oversees the Voluntary Remediation Program (VRP), UECA-LUST Program, Brownfields Assistance Program, and CERCLA Programs. The WVEP TCAU section also utilizes Risk Assessments.

Within these programs, human health and ecological risks are assessed by use of one or more levels of evaluation in order to determine suitability of these sites for reuse and the need for applying controls to mitigate remaining site risks. Guidance for WVDEP Risk Assessments can be found in OER's Voluntary Remediation Program Guidance Manual located on OER's website: https://dep.wv.gov/dlr/oer/technicalguidanceandtemplates/Documents/VRP%20Guidance%20Manual.pdf

The primary responsibility for providing an accurate assessment of site risks resides with the Licensed Remediation Specialist (LRS), who is retained by the property owner or interested party to oversee the site evaluation.

In addition, an Agency risk assessor/toxicologist is often consulted during the early stages of a site investigation to assist in developing a preliminary conceptual site model supported by an appropriate sampling and analysis plan.

Currently, risk assessments are most often evaluated by the Agency's risk assessor/toxicologist, but the Agency may experience a temporary need for additional capacity in order to meet required review deadlines for risk assessment and related documents.

The Agency also requires a third-party contractor to review updates to the De Minimis Standards, as applicable: https://dep.wv.gov/dlr/oer/technicalguidanceandtemplates/Documents/De%20Minimis%20and%20Relevant%20Benchmarks.xlsx

3.1.1.2 **Qualifications:** Vendor or Vendor's staff if requirements are inherently limited to individuals rather than corporate entities, shall have the following minimum qualifications:

3.1.1.2.1 A doctoral degree in a relevant field of study from an accredited university and a minimum of three (3) years of relevant professional experience; ***OR***

3.1.1.2.2 A Master of Science degree in a relevant field of study from an accredited university and a minimum of five (5) years of relevant professional experience.

3.1.1.2.3 Relevant professional experience must consist of work related directly to risk assessment, risk characterization, and risk management activities.

3.1.1.2.4 At the discretion of the Vendor, an employee of the Vendor with knowledge in the applicable disciplines of toxicology, statistics, biology, and chemistry may conduct the review. The final report, however, must be prepared by, or under the direction of, an Environmental Risk Assessor.

3.1.1.2.5 Compliance with experience requirements will be determined prior to contract award

by the State through references provided by the Vendor with its bid or upon request, through knowledge or documentation of the Vendor's past projects, or some other method that the State determines to be acceptable. Vendors should submit a current resume' which includes information regarding the number of years of qualification, experience and training, and relevant professional education for each individual that will be assigned to this project. Vendor must provide any documentation requested by the State to assist in confirmation of compliance with this provision. References, documentation, or other information to confirm compliance with this experience requirement are preferred with the bid submission; but may be requested prior to award.

3.1.1.2.6 An example risk assessment report or a risk assessment review prepared by the Vendor demonstrating evidence of relevant professional experience must also be provided prior to award. Submission of the sample document(s) may be in electronic format. Redaction of confidential information regarding site/client names on the sample documents is acceptable.

The WVDEP reserves the right to request and approve credentials of any person assigned to perform work under this contract.

3.1.1.3 Record Retention: The Vendor shall maintain such records a minimum of five (5) years and make available all records to Agency personnel at the Vendor's location during normal business hours, 8:00AM to 5:00PM, upon written request by the Agency within ten (10) calendar days after receipt of the request.

3.1.1.4 Confidentiality: The Vendor shall have access to private and confidential data maintained by the Agency to the

extent required for the Vendor to carry out the duties and responsibilities defined in this contract. Documents will be sent to the Vendor through a secured server. Failure to maintain confidentiality will result in cancellation of the contract.

The Vendor agrees to maintain confidentiality and security of the data made available and shall indemnify and hold harmless the State and Agency against any and all claims brought by any party attributed to actions of breach of confidentiality by the Vendor, subcontractors, or individuals permitted access by the Vendor.

3.1.1.5 **Testimony:** Should the Agency request additional assistance from the contractor for testimony in any state or federal court or before any board of other administrative body associated with a document prepared under this agreement, such assistance shall be considered to be within the scope of work for this contract and thus billed at the same hourly rate as the rest of the items in this contract. An estimated number of times this might occur is twice a year. Meetings/testimony would likely take place in Charleston, WV; however, other locations are possible.

4. CONTRACT AWARD:

4.1 **Contract Award:** The Contract is intended to provide the Agency with a purchase price on all Contract Items. The Contract shall be awarded to the two (2) lowest bid Vendors that provide the Contract Items meeting the required specifications for the lowest overall TOTAL BID AMOUNT as shown on the commodity lines in wvoasis. Vendors must provide resumes for verification of qualifications with their bid. Selection will be based on the lowest qualified bids. However, if the Vendor has a conflict of interest on the job, the next Vendor will be selected to avoid the conflict of interest.

4.2 **Pricing Pages:** Vendor should complete the Pricing Pages by bidding on the price per hour (x) multiplied by the Estimated Quantity of Hours needed (=) equals the extended cost. Vendor should complete the Pricing Pages in their entirety as failure to do so may result in Vendor's bids being disqualified.

The Pricing Pages contain a list of the Contract Items and estimated purchase volume. The estimated purchase volume for each item represents the

approximate volume of anticipated purchases only. No future use of the Contract or any individual item is guaranteed or implied.

Vendor should type or electronically enter the information into the Pricing Pages through wvOASIS, if available, or as an electronic document. Vendors can download the electronic copy of the Pricing Pages from the wvOASIS Vendor Self-Service (VSS) website. If responding with paper bid, Vendors should download and/or print the assembled CRFQ document (with the highest version number) from wvOASIS and insert their unit price and extended cost for each item.

5. ORDERING AND PAYMENT:

5.1 Ordering: Vendor shall accept orders through wvOASIS, regular mail, facsimile, e-mail, or any other written form of communication. Vendor may, but is not required to, accept on-line orders through a secure internet ordering portal/website. If Vendor has the ability to accept on-line orders, it should include in its response a brief description of how Agencies may utilize the on-line ordering system. Vendor shall ensure that its on-line ordering system is properly secured prior to processing Agency orders on-line.

5.1.1 Work Directives: Work will be ordered by issuance of a work Directive. The Work Directive will contain the location of the project site, the specific problem, the work to be performed, and the time frame during which the work must be completed.

5.1.1.1 Provided there is no conflict of interest in review of a specific project, the Work Directive shall be awarded in the following manner:

5.1.1.1.1 The Work Directive award will go to the first lowest successful Vendor.

5.1.1.1.2 If the Vendor accepts the Work Directive, a work plan and cost proposal will be required from the Vendor as specified in the Work Directive. The Vendor will have five (5) working days to accept or refuse the project. The work plan/cost proposal will consist of a brief description of the work to be performed, the number of hours, and the total dollar amount it will cost to perform each task included in the Work Directive. This can be provided in a simple email. Vendors will not be reimbursed for providing the work plan/cost estimate.

5.1.1.1.3 If the Vendor refused the Work Directive, it will be offered to the second lowest successful Vendor and so on.

5.1.1.1.4 The Vendor's submitted work plan and cost estimate, containing the quantity estimates, shall be in accordance with the unit process provided in the response to this RFQ. If the work plan and cost estimate are approved, the WVDEP will issue a Notice to Proceed which will specify the cost of the project and the starting and ending dates. Deliverables will be submitted electronically.

5.1.1.1.5 The Vendor shall not begin work until a signed Notice to Proceed has been issued by the WVDEP.

5.2 Payment: Vendor shall accept payment in accordance with the payment procedures of the State of West Virginia.

5.2.1 Invoice: A flat rate per hour will be the total charge to the state and will cover the full cost of all work hours including labor, travel, and materials. The Vendor will be contacted to provide Risk Assessor services on an "as needed" basis only. The Vendor will invoice the WVDEP on a monthly basis. All Invoices must be accompanied by a sworn statement detailing actual hours worked.

6. DELIVERY AND RETURN:

6.1 Delivery Time: Vendor shall deliver standard orders as stated in the Work Directive. The Notice to Proceed will specify the starting and ending dates for each Work Directive. Deliverables shall be submitted electronically, unless a specific request is made.

6.2 Late Delivery: The Agency placing the order under this Contract must be notified in writing if orders will be delayed for any reason. Any delay in delivery that could cause harm to an Agency will be grounds for cancellation of the delayed order, and/or obtaining the items ordered from a third party.

Any Agency seeking to obtain items from a third party under this provision must first obtain approval of the Purchasing Division.

6.3 Delivery Payment/Risk of Loss: Standard order delivery shall be F.O.B. destination

to the Agency's location. Vendor shall include the cost of standard order delivery charges in its bid pricing/discount and is not permitted to charge the Agency separately for such delivery. The Agency will pay delivery charges on all emergency orders provided that Vendor invoices those delivery costs as a separate charge with the original freight bill attached to the invoice.

6.4 Return of Unacceptable Items: If the Agency deems the Contract Items to be unacceptable, the Contract Items shall be returned to Vendor at Vendor's expense and with no restocking charge. Vendor shall either make arrangements for the return within five (5) days of being notified that items are unacceptable or permit the Agency to arrange for the return and reimburse Agency for delivery expenses. If the original packaging cannot be utilized for the return, Vendor will supply the Agency with appropriate return packaging upon request. All returns of unacceptable items shall be F.O.B. the Agency's location. The returned product shall either be replaced, or the Agency shall receive a full credit or refund for the purchase price, at the Agency's discretion.

6.5 Return Due to Agency Error: Items ordered in error by the Agency will be returned for credit within 30 days of receipt, F.O.B. Vendor's location. Vendor shall not charge a restocking fee if returned products are in a resalable condition. Items shall be deemed to be in a resalable condition if they are unused and in the original packaging. Any restocking fee for items not in a resalable condition shall be the lower of the Vendor's customary restocking fee or 5% of the total invoiced value of the returned items.

7. VENDOR DEFAULT:

7.1 The following shall be considered a vendor default under this Contract.

7.1.1 Failure to provide Contract Items in accordance with the requirements contained herein.

7.1.2 Failure to comply with other specifications and requirements contained herein.

7.1.3 Failure to comply with any laws, rules, and ordinances applicable to the Contract Services provided under this Contract.

7.1.4 Failure to remedy deficient performance upon request.

7.2 The following remedies shall be available to Agency upon default.

7.2.1 Immediate cancellation of the Contract.

7.2.2 Immediate cancellation of one or more release orders issued under this Contract.

7.2.3 Any other remedies available in law or equity.

8. MISCELLANEOUS:

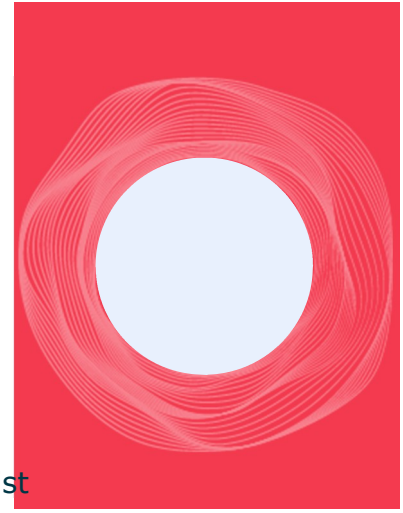
8.1 No Substitutions: Vendor shall supply only Contract Items submitted in response to the Solicitation unless a contract modification is approved in accordance with the provisions contained in this Contract.

8.2 Vendor Supply: Vendor must carry sufficient inventory of the Contract Items being offered to fulfill its obligations under this Contract. By signing its bid, Vendor certifies that it can supply the Contract Items contained in its bid response.

8.3 Reports: Vendor shall provide quarterly reports and annual summaries to the Agency showing the Agency's items purchased, quantities of items purchased, and total dollar value of the items purchased. Vendor shall also provide reports, upon request, showing the items purchased during the term of this Contract, the quantity purchased for each of those items, and the total value of purchases for each of those items. Failure to supply such reports may be grounds for cancellation of this Contract.

8.4 Contract Manager: During its performance of this Contract, Vendor must designate and maintain a primary contract manager responsible for overseeing Vendor's responsibilities under this Contract. The Contract manager must be available during normal business hours to address any customer service or other issues related to this Contract. Vendor should list its Contract manager and his or her contact information below.

Contract Manager: Lisa Poppelreiter
Telephone Number: 412-377-5089
Fax Number: _____
Email Address: lisa.poppelreiter@worley.com



Tiona Todoruk, Ph.D., P.Chem.

Principal Environmental Scientist / Risk Assessment Specialist

Summary

Tiona is a principal environmental scientist with more than 20 years of experience in scoping and executing toxicology studies, permitting and contaminated lands risk assessment. She is the technical director of Worley's risk assessment practice and supports the global Worley business in this aspect, having completed projects on six continents. She has worked across a range of industries including in power generation, upstream and downstream oil and gas, waste management and infrastructure development to support permitting, contaminant management and overall site closure. She has supported numerous clients in the development of defensible risk-based benchmarks for metals, pesticides, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), hydrocarbons and a range of other parameters in soil, water, sediment, soil gas and air. She has also supported customers in WQBEL development, TBEL development and NPDES permitting in Canada, the United States and Europe.

Education

2003	Ph.D., Physical/Environmental Chemistry, University of Calgary, Alberta, Canada
2000	B.S., Chemistry, University of Northern British Columbia, Prince George, British Columbia, Canada

Experience

2005-Present Risk Assessment Specialist, Worley Consulting, United States

City of Edmonton, Technical Director, Development of Effluent Discharge Limits Using WQBELs for a Former Landfil, Edmonton, Alberta, Canada.

Oversight and senior technical support for development of effluent discharge limits for a former landfill in Edmonton, Alberta.

IPL, Technical Direction, Development of Microplastics Discharge Limits for Polypropylene Plant, Alberta, Canada.

Senior technical direction for development of a CSM and microplastics discharge limits into a regionally important river for a polypropylene plant in Alberta. The limits were toxicity based and incorporated practical limitations of treatment technologies for microplastics. Regulatory approval of the limits was achieved and an Approval to Operate was granted.

Water-link, Technical Director, Risk Analysis for Water Reuse Design Basis, Antwerp, Belgium.

Oversight and senior technical support for assessment of risks associated with water recycling / reuse and input into design basis to identify log reduction values for water treatment processes.

EPRI, Technical Specialist, Manual on WET Testing Methods for the Power Sector, United States

Technical specialist involved in development of a guidance manual for WET testing in the Power Sector.

Chevron, HSE Manager, Salt Lake Refinery Retrofit Project, Salt Lake City, Utah, USA

HSE Manager for Salt Lake Refinery Retrofit / Upgrade project. Responsible for HSE Strategy development and HSE behavior based safety program implementation for FEED, detailed design, construction and operations, permitting support including support on NPDES permit renewal to incorporate new contaminants associated with the Retrofit.

ASAP – Alaska Gas Development Corporation, HSE Support, Alaska, USA.

HSE support for FEED phase of ASAP project for grassroots development of gas processing facilities. Roles include identification of potential existing and future environmental issues, permitting support including NPDES permits, reviews of project documentation produced by technical specialists such as HSSE Management System, HSSE plans and philosophies, QRA, EIS and participation in workshops including HAZOP, SIL Assignment, SIMOPs and ISD.

Technical Reviewer | Step 5 DDW Evaluation | Los Angeles Department of Water and Power | San Fernando Basin, Los Angeles County, California.

Technical reviewer for updates to DDW Step 5 Evaluation for drinking water supply to confirm wellhead treatment of impacted groundwater was appropriate.

Exxon Mobill, Technical Director, Produced Water Study, Permian Basin, Conceptual Site Model and Ecological Risk Assessment, New Mexico and Texas, USA

Technical direction for development of conceptual site model and ecological risk assessment associated with produced water management within the Permian Basin.

SABIC, Technical Lead, EHSS and Risk, Saudi Arabia.

Development of EHSS study and project Risk Assessment including report and presentation development and workshop facilitation.

Ventura, Los Angeles, Technical Lead, HSE Evaluation and Risk Assessment, Southern California Edison – Various RO Water Treatment Systems, Orange and San Bernardino Counties, California, USA.

Development of technical document comparing treatment chemicals to allow for risk-based selection of treatment option.

LADWP, Technical Director, Owner's Engineer, Risk Assessment Services, San Fernando Valley Superfund Site, Los Angeles, California, USA.

Human health and ecological risk assessment services.

Technical Director | Portfolio Technical Director | ATCO | Alberta, Canada.

Technical director for the ATCO portfolio of sites including substations, distribution and transmission stations, pipelines, gas plants, leases and maintenance depots. Responsible for overall oversight to confirm the application of risk-based guidelines for remediation and to facilitate site closure.

Pieridae, Technical Director, Waterton 1 Risk Management Plan, Alberta, Canada

Technical director for risk management plan of operational well site with potential hydrocarbon discharge to a nearby creek assessed using sediment triad monitoring.

IOL, Technical Director, CSM and Problem Formulation Development, Kearl Oil Sands Mine, Alberta, Canada

Technical director for risk-based CSM development of Kearl Oil Sands Mine including consideration of geochemical processes associated with leaching from tailings pond and discharge of ARD impacted water to nearby sensitive aquatic receiving environments.

Keyera, Technical Director, Sulphur Risk Assessment and Management Plan for Strachan Gas Plant, Alberta, Canada

Technical director for site-specific sulphur risk assessment and risk management plan for former sulphur block area at a gas plant in Alberta.

Bayer, Technical Director, Development of RBCLs for DEET in Groundwater, Sao Paulo, Brazil.

Development of RBCLs for DEET plume in groundwater beneath a Bayer facility in Sao Paulo, Brazil.

OCP, Technical Director, Phosphate Mine Sites Wide Area Site-Specific Risk Assessment, Morocco.

Development of SSRA for metals, nutrients and radionuclides at five mines sites across a region in Morocco to assess potential risks to human health and bioaccumulation of parameters within the food chain including in marine organisms and livestock.

Heliogen, Technical Support, Permitting and Compliance Support for Solar Plant, California, USA

Permitting and compliance support for front end engineering design packages including containment basins, civil works and review of potential requirements for permitting discharges and emergency release from the Facility.

Pieridae, Technical Director, Liquid Sulphur Pipeline Spill Response and Risk Assessment, Alberta, Canada

Oversight and senior technical support for spill response and risk assessment of pipeline break in Alberta that discharged into a nearby fishbearing water course. Evaluation of acute toxicity through desktop assessment, effects monitoring and bioassays to confirm risks to aquatic life were negligible.

Braskem, Technical Director, Development of RBCLs for MDD Site, Brazil

Oversight and senior technical support for development of RBCLs for a former chlorinated solvent storage facility in Brazil.

IOL, Technical Director, Toxicity Study, Norman Wells, NWT, Canada

Senior technical support for toxicity study associated with hydrocarbons in Norman Wells.

IOL, Technical Director, Nitrate SSRO for Soils, Northwest Territories, Canada

Oversight and senior technical support for development of nitrate SSRO for soils to protect aquatic life.

City of New Westminster, Technical Director, Porewater Assessment and Detailed Ecological Risk Assessment, British Columbia, Canada

Oversight and senior technical support for desktop assessment of risks to evaluate if porewater sampling was required after a wharf fire adjacent to a Park in the Fraser River Estuary.

Wood Buffalo Regional Municipality, Site Specific Risk Assessment Work Plan, Former Salt Storage Site, Fort McMurray, Alberta, Canada

Development of technical work plan and risk management plan for regulatory approval documenting site specific risk assessment of the site including aquatic toxicity of a discharging salinity plume to make informed decisions about remediation and risk management and develop site specific remedial objectives.

Enel, Holding Pond Characterization, Colombia.

Support on development of a characterization program for odor, air emissions and water quality of a holding pond in support of treatment option development.

Memberships and affiliations

Professional Chemist, Association of the Chemical Profession of British Columbia, Canada

Professional Chemist, Association of the Chemical Profession of Alberta, Canada

Director, Science Advisory Board for Contaminated Sites of British Columbia

Publications and presentations

Available upon request

Warren Stein, MPH

Human Health and Ecological Risk Assessment

Summary

Warren is a senior environmental scientist in Edmonton's Decommissioning and Restoration Group. He has conducted human health and environmental risk assessments in Western Canada for over 30 years. He has a wealth of experience in all aspects in the field of risk assessment/risk management, including project design, conceptual site model development, exposure modelling, toxicity assessment, food web modelling, weight of evidence approach, bioaccumulation, site-specific remedial objective development, stakeholder engagement, and project management. Warren has experience with conducting risk assessments on both public and private lands.

Warren also has extensive experience in contaminated sites project management, where he has supervised numerous groundwater monitoring, environmental site assessment, remediation and spill response projects involving cost estimating, coordinating and supervising various levels of staff, subcontractor management, budget control, client and regulatory liaison, evaluation of analytical data, interpretation of environmental regulations, site-specific guideline development, and report preparation and/or review.

Education

2006	Masters of Public Health (Environmental Science [Specializing in human health risk assessment]), University of Alberta, Edmonton, AB,
1992	B. Ed. (Secondary Education), University of Alberta, Edmonton, AB, Canada
1990	B. Sc. (Mathematics / Biology), Concordia College, Edmonton, AB, Canada

Relevant Experience

1999-Present Sr. Environmental Scientist, Environmental Program Management, Worley Consulting

- Confidential – Alberta – Conduct a risk management plan and site-specific human health and ecological risk assessment for soil and groundwater impacts at a former well site. The site is located within the foothills of Alberta and lies on a native reserve. Tasks included review of available site investigation data, conceptual site model development, toxicity assessment, exposure assessment, risk characterization and development of risk management objectives. Contaminants of concern included salinity, petroleum hydrocarbons and metals. Work needed to meet both provincial and federal regulatory standards.
- ATCO – Drumheller, AB – Conduct a site-specific human health and ecological risk assessment for soil impacts at a former electrical substation. The site is located within the Town of Drumheller, Alberta, and lies adjacent to two residential properties and the Red Deer River valley. Tasks included review of available site investigation data, conceptual site model development, toxicity assessment, exposure assessment, risk characterization and development of site-specific remedial objectives. Contaminants of concern included sterilants, petroleum hydrocarbons and metals.
- ATCO – High Prairie, AB – Conduct a site-specific human health and ecological risk assessment for soil impacts at a former electrical substation. The site is located on the outskirts of the Town of High Prairie,

Alberta, and lies adjacent to an industrial facility and agricultural lands. Tasks included review of available site investigation data, conceptual site model development, toxicity assessment, exposure assessment, and risk characterization. Contaminants of concern included sterilants, chlorinated phenolics, petroleum hydrocarbons and polycyclic aromatic hydrocarbons.

- City of Edmonton – Edmonton, AB – Conduct an ecological risk assessment on the North Saskatchewan River with respect to contaminants in the outfall from Edmonton's Waste Management Facility. The project included the collection of samples for site-specific toxicity testing, review of toxicity data, and reporting.
- TELUS – Northern Alberta – Risk assessment specialist and senior technical reviewer for the TELUS Birch Mountain Remote Microwave Tower Site. Duties included evaluation of soil and groundwater analytical data, interpretation of environmental regulations, development of site-specific Tier 2 guidelines, technical support and senior review of the technical report.
- Pembina Pipeline Corporation – Redwater Facility, Redwater, AB- Manage all environmental work at the facility, including compliance soil and groundwater monitoring, spill response, remediation, remedial system installation and operation, human health risk assessment, data analysis, reporting, and client and regulatory liaison.

1994 to 1999 **Risk Assessment Specialist, Toxcon Inc., Edmonton, AB**

Affiliations

- Numerous external courses and seminars on workplace safety, analytical sampling programs, contaminated sites management, database software, hydrogeology, risk assessment, risk management, and uncertainty.
- Numerous internal seminars on project management, workplace safety, contaminated site management, risk assessment, and risk management.

Technical expertise

- Risk Management
- Human Health Risk Assessment
- Subsoil Salinity Tool Certification
- Ecological Risk Assessment
- Project Management
- Public Safety Risk Assessment for Hazardous Materials