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Additional Characterization – Alluvial Groundwater at Site 2, Allegany Ballistics Laboratory, Rocket Center, West Virginia

PREPARED FOR: John Aubert/NAVSEA
Sun Yi/USEPA
Tom Bass/WVDEP
Michael Helbling/NAVFAC Mid-Atlantic
Lou Williams/NAVSEA

PREPARED BY: CH2M HILL

DATE: April 20, 2009

1 Introduction

This technical memorandum summarizes the results of additional groundwater characterization activities at Site 2 at Allegany Ballistics Laboratory (ABL), Rocket Center, West Virginia. This memorandum provides a summary of information gathered during the additional characterization, as well as a discussion of the data assessment. Unless otherwise noted, the work was completed in accordance with the *Final Work Plan Addendum for Additional Characterization Activities – Alluvial Groundwater at Site 2,* CH2M HILL, 2008.

2 Background

2.1 Site Description and History

Site 2, located in the northeastern developed portion of ABL - Plant 1, consists of a former waste burning ground, likely utilized from 1942 to 1949 (**Figure 1**). Based upon aerial photographs dated 1947 and 1955, as well as information from a focused facility audit, the former burn pad, measuring approximately 45 feet in diameter, is suspected to have been located southeast of the current location of Building 361, shown in **Figure 2**. The amount of wastes disposed at Site 2 is unknown due to a lack of historical records about past disposal practices; however, the burning of waste at the burn pad was suspected to have caused a release of contaminants into the environment. Currently, there is no visual evidence of the former burn pad, as the site consists of an open field that is periodically mowed.

2.2 Previous Investigations

Several environmental investigations have been conducted at Site 2 since 1983, including an Initial Assessment Study/Confirmation Study (1983 through 1987), a Remedial Investigation (1992), a Phase II Remedial Investigation (1994), Supplemental Sampling (2001) and a Human Health Risk Assessment (HHRA) (2005). In 2007, an HHRA Addendum was conducted to evaluate potential risks associated with the potable use of alluvial groundwater at Site 2. The Addendum identified potential human health risks associated with exposure to arsenic in groundwater, primarily due to the arsenic concentration in well

2GW01, which was a hybrid well with a screen installed across the alluvial/bedrock contact. Arsenic data were from a sample collected from the well on April 6, 2004.

The ABL Partnering Team (Navy, USEPA, and WVDEP representatives) concluded that it would be appropriate to abandon the hybrid well and install two new alluvial wells in the area to evaluate current arsenic concentrations and ascertain whether these concentrations could be attributable to former operations at the burn pad. In addition, the team decided that existing alluvial wells in the area would be sampled and the results used to re-evaluate Site 2 groundwater arsenic concentrations and associated risk.

3 Additional Groundwater Characterization Objectives

The objectives of the additional groundwater characterization activities at Site 2 were to evaluate current arsenic concentrations in the alluvial aquifer (relative to historic arsenic concentrations in a hybrid well located adjacent to the site), to determine if arsenic concentrations in the vicinity of the hybrid well (2GW01) could be attributable to historic releases at Site 2 and, based upon these new data, determine whether potential human health risks associated with exposure to alluvial groundwater at Site 2 are acceptable.

4 Methodology

In order to meet the objectives of this investigation, hybrid well abandonment, additional monitoring well installation, and groundwater sampling were performed. The field work for this investigation took place between May 4 and June 7, 2008 and is summarized in the following subsections.

4.1 Monitoring Well Abandonment

Though elevated (with respect to risk-based levels) concentrations of arsenic were historically detected in monitoring well 2GW01, the hybrid nature of the well caused the validity of the data to be questioned, and the location of the well with respect to the direction of alluvial groundwater migration (i.e., cross-gradient) caused the association of the elevated arsenic with Site 2 to be questioned. Because the well had been screened across both the alluvial and bedrock aquifers and did not appropriately represent alluvial or bedrock groundwater conditions exclusively, the well was abandoned in place by cutting the PVC casing below the ground surface and filling the remaining casing with concrete via tremie pipe. The abandonment procedure was carried out in accordance with West Virginia regulations (§19-47-CSR-60). The complete abandonment report is attached as **Appendix A**.

4.2 Alluvial Monitoring Well Installation

Two monitoring wells were installed in the alluvial aquifer, using casing advancement and air rotary drilling techniques. The wells were installed and screened to the top of bedrock, at the base of the alluvial aquifer (approximately 27 feet below ground surface). One monitoring well (2GW11) was installed adjacent to the former hybrid well 2GW01. The additional well, 2GW10, was installed in an asphalt parking area between the former 2GW01 location and the location of the suspected source area (i.e., former burn pad area), as shown in **Figure 2**. Well construction diagrams are included as **Appendix B**.

4.3 Groundwater Sampling

Following installation and development of the wells, groundwater samples were collected and analyzed for total and dissolved arsenic from alluvial wells 2GW10 and 2GW11, as well as from the pre-existing well 2GW02. Samples from wells 2GW08 and 2GW09 could not be collected because the area was restricted because of facility activities. Measurements of pH, specific conductivity, dissolved oxygen, turbidity, and oxidation reduction potential were made during well development and prior to sample collection to ensure collection of groundwater representative of aquifer conditions. Monitoring well locations are shown in **Figure 2**.

Groundwater samples were collected from each well using a low-flow submersible pump positioned in the middle of the screen. Samples were sent under chain-of-custody to GPL Laboratory, of Frederick, Maryland for analysis of total and dissolved arsenic. **Table 1** presents a summary of the validated analytical results.

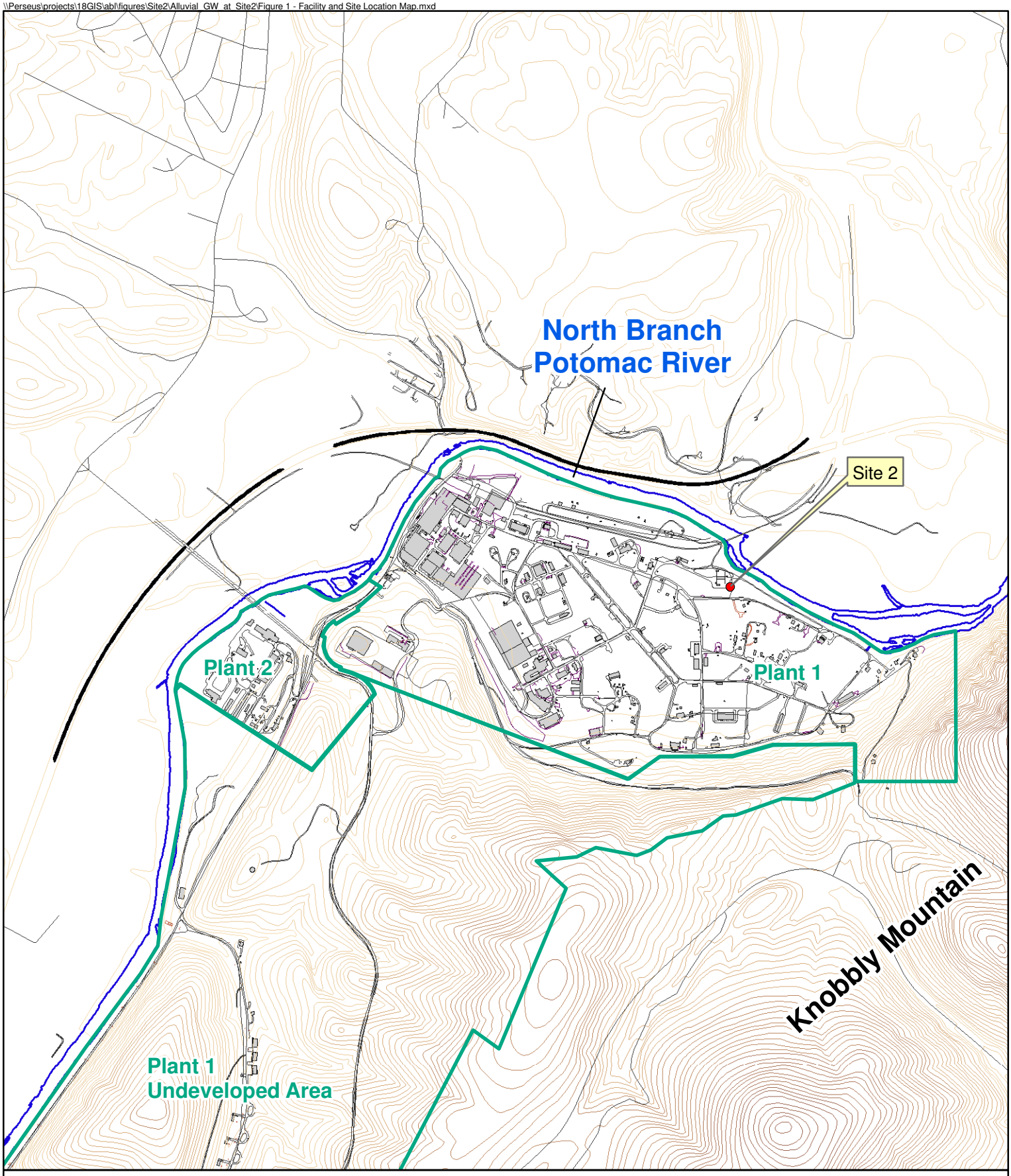
5 Discussion

The analytical results from alluvial groundwater sampling at Site 2 show that arsenic was not detected in samples collected from wells 2GW02, 2GW10 or 2GW11 above the method detection limit of 1.6 micrograms per liter (µg/L) (**Table 1**). Based on this information, the historic arsenic concentrations detected in former hybrid well 2GW01 were not likely representative of alluvial aquifer conditions. Groundwater flow within the alluvium across the ABL facility is generally in the direction of the North Branch Potomac River, this direction of groundwater flow is also evident at Site 2, with alluvial groundwater flowing in a northeasterly direction toward the the North Branch Potomac River (i.e., not in the direction of former hybrid well 2GW01), as shown in **Figure 2**. Therefore, regardless of the historic arsenic concentatrations in former hybrid well 2GW01, it is highly unlikely those arsenic concentrations would have been attributable to Site 2 activities.

The arsenic analytical results for the samples collected in 2008 were utilized to re-assess the potential human health risks associated with exposure to alluvial groundwater at Site 2 and were incorporated into the revised HHRA for Site 2 groundwater (**Appendix C**). The results of the baseline HHRA for groundwater at Site 2, which incorporated the most recent groundwater analytical data for arsenic, revealed no unacceptable risk associated with exposure to alluvial groundwater. Consequently, no further action is necessary to protect human health under industrial or residential use scenarios (i.e., unrestricted land use is applicable).

Figures

\\Perseus\projects\18GIS\abl\figures\Site2\Alluvial_GW_at_Site2\Figure 1 - Facility and Site Location Map.mxd



Legend

- Roads
- Railroads
- North Branch Potomac River
- Plant Boundaries
- Site 2
- Buildings

N

0 750 1,500 3,000 Feet

Figure 1
Facility and Site Location Map
Additional Characterization Activities
Alluvial Groundwater at Site 2
Allegany Ballistics Laboratory
Rocket Center, West Virginia

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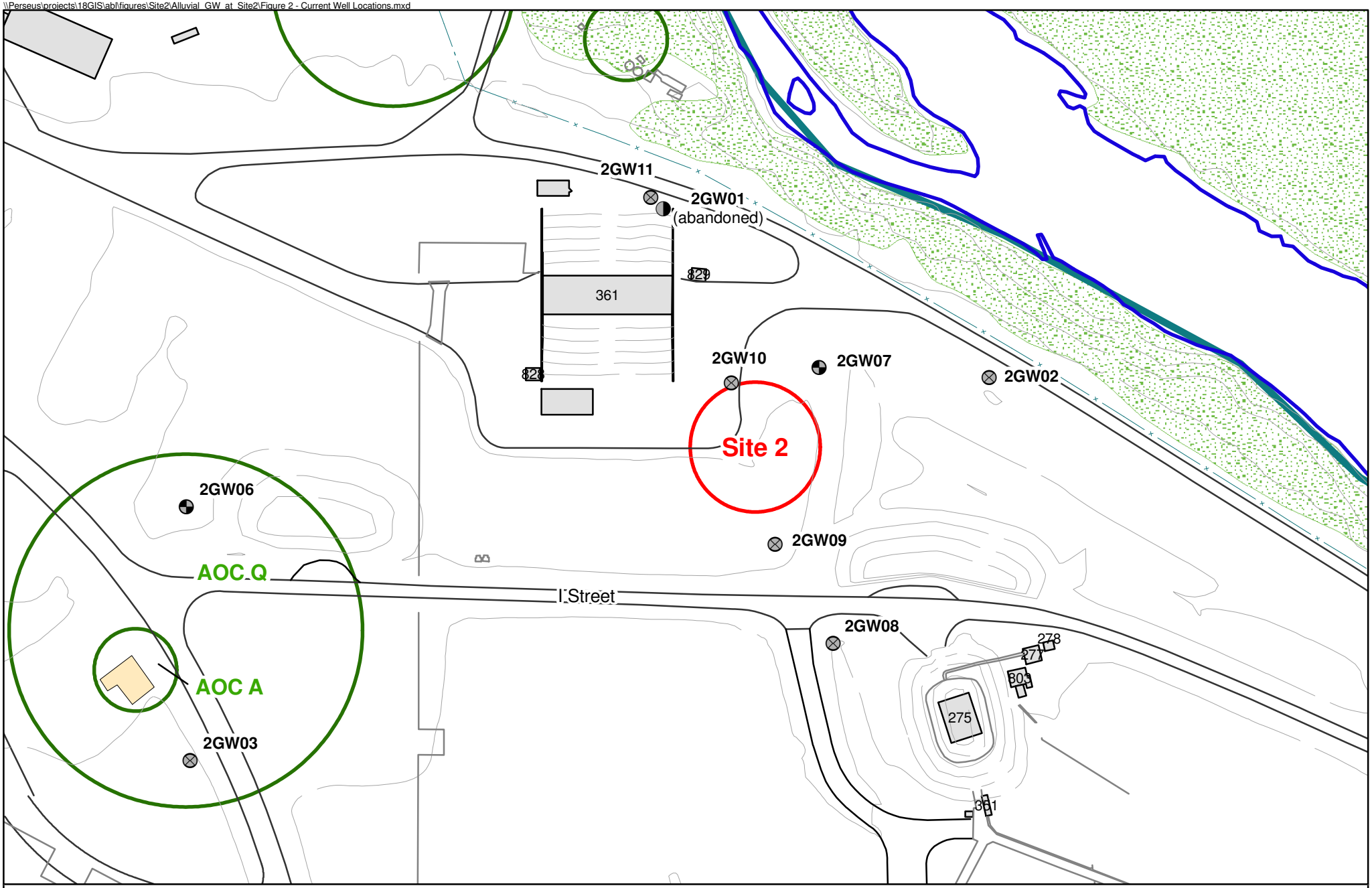
\\Perseus\projects\18GIS\abl\figures\Site2\Alluvial_GW_at_Site2\Figure 2 - Current Well Locations.mxd



Legend

- Alluvial Monitoring Well
- Bedrock Monitoring Well
- Hybrid Monitoring Well
- Buildings
- Former Building 100
- Site 2
- aoc

N

0 50 100 200 Feet

Figure 2
Site 2 - Current Well Locations
Additional Characterization Activities
Alluvial Groundwater at Site 2
Allegany Ballistics Laboratory
Rocket Center, West Virginia

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Tables

Table 1
Validated Analytical Results from Groundwater Sampling at Site 2
Additional Characterization - Alluvial Groundwater at Site 2
Rocket Center, West Virginia

Station ID	2GW02	2GW10	2GW11	
Sample ID	AS02-2GW02-0608	AS02-2GW10-0608	AS02-2GW11-0608	AS02-2GW11P-0608
Sample Date	06/07/08	06/07/08	06/07/08	06/07/08
Chemical Name				
Total Metals (UG/L)				
Arsenic	1.6 U	1.6 U	1.6 U	1.6 U
Dissolved Metals (UG/L)				
Arsenic	1.6 U	1.6 U	1.6 U	1.6 U

Notes:

NA - Not analyzed
U - The material was analyed for, but not detected
UG/L - Micrograms per liter

Appendix A
Well Abandonment Report

State of West Virginia
Department of Environmental Protection

Abandonment Documentation
Well Number: DK08112-2GW01

Site Name/Physical Address:
Site: ALLEGHENY BALLISTICS LABORATORY
Line 1: RTE 956
Line 2:
City: ROCKET CENTER
State: WV
Zip: 26726-
County: Mineral

Locational Data:
a. Latitude: 39 33 59 .0
b. Longitude: 78 50 59 .0
c. Method Used: GPS

Well Owner (Name, Firm, Address):
Owner: US NAVY
Line 1: RTE 956
Line 2:
City: ROCKET CENTER
State: WV
Zip: 26726-
Phone: 206-979-2575

Initial Installation Date: 05/19/2008

Abandonment Type:
Monitoring Well - DK08112-2GW01

Condition of Well: Good
Reason for Abandonment: NO LONGER NEEDED
Abandonment Date: 05/19/2008

Abandonment Procedure:
Material Used: CEMENT GROUT WITH 5% BENTONITE
Procedure Used: GROUT PUMPED THROUGH TREMIE LINE
Total Well Depth: 28 ft. Height of Standing Water in Well: 20 ft.
Annular Space Type: Impermeable
Decontamination Procedure: Steam clean with Potable Water and Alconox
Special Circumstances: No Number:

Abandoned By (Name, Firm, Address):
Name: CHRISTOPHER BRENNEMAN
Line 1: EICHELBERGERS, INC
Line 2: 107 TEXACO RD.
City: MECHANICSBURG
State: PA
Zip: 17050-
Phone: 717-766-4800
Driller Certification: MartiP14

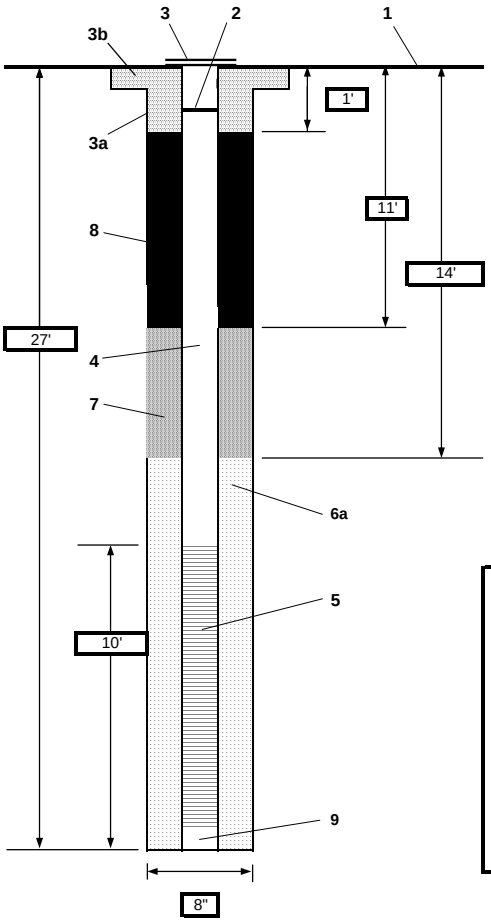
Driller Certification Number: MartiP14 **WV Contractor License Number:** WV00627

Appendix B
Well Construction Diagrams

PROJECT NUMBER:	WELL NUMBER:
344182.FI.MW.02	2GW10

WELL COMPLETION DIAGRAM

PROJECT: ABL Site 2 Monitoring Well Installation
LOCATION : Allegany Ballistics Laboratory, Rocket Center, WV
DRILLING CONTRACTOR: Eichelbergers
DRILLING METHOD AND EQUIPMENT USED: Air Rotary
WATER LEVEL START: 12.16' below TOC WATER LEVEL END: 13.84' below TOC
LOGGER: cgr



1- Ground elevation at well	665.54'
2- Top of casing (TOC) elevation	665.09'
3- Wellhead protection cover type	Steel flush mount
a) Type of outer surface casing	8" dia. steel
b) Concrete pad dimensions	2' x 2' x 8" thickness
4- Dia./type of inner well casing (riser)	2" dia. ASTM Sched. 40 PVC
5- Type/slot size of screen	2" dia. ASTM Sched. 40 PVC/0.01" slot
6- Type of filter pack	Filpro W.G. sand
a) Quantity (#1) used	10 - 50 lb. bags
b) Quantity (#00) used	None
7- Type of seal	Pel-Plug bentonite chips
Quantity used	2 - 50 lb. bags
8- Type of grout	Concrete/bentonite (5%) mix
Method of placement	Tremie pipe
9- End cap	2" dia. x 6" PVC

Development method	Whale pump/surge block
Development time	Approx. 2 hours
Estimated purge volume	Approx. 220 gallons

Final Parameters			
	pH:	6.46	
	Conductivity:	0.435	mS/cm
	Turbidity:	753.0	NTU
	Dissolved oxygen:	6.61	mg/L
	Temperature:	14.0	Celsius
	Oxidation reduction potential:	190	mV

PROJECT NUMBER:	WELL NUMBER:
344182.FI.MW.02	2GW11

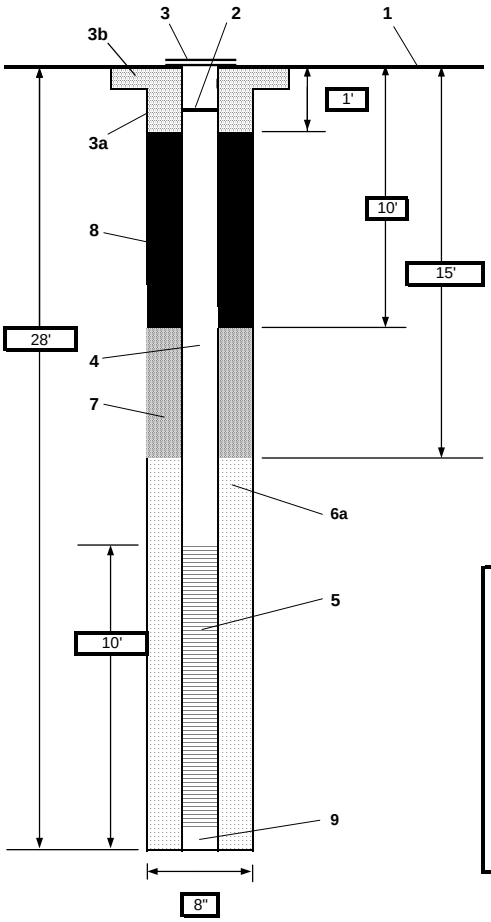
WELL COMPLETION DIAGRAM

PROJECT: ABL Site 2 Monitoring Well Installation — LOCATION : Allegany Ballistics Laboratory, Rocket Center, WV

DRILLING CONTRACTOR: Eichelbergers

DRILLING METHOD AND EQUIPMENT USED: Air Rotary

WATER LEVEL START: 10.65' below TOC — WATER LEVEL END: 12.40' below TOC — LOGGER: cgr



1- Ground elevation at well	665.72'
2- Top of casing (TOC) elevation	665.41'
3- Wellhead protection cover type	Steel flush mount
a) Type of outer surface casing	8" dia. steel
b) Concrete pad dimensions	2' x 2' x 8" thickness
4- Dia./type of inner well casing (riser)	2" dia. ASTM Sched. 40 PVC
5- Type/slot size of screen	2" dia. ASTM Sched. 40 PVC/0.01" slot
6- Type of filter pack	Filpro W.G. sand
a) Quantity (#1) used	9 - 50 lb. bags
b) Quantity (#00) used	None
7- Type of seal	Pel-Plug bentonite chips
Quantity used	2 - 50 lb. bags
8- Type of grout	Concrete/bentonite (5%) mix
Method of placement	Tremie pipe
9- End cap	2" dia. x 6" PVC

Development method	Whale pump/surge block
Development time	Approx. 2 hours
Estimated purge volume	Approx. 165 gallons

Final Parameters			
	pH:	6.29	
	Conductivity:	0.477	mS/cm
	Turbidity:	126.0	NTU
	Dissolved oxygen:	9.14	mg/L
	Temperature:	14.3	Celsius
	Oxidation reduction potential:	304	mV

Appendix C
Revised Human Health Risk Assessment

Human Health Risk Assessment Addendum for Groundwater at Site 2, Allegany Ballistics Laboratory, Rocket Center, West Virginia.

PREPARED FOR: ABL Partnering Team

PREPARED BY: Debbie Stannard/CH2M HILL
Roni Warren/CH2M HILL
Mark Callaghan/CH2M HILL

DATE: July 21, 2008

Introduction

This technical memorandum presents the results of an assessment of potential human health risks associated with groundwater at Site 2, at Allegany Ballistics Laboratory (ABL), Rocket Center, West Virginia (Figure 1). A human health risk assessment for exposure to Site 2 soil was previously submitted as part of the *Final Risk Assessment Report for Site 10 Soil and Sites 2 and 3 at the Allegany Ballistics Laboratory Site, Rocket Center, West Virginia* (CH2M HILL, July 2005). Because an evaluation of potential risks associated with groundwater was not previously conducted, this technical memorandum serves as an addendum to the Risk Assessment Report (CH2M HILL, 2005).

This risk assessment has been prepared using conservative assumptions, and feasible exposure pathways for groundwater have been considered based on current site conditions and potential future site use. The risk assessment incorporates the general methodology described in *Risk Assessment Guidance for Superfund (RAGS), Volume 1, Human Health Evaluation Manual, Part A* (U.S Environmental Protection Agency [USEPA], December 1989), *Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual, Part D* (USEPA, December 2001), and USEPA Region III Technical Guidance Manuals for Risk Assessment.

Scope of Risk Assessment

The human health risk assessment comprises the following components:

- **Identification of Constituents of Potential Concern (COPCs)**—identifies and characterizes the distribution of COPCs found on the site. COPCs identified in this screening are evaluated quantitatively in the risk assessment.
- **Exposure Assessment**—identifies potential pathways by which exposure could occur, characterizes the potentially exposed populations (e.g., construction workers and residents), and estimates the magnitude, frequency, and duration of potential exposures.
- **Toxicity Assessment**—identifies the types of adverse health effects potentially associated with exposure to COPCs and lists available toxicity factors (e.g., cancer slope

factors and reference dose values). It also identifies related uncertainties (such as the weight-of-evidence for carcinogenicity of a particular constituent in humans) associated with the toxicity values.

- **Risk Characterization**—integrates the results of the exposure assessment and toxicity assessment to estimate the potential risks to human health. Both cancer and noncancer human health effects are evaluated.
- **Uncertainty Assessment**—identifies sources of uncertainty associated with the data, methodology, and the values used in the risk assessment and how the uncertainty could affect the potential risks identified.

These components are described briefly in this memorandum. Spreadsheets prepared in accordance with USEPA RAGS Part D (USEPA, December 2001) were used to screen for COPCs, and to calculate estimated exposures and potential health risks associated with the COPCs. These spreadsheets are presented in Attachment 1, Tables 1 through 10.3.CTE.

Identification of Constituents of Potential Concern

Groundwater data collected from Site 2 monitoring wells in April 2004 and June 2008 were evaluated quantitatively in the risk assessment. These data are presented in Attachment 2 to this memorandum. Monitoring wells 2GW01 and 2GW02 are alluvial aquifer wells, and monitoring well 2GW07 is a bedrock well (Figure 2). Monitoring wells 2GW08 and 2GW09 are upgradient from Site 2 and represent background alluvial conditions. Table 1 summarizes the samples that were used to estimate potential exposures and risks for Site 2.

Monitoring well 2GW01 is a hybrid well that was improperly installed across the alluvial and bedrock aquifers. The concentration of arsenic detected in the well was much higher than the arsenic concentrations detected in the background well. Additional, arsenic was not detected in any of the other site related wells. Therefore, an additional monitoring well was installed at the site (2GW11) and sampled in June 2008 for arsenic. Monitoring well 2GW02 was also sampled again in June 2008, along with monitoring well 2GW10. These samples were analyzed for arsenic. The June 2008 arsenic samples were used in place of the April 2004 arsenic analysis. Arsenic was not detected in any of the June 2008 samples, which had method detection limits of 1.6 micrograms per liter (ug/L).

These data have been appropriately validated, meet the Data Quality Objectives (DQOs), and are assumed to represent current conditions

Data selected for evaluation were reviewed to determine their reliability for quantitative risk assessment. A review of the data and discussions with USEPA and the Navy identified the following criteria for data usability:

- Estimated values flagged with a J qualifier were treated as unqualified detected concentrations
- Data qualified with an R (rejected) were not used in the risk assessment
- Data qualified with a B (blank contamination) were used as if they were nondetects. One-half of the blank-related concentrations were used to calculate exposure point

concentrations if the constituent was detected in other samples within the data grouping.

- One-half of the sample quantitation limit (SQL) was used for cases where no detectable constituent quantities were reported for a sample, but the constituent was detected in other samples from the data grouping.
- For duplicate samples, the maximum concentration of the primary and duplicate sample was used as the sample concentration.

Selection of COPCs

All of the detected constituents were screened in accordance with USEPA Region III guidelines (USEPA, January 1993), using the steps described below. The COPC selection process was conservative to ensure selection of the constituents comprising the majority of the potential risk associated with the site. The maximum detected concentration of each constituent was compared to a screening value (typically a risk-based concentration) to select the COPCs. If the maximum concentration of a constituent exceeded the screening value, the constituent was selected as a COPC and retained for the risk evaluation. The following screening values were used to screen the groundwater data:

- Risk-based Concentrations: The maximum detected chemical concentrations in groundwater were compared with the tap water risk-based concentrations (RBCs) in the latest version of USEPA Region III's Risk-Based Concentration Table (USEPA, October 2006). The RBCs for noncarcinogens were adjusted (divided by 10) to reflect a target hazard quotient of 0.1. The RBCs for carcinogens are based on a target cancer risk of $1x10^{-6}$ and were not adjusted from the values presented in the RBC table.
- Lead: Lead concentrations in groundwater were compared to the Safe Drinking Water Act action level of 15 parts per billion (ppb).
- Human Nutrients: Chemicals that are human nutrients, present at low concentrations (i.e., only slightly elevated above naturally occurring levels), and toxic only at very high doses were eliminated from the quantitative risk analysis. These constituents are calcium, magnesium, potassium, and sodium.

The filtered inorganic data were screened and evaluated for the residential scenario following USEPA Region III guidance (USEPA Region III, August 1992) because a notable disparity exists between the filtered and unfiltered data. For the construction worker scenario, the unfiltered data were evaluated because a construction worker could contact the groundwater directly in an excavation.

Constituents of Potential Concern

Table 2 identifies the constituents that were selected as COPCs for groundwater within the alluvial and bedrock aquifers at Site 2. The COPC screening is presented in Tables 2.1 through 2.6 in Attachment 1.

The COPCs for groundwater in the alluvial aquifer are trichloroethene (TCE), vinyl chloride (VC), aluminum, antimony, chromium, iron, lead, manganese, and vanadium. The COPCs for groundwater in the bedrock aquifer are TCE and iron.

Exposure Assessment

A conceptual exposure model showing potential exposure scenarios identified under potential future conditions is presented in Figure 3. The following subsections discuss the three components of exposure assessment:

- Characterization of exposure setting
- Identification of exposure pathway
- Quantification of exposure

Characterization of Exposure Setting

Basic site characteristics such as physical setting, climate, and groundwater hydrogeology are presented in the Risk Assessment Report (CH2M HILL, 2005).

Potentially exposed populations are identified based on their locations relative to the site, their activity patterns, and the presence of potentially sensitive subpopulations. Table 3 summarizes the potentially exposed populations identified in this risk assessment addendum.

Current Land Use.

Sites 2 lies within Plant 1 (Figure 1), an industrial area of ABL. The current and planned use of this area is industrial. Groundwater is not currently used as a potable supply. In addition, there are no offsite groundwater residential receptors downgradient of Site 2. Consequently, pathways associated with current groundwater use at the facility are considered incomplete.

Future Land Use

Site 2 is anticipated to remain an industrial area in the future. The groundwater beneath Site 2 is not currently used and is not expected to be used as a future potable supply. However, potable use of the groundwater was conservatively evaluated as a worst case scenario. Exposure to the groundwater within the alluvial and bedrock aquifers by future adult and child residents was evaluated.

Exposure to bedrock groundwater was not evaluated for a construction worker. However, exposure to alluvial groundwater in an open excavation pit by a construction worker was evaluated. It was assumed that adult construction workers could be exposed to groundwater in the alluvial aquifer that may seep into trenches or pits excavated during future development activities at the site. This scenario is considered conservative and unlikely to occur in practice because, under normal excavation procedures, excavations may not encounter groundwater, or if encountered, the groundwater would be pumped from the excavation.

Noncarcinogenic risks were calculated for adult and child residents separately, and carcinogenic risks were calculated for lifetime residents (not separately for children and adults).

Identification of Exposure Pathways

An exposure pathway may be described as the physical course that a COPC takes from the point of release to a receptor. To be complete, an exposure pathway must have all of the following components present:

- A source
- A mechanism of a chemical release and transport
- An environmental transport medium
- An exposure point (receptor location)
- An exposure route (inhalation, dermal absorption, ingestion)
- A receptor or exposed population

In the absence of any one of these components, an exposure pathway is considered incomplete and, by definition, there is no risk or hazard. In some cases, a receptor may contact a source directly, eliminating the release and transport pathways.

Constituent Sources

Probable constituent sources at Site 2 comprise the residue from the burning of propellants and explosives at the site.

Release and Transport Mechanisms

The fate and transport of constituents in soil and groundwater are determined by the physical characteristics of the site, as well as by the chemical and physical properties of the constituents. Additional information of fate and transport mechanisms is provided in the Risk Assessment Report (CH2M HILL, 2005).

Potential Exposure Points and Exposure Routes

Potential exposure routes were evaluated for future site use. Potential future exposure pathways are illustrated in the Conceptual Site Model (CSM) shown in Figure 3. Exposure scenarios and potentially complete pathways of exposure evaluated in this risk assessment are presented in Table 3.

Current Exposure Routes

Groundwater is not currently accessible at the site; consequently there are no current exposure routes for groundwater.

Future Exposure Routes

Based on potential future site use, potential receptors for Site 2 groundwater comprise adult and child residents and construction workers. The future land use exposure routes are as follows:

- Residents (adult): ingestion of groundwater, dermal contact with groundwater, and inhalation of volatiles whilst showering.
- Residents (child): ingestion of groundwater and dermal contact with groundwater whilst bathing.
- Construction Worker: dermal contact with groundwater and/or inhalation of volatiles from groundwater during excavation activities.

Quantification of Exposures

Exposure is quantified by estimating the exposure point concentrations (EPCs) and constituent intakes by the receptors for both the reasonable maximum exposure (RME) and central tendency exposure (CTE) scenarios.

Exposure Point Concentrations.

EPCs are estimated constituent concentrations that a receptor may contact. EPCs may be directly monitored or estimated using environmental fate and transport models. For this assessment, the Foster and Chrostowski shower model (Foster and Chrostowski, 1987) was used to estimate the vapor concentration during showering, and a two-film volatilization model along with USEPA's Screen3 model was used to estimate the volatile organic compound air concentration in an open excavation. These models are shown in the Attachment 1, Table 7s. The maximum detected concentration was used as the RME EPC for all data groupings since less than five samples were available for each data grouping. The average concentration was used as the CTE EPC. The EPCs are presented in Attachment 1, Table 3s.

As mentioned previously, the filtered inorganic groundwater data were used to evaluate the residential potable water use scenario, following USEPA guidance (USEPA, August 1992). Unfiltered inorganic data were used to evaluate the construction worker scenario.

Estimation of Constituent Intakes for Individual Pathways.

Constituent intake is the amount of the constituent entering the receptor's body. Constituent intakes are generally expressed as follows:

$$I = \frac{C \; x \; CR \; x \; EF \; x \; ED}{BW \; x \; AT} \; (mg/kg/day)$$

Where:

I =	intake (mg/kg/day)
C =	constituent concentration at exposure point (mg/L, mg/m^3)
CR=	contact rate, or amount of contaminated medium contacted per unit time or event (L/day, m^3/day)
EF=	exposure frequency (days/year)
ED=	exposure duration (years)
BW=	body weight of exposed individual (kg)
AT=	averaging time, or period over which exposure is averaged (days)

The intake equation requires specific exposure parameters for each exposure pathway. Exposure parameters are often assumed values, and their magnitude influences the estimates of potential exposure (and risk). The reliability of the values chosen can contribute substantially to the uncertainty of the resulting risk estimates. Many of the exposure parameters have default values, which were used for this assessment. These assumptions, based on estimates of body weights, media intake levels, and exposure frequencies and duration are provided by USEPA guidance (USEPA, 1991; August 1997; and July 2004). Other assumptions (e.g., exposure duration for the construction worker) required consideration of location-specific information and were determined using professional judgment. Attachment 1, Tables 4.1.RME through 4.4.CTE present the exposure factors and intake equations used for the exposure scenarios evaluated for Site 2 groundwater. Both RME and CTE intakes were included in this evaluation. CTE intakes were calculated for

exposure scenarios with RME cumulative cancer risks greater than $1x10^{-4}$ or cumulative noncancer hazards greater than 1.

For residential exposure to groundwater, lifetime age-adjusted intakes were calculated for carcinogenic constituents. This involved calculating age-adjusted factors for each exposure pathway.

Toxicity Assessment

Additional information on the definition of toxicity assessment and the process is provided in the Risk Assessment Report (CH2M HILL, 2005). The primary source of toxicity values is the USEPA's Integrated Risk Information System (IRIS) database, which contains up-to-date health risk and USEPA regulatory information. IRIS includes only noncarcinogenic reference doses (RfDs) and cancer slope factors (CSFs) that have been verified by USEPA work groups. The IRIS database is the USEPA's preferred source of toxicity information. In accordance with USEPA guidance (USEPA, December 2003), the second tier of toxicity factors is the Provisional Peer Reviewed Toxicity Value (PPRTV) database maintained by the USEPA's National Center for Environmental Assessment (NCEA) and the Superfund Health Risk Technical Support Center (STSC). This database is publicly available online for a trial basis, so toxicity values were obtained from the PPRTV database for several COPCs, as noted in Tables 5.1, 5.2, 6.1, and 6.2 in Attachment 1. If toxicity data are not available from either of these sources, the USEPA will consider toxicity values obtained from other USEPA and peer-reviewed non-USEPA sources (USEPA, December 2003), such as provisional NCEA toxicity values and the USEPA's Health Effects Assessment Summary Tables (HEAST) (USEPA, July 1997). The use of provisional toxicity values, including those from the PPRTV database, in an HHRA increases the uncertainty of the quantitative risk estimate.

Health effects are divided into two broad groups: noncarcinogenic and carcinogenic effects. This division is based on the different mechanisms of action currently associated with each category. Constituents causing noncarcinogenic health effects are evaluated independently from those having carcinogenic effects. Some constituents may produce both noncarcinogenic and carcinogenic effects, and are therefore evaluated in both groups. This section discusses noncarcinogenic and carcinogenic effects separately, and concludes with a brief discussion of the toxicological properties of selected COPCs.

Toxicity Information for Noncarcinogenic Effects

Noncarcinogenic health effects include a variety of toxic effects on body systems, such as renal toxicity (toxicity to the kidneys) or central nervous system disorders. Noncarcinogenic health effects are grouped into two basic categories: acute toxicity and chronic toxicity. Acute toxicity can occur after a single exposure (usually at high doses), and the effect is most often seen immediately. Chronic toxicity generally occurs after repeated exposure (usually at low doses) and is seen months or years after the initial exposure. The toxicity of a constituent is assessed through a review of toxic effects noted in short-term (acute) animal studies, long-term (chronic) animal studies, and epidemiological investigations of exposed human populations, typically in the workplace.

USEPA defines the chronic RfD as a dose that is likely to be without appreciable risk of deleterious effects during a lifetime of exposure (USEPA, December 1989). Chronic RfDs are specifically developed to be protective for long-term exposure to a compound (7 years to a

lifetime), and consider uncertainty in the toxicological database and sensitive receptors. Chronic RfDs may be overly protective if used to evaluate the potential for adverse health effects resulting from short-term exposure. USEPA's NCEA develops subchronic RfDs for short-term exposure (2 weeks to 7 years). Subchronic RfDs were used for the construction worker scenario because the exposure duration is 1 year. Chronic RfDs were used for all other receptors evaluated in the HHRA.

In the development of RfDs, available studies examining the toxicity of a constituent following exposure are considered based on their scientific merit. The lowest dose level at which an observed toxic effect is observed is identified as the "lowest-observed-adverse-effect-level" (LOAEL) and the dose at which no effect is observed is identified as the "no-observed-adverse-effect-level" (NOAEL). Several uncertainty factors (UFs) may be applied to account for uncertainty. These factors account for uncertainties such as poor data quality, extrapolation of data from animal studies to human exposures, or the use of subchronic studies to develop chronic criteria. UFs range between 10 and 10,000 and reflect the varying degrees of uncertainty in the toxicity criteria.

USEPA-derived oral and inhalation chronic RfDs, and associated UF and modifying factor (MF) values, for the COPCs are listed in Attachment 1, Tables 5.1 and 5.2.

Per USEPA guidance, oral RfDs were adjusted from administered doses to absorbed doses for evaluating dermal toxicity when deemed appropriate (USEPA, July 2004). The RfDs were adjusted using oral absorption factors (USEPA, July 2004). The adjusted dermal RfDs are presented in Attachment 1, Table 5.1.

Toxicity Information for Carcinogenic Effects

Potential carcinogenic effects are quantified using CSFs that may be derived from the results of chronic animal bioassays, human epidemiological studies, or both. Animal bioassays are usually conducted at dose levels that are much higher than are likely to be encountered in the environment. This study design detects possible adverse effects in the relatively small test populations used in the studies.

A number of mathematical models and procedures have been developed to extrapolate from the high doses used in studies to the low doses typically associated with environmental exposures. The USEPA-preferred linearized multistage (LMS) model is usually used to estimate the largest linear slope (within the upper 95 percent Upper Confidence Limit [UCL]) at low extrapolated doses that is consistent with the data. The 95 percent UCL slope of the dose-response curve is subjected to various adjustments, and an interspecies scaling factor is usually applied to derive a CSF or inhalation unit risk factor for humans. It is assumed that if a cancer response occurs at the dose level in the study, there is some probability that a response will occur at all lower exposure levels (i.e., a dose-response relationship with no threshold assumed). Dose-response data derived from human epidemiological studies are fitted to dose-time-response curves on an *ad hoc* basis. In both types of analyses, conservative (e.g., health protective) assumptions are applied and the models are believed to provide rough estimates of the upper limits on potential lifetime risk.

USEPA-derived oral and inhalation CSFs are listed in Tables 6.1 and 6.2 in Attachment 1. Certain oral CSFs were adjusted from administered doses to absorbed doses to evaluate dermal toxicity. When appropriate, the CSFs were adjusted using oral absorption factors

from USEPA (USEPA, July 2004). The adjusted dermal CSFs are summarized in Table 6.1 in Attachment 1.

In addition to deriving a quantitative estimate of cancer potency, USEPA also assigns weight-of-evidence classifications to potential carcinogens. Constituents are classified as Group A, Group B1, Group B2, Group C, Group D, or Group E carcinogens. The classifications for each constituent and their definitions are included on Tables 6.1 and 6.2, Attachment 1.

Risk Characterization

Risk characterization is the process of integrating the previous elements of the risk assessment into quantitative and semiquantitative expressions of risk. The quantification of risk is then used as an integral component in remedial decision making and selection of potential remedies or actions, if necessary.

Noncarcinogenic and Carcinogenic Risk Estimation Methods

Potential human health risks are discussed independently for carcinogenic and noncarcinogenic constituents because of the different toxicological endpoints, relevant exposure duration, and methods used to characterize risk. The noncarcinogenic health impacts from carcinogens are also assessed.

Noncarcinogenic Risk Estimation.

Noncarcinogenic health risks are estimated by comparing actual or expected exposure levels to threshold concentrations (or RfDs). The expected intake divided by the RfD is equal to Hazard Quotient (HQ):

$$HQ = Intake / RfD$$

The intake and RfD are expressed in the same units and represent the same exposure period (i.e., chronic or subchronic). The intake and RfD also represent the same exposure route, (i.e., oral intakes are divided by the oral RfDs). When the HQ exceeds 1.0 (i.e., exposure exceeds the RfD), a certain degree of health risk is indicated. To assess the potential for noncarcinogenic health effects posed by exposure to multiple constituents, a “hazard index” approach is used (USEPA, December 1989). This approach assumes that noncarcinogenic hazards associated with exposure to more than one constituent are additive. Synergistic or antagonistic interactions between constituents are not accounted for. The hazard index (HI) may exceed 1.0 even if all of the individual HQs are less than 1.0. The constituents may then be segregated by similar mechanisms of toxicity and toxicological effects, and separate HIs derived based on mechanism and target organs affected. If the separate HIs by target organs are less than 1, it is generally assumed that the hazard falls within acceptable health risks. Hazards were also added across the pathways (i.e., ingestion or dermal), if an individual would be exposed through multiple pathways.

Carcinogenic Risk Estimation.

The potential for carcinogenic effects due to exposure to site-related constituents is evaluated by estimating excess lifetime cancer risk. Excess lifetime carcinogenic risk is the incremental increase in the probability of developing cancer during one’s lifetime in addition to the background probability of developing cancer. The background probability of developing cancer is about one in two for men and one in three for women (American

Cancer Society, 2002). Therefore, a $2x10^{-6}$ excess lifetime carcinogenic risk means that an individual's probability of developing cancer in his or her lifetime changes from approximately 0.500000 to 0.500002. Or, expressed another way, for every 1 million people exposed to the carcinogen throughout their lifetime, the incidence of cancer *may* increase by two cases.

Risk is calculated by multiplying the intake by the CSF.

$$\text{Risk} = \text{Intake} \times \text{CSF}$$

The combined risk from exposure to multiple constituents was evaluated by adding the risks from individual constituents. Risks were added across the pathways, if an individual would be exposed through multiple pathways. For example, a person contacting groundwater could be exposed by both the oral and dermal pathways.

When a cumulative carcinogenic risk to an individual receptor under the assumed RME exposure conditions at the site exceeds 100 in a million (10^{-4} excess cancer risk), Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) generally requires remedial action to reduce risks at the site [400CFR300.430 (e)(2)(i)(A)(2)]. If the cumulative risk is less than 10^{-4}, action generally is not required, but may be warranted if a risk-based constituent-specific standard, for example, the maximum contaminant level (MCL), is exceeded.

Risk Assessment Results

The results of the risk assessment for groundwater at Site 2 are discussed below, and summarized in Tables 1 through 5. The tables used to evaluate the human health risks associated with exposure to Site 2 groundwater are presented in Attachment 1.

The COPCs retained for Site 2 filtered alluvial groundwater (residential exposure) are TCE, VC, antimony, iron, and manganese. The COPCs for the unfiltered groundwater (construction worker exposure) are TCE, VC, aluminum, chromium, iron, lead, manganese, and vanadium. The COPCs retained for Site 2 filtered bedrock groundwater are TCE and iron. Risks associated with exposure to the COPCs in the alluvial groundwater by potential future residents and construction workers and bedrock groundwater by potential future residents were evaluated for Site 2.

Alluvial Aquifer Groundwater Exposure

- **Future Adult Resident (noncarcinogenic hazard**)
  Table 9.1.RME, Attachment 1, summarizes the hazard to the future adult resident. The RME noncarcinogenic hazard associated with use of the alluvial aquifer groundwater as a potable water supply (1.2) is above USEPA's target hazard index of 1.0. However, there are no individual individual constituents or target organ/effects with hazard indices above 1.0. The CTE HI (0.32) is below the USEPA's target hazard index of 1.0 (Table 9.1.CTE, Attachment 1).

- **Future Child Resident (noncarcinogenic hazard)**
  Table 9.2.RME, Attachment 1, summarizes the hazard to the future child resident. The RME noncarcinogenic hazard associated with exposure to the alluvial aquifer groundwater as a potable water supply (2.9) exceeds USEPA's target hazard index of

1.0. Manganese is the risk driver contributing an HI = 1.5 from the ingestion pathway. The target organ associated with manganese, the central nervous system, is the only target organ/effect with an HI above 1.0. The CTE noncarcinogenic hazard associated with use of the alluvial aquifer groundwater (1.0) does not exceed USEPA's target HI (Table 9.2.CTE, Attachment 1).

- **Future Lifetime Resident (carcinogenic risk)**
  Table 9.3.RME, Attachment 1, summarizes the carcinogenic risks to the future lifetime resident. The RME carcinogenic risk associated with exposure to the alluvial aquifer groundwater as a potable water supply (6.1×10^{-5}) is within USEPA's target risk range of 10^{-6} to 10^{-4}.

- **Future Adult Construction Worker (noncarcinogenic hazard and carcinogenic risk**)
  Table 9.4.RME, Attachment 1, summarizes the hazard and carcinogenic risk to the future adult construction worker.

  The RME noncarcinogenic hazard to the construction worker exposed to the alluvial aquifer groundwater (0.20) is below USEPA's target hazard index of 1.0. The RME carcinogenic risk (1.4×10^{-8}) is below USEPA's target risk range of 10^{-6} to 10^{-4}.

  Lead was retained as a COPC for unfiltered alluvial aquifer groundwater for the construction worker exposure scenario. There are no methods to evaluate construction worker exposure to lead in groundwater (only residential child). However, the exposure point concentration (the arithmetic mean lead concentration = 12 µg/L) is less than the lead screening level of 15 µg/L. Therefore, it is unlikely that exposure to lead would be a concern to construction workers.

Bedrock Aquifer Groundwater Exposure

- **Future Adult Resident (noncarcinogenic hazard**)
  Table 9.5.RME, Attachment 1, summarizes the hazard to the future adult resident. The RME noncarcinogenic hazard associated with use of the bedrock aquifer groundwater as a potable water supply (0.057) is below USEPA's target hazard index of 1.0.

- **Future Child Resident (noncarcinogenic hazard**)
  Table 9.6.RME, Attachment 1, summarizes the hazard to the future child resident. The RME noncarcinogenic hazard associated with use of the bedrock aquifer groundwater as a potable water supply (0.13) is below USEPA's target hazard index of 1.0.

- **Future Lifetime Resident (carcinogenic risk)**
  Table 9.7.RME, Attachment 1, summarizes the carcinogenic risks to the future lifetime resident. The RME carcinogenic hazard associated with use of the bedrock aquifer groundwater as a potable water supply (2.4×10^{-7}) is below USEPA's risk range of 10^{-6} to 10^{-4}.

Summary of Risks Associated with Exposure to Site 2 Soil

A risk assessment for Site 2 soil was completed in 2004. Potential risks were calculated for a current/future industrial worker, current/future adolescent trespasser/visitor, future adult resident, future child resident, future lifetime resident, future construction worker, and future adolescent trespasser/visitor. The risks calculated for current site use (industrial

worker and adolescent trespasser/visitor exposed to surface soil) and future site use (with the exception of the child resident) were all within USEPA target levels. The potential future child resident was the only receptor with a calculated RME noncarcinogenic hazard that exceeded USEPA's target levels. The hazard was associated with exposure to manganese. Manganese is an essential human nutrient, and the intake of manganese from soil would fall within the recommended dietary intake levels, as presented in the RI.

Uncertainty Associated with Human Health Assessment

The risk measures used in risk assessments are not fully probabilistic estimates of risk but are conditional estimates given that a set of assumptions about exposure and toxicity are realized. Thus it is important to specify the assumptions and uncertainties inherent in the risk assessment to place the risk estimates in proper perspective.

Due to the limited number of groundwater samples evaluated in the risk assessment, the maximum detected concentration was used as the EPC. This results in uncertainty in the EPC, but use of the maximum concentration most likely overestimates the actual exposure concentration.

Background concentrations were not used to screen for the COPCs and focus the risk assessment on only those site-related COPCs. Therefore, it is likely some of the calculated risks for the site may be attributable to background conditions.

Uncertainty associated with the noncarcinogenic toxicity factors is included in Attachment 1, Tables 5.1 and 5.2. Several UFs and MFs were applied to extrapolate dose points from animal studies to humans. These UFs and MFs range between 10 to 1000. Additional modification factors are also used based on the professional judgment of the USEPA. Therefore, there is a high degree of uncertainty in the noncarcinogenic toxicity criteria, based on the available scientific data for each compound. The noncarcinogenic toxicity factors are most likely an overestimate of actual toxicity.

CSFs developed by USEPA represent upper bound estimates. Carcinogenic risks generated in this assessment should be regarded as an upper bound estimate on the potential carcinogenic risks rather than an accurate representation of carcinogenic risk. The true carcinogenic risk is likely to be less than the predicted value (USEPA, December 1989).

The provisional toxicity values used for TCE in this assessment were provided by NCEA. NCEA developed these provisional toxicity values subsequent to the withdrawal of the TCE CSFs from IRIS in 1989. The NCEA CSFs were the same values that were withdrawn from IRIS in 1989 (oral CSF = 1.1×10^{-2} per mg/kg-day and inhalation CSF = 6.0×10^{-3} per mg/kg-day). In 1992, NCEA also recommended a provisional noncarcinogenic toxicity value (oral RfD = 6.0×10^{-3} mg/kg-day). However, as with all NCEA toxicity values, these are considered provisional and are to be periodically reassessed to include up-to-date scientific understanding.

In August 2001, NCEA completed a draft health assessment of the health risks posed by TCE. The draft health assessment was made available for public comment and includes a disclaimer that it is a preliminary draft and "has not been formally released by USEPA and should not at this stage be construed to represent Agency policy. It is being circulated for comment on its technical merit and policy implications," (USEPA, 2001c). The draft health assessment

proposed a provisional oral RfD of $3.0x10^{-4}$ mg/kg-day based on effects to the liver, kidney, and developing fetuses. A provisional inhalation RfD of $1.0x10^{-2}$ mg/kg-day was also suggested based on critical effects in the central nervous system, liver, and endocrine system. Several CSFs were developed in the 2001 draft health assessment, with most slope factors falling between $2x10^{-2}$ and $4x10^{-1}$ per mg/kg-day.

Because the toxicity values in the draft 2001 health assessment are different than the current provisional toxicity values, to characterize the uncertainty associated with the quantitative estimate of risk from exposure to TCE, a parallel set of risk calculations was performed using the toxicity values in the draft 2001 health assessment. The following toxicity values were used for these calculations:

- Oral CSF = $4.0x10^{-1}$ $(mg/kg\text{-}day)^{-1}$
- Inhalation CSF = $4.0x10^{-1}$ $(mg/kg\text{-}day)^{-1}$
- Oral RfD = $3.0x10^{-4}$ mg/kg-day
- Inhalation RfD = $1.0x10^{-2}$ mg/kg-day

Table 6 shows the results of the risk assessment using these toxicity values, and compares them to the results using the pre-2001 values. As shown in Table 6, use of the draft 2001 values would not result in a different conclusion than the values used in the risk assessment.

There is a large degree of uncertainty associated with the oral to dermal adjustment factors (based on chemical-specific gastrointestinal absorption factors) used to transform the oral RfDs based on administered doses to dermal RfDs based on absorbed doses. It is not know if the adjustment factor results in an underestimate or overestimate of the actual toxicity associated with dermal exposure.

Use of provisional toxicity factors increases the degree of uncertainty associated with the groundwater risk assessments. A provisional RfD for iron was used in this assessment. Iron is an essential human nutrient, which complicates the derivation of an RfD (USEPA, January 1999).

Although the oral RfD for manganese is not provisional (that is, the RfD has been approved by a USEPA workgroup), the derivation of toxicity factors for essential nutrients is complicated and therefore warrants further discussion. Manganese is an essential human nutrient responsible for activating several enzymes (USEPA, September 2003). Exposure to manganese in groundwater resulted in an HQ above 1 for the child resident. However, the recommended dietary intakes from the Food and Nutrition Board, Institute of Medicine, National Academies (National Academy of Sciences, 2004) for children 1–3 years of age and 4–8 years of age are 1.2 mg/day and 1.5 mg/day, which correlate to intakes of 0.08 mg/kg-day and 0.1 mg/kg-day. The estimated intake for the child receptor at Site 2 is 0.03 mg/kg-day, which is below this range. Exposure to manganese in groundwater by child residents should not be considered a health concern for Site 2.

The uncertainties identified in each component of risk assessment ultimately contribute to uncertainty in risk characterization. The addition of risks and HIs across pathways and constituents contributes to uncertainty based on the interaction of constituents such as additivity, synergism, potentiation, susceptibility of exposed receptors, etc.

Human Health Risk Assessment Summary

The Site 2 baseline risk assessment was conducted to evaluate the potential human-health risks associated with exposure to groundwater within the alluvial aquifer and the bedrock aquifer at the site.

Potential risks were calculated for a future adult resident, future child resident, future lifetime resident, and future construction worker. Tables 4 and 5 summarize the risks and hazards for the RME and CTE scenarios, respectively.

Potential future potable use of the groundwater within the alluvial aquifer by a child resident may result in potential hazards that exceed USEPA target levels, associated with manganese. The intakes of manganese for the child resident (the only receptor for which manganese was a risk driver) are below RDA levels, and therefore should not be considered a health risk. Therefore, it can be assumed there are no unacceptable health risks associated with potable use of groundwater from the alluvial aquifer at Site 2. Although to total hazard to the adult resident exceeds USEPA target levels, there are no individual constituents or target organs that exceed USEPA target levels, and therefore, the hazard is considered acceptable. The carcinogenic risk to the lifetime resident is within USEPA's target risk range.

Potential exposure to groundwater within the alluvial aquifer by a construction worker would result in a noncarcinogenic hazard and carcinogenic risk below USEPA target levels. Therefore, it can be assumed that there are no unacceptable health risks associated with exposure to groundwater within the alluvial aquifer for a construction worker.

Potential future potable use of groundwater within the bedrock aquifer by an adult, child, and lifetime resident would not result in hazards or risks that exceed USEPA target levels. Therefore, it can be assumed that there are no unacceptable health risks associated with potable use of groundwater from the bedrock aquifer at Site 2.

Based upon the results of the baseline human health risk assessment for groundwater at Site 2, no further action is needed to be protective of human health under industrial or residential use scenarios (i.e., unrestricted land use is applicable).

References

CH2M HILL. 2005. *Final Risk Assessment Report for Site 10 Soil and Sites 2 and 3 at the Allegany Ballistics Laboratory Site, Rocket Center, West Virginia.* July.

Foster, S. A. and P. C. Chrostowski. 1987. *Inhalation Exposures to Volatile Organic Contaminants in the Shower*. ICF-Clement Associates, Inc. Washington, D.C.

USEPA. 1989. *Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual, Part A, Interim Final*. Office of Solid Waste and Emergency Response. EPA/540/1-89/002. December.

USEPA. 1991. *Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors*. Office of Solid Waste and Emergency Response. OSWER Directive No. 9285.6-03, March 25.

USEPA Region III. 1992. Draft Guidance on the Selection of Analytical Metal Results from Monitoring Well Samples for Use in the Quantitative Assessment of Risks. August, 10.

USEPA. 1993. *Selecting Exposure Routes and Contaminants of Concern by Risk-Based Screening*. Region III, Hazardous Waste Management Division, Office of Superfund Programs. EPA/903/R-93-001. January

USEPA, 1997. *Exposure Factors Handbook, Volume 1, General Factors*. EPA/600/P-95/002Fa. National Center for Environmental Assessment. Washington, DC. August.

USEPA. 1997. *Health Effects Assessment Summary Tables (HEAST), Annual Update*. USEPA, Environmental Criterion Assessment Office, Office of Research and Development, Cincinnati, OH. July.

USEPA. 1999. *Risk Assessment Issue Paper for Derivation of a Provisional RfD for Iron (CASRN 7439-89-6).* National Center for Environmental Assessment. January.

USEPA. 2001. *Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual (Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessment) Final.* Office Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C. Publication 9285.7-47. December.

USEPA 2003. Human Health Toxicity Values in Superfund Risk Assessments. OSWER Directive 9285.7-53. December 5.

USEPA, 2004. *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), Interim.* USEPA/540/R/99/005. OSWER 9285.7-02EP. September.

USEPA. 2006. Integrated Risk Information System Database.

USEPA. 2006. *USEPA Region III Risk-Based Concentration Table*. October 31.

Table 1
Summary of Data Quantitatively Used in Baseline Risk Assessment
Site 2, Allegany Ballistics Laboratory

Medium	Date of Sampling	Sample Location	Sample	Parameters
Groundwater				
Alluvial Groundwater	4/06/2004	2GW01	2GW01-0404	VOCs, SVOCs, Explosives, Metals, Dissolved Metals
	4/06/2004	2GW02	2GW02-0404	VOCs, SVOCs, Explosives, Metals, Dissolved Metals
	6/7/2008	2GW02	AS02-2GW02-0608	Arsenic, Dissolved and Total
	6/7/2008	2GW10	AS02-2GW10-0608	Arsenic, Dissolved and Total
	6/7/2008	2GW11	AS02-2GW11-0608	Arsenic, Dissolved and Total
	6/7/2008	2GW11	AS02-2GW11P-0608	Arsenic, Dissolved and Total
Background Alluvial Groundwater	4/06/2004	2GW08	2GW08-0404	VOCs, SVOCs, Explosives, Metals, Dissolved Metals
	4/06/2004	2GW09	2GW09-0404	VOCs, SVOCs, Explosives, Metals, Dissolved Metals
Bedrock Groundwater	4/06/2004	2GW07	2GW07-0404	VOCs, SVOCs, Explosives, Metals, Dissolved Metals

Definitions:
SVOCs - Semivolatile Organic Compounds
VOCs - Volatile Organic Compounds
Notes:
1. AS02-2GW11P-0608 is duplicate sample of AS02-GW11-0608
2. The hybrid well (2GW01) was improperly installed across the alluvial and bedrock aquifers, which resulted in elevated arsenic concentrations, therefore, alluvial groundwater samples collected in 2008 and analyzed for arsenic replace arsenic analysis from 2GW01 in 4/06/2004. 2GW11 was installed as a replacement well for 2GW01.

Table 2
Summary of Chemicals of Potential Concern for the HHRA
Site 2, Allegany Ballistics Laboratory

Alluvial Groundwater	Bedrock Groundwater
Site 2	**Site 2**
Tap Water	***Tap Water***
Trichloroethene	Trichloroethene
Vinyl chloride	Iron
Antimony	
Iron	***Water Vapors at Showerhead***
Manganese	Trichloroethene
Water Vapors at Showerhead	
Trichloroethene	
Vinyl chloride	
Water in Excavation Pit	
Trichloroethene	
Vinyl chloride	
Aluminum	
Chromium	
Iron	
Manganese	
Vanadium	
Volatilization from Water in Excavation Pit	
Trichloroethene	
Vinyl chloride	

Table 3
Potentially Complete Human Health Exposure Pathways
Conceptual Site Model
Site 2, Allegany Ballistics Laboratory

Land Use	Contaminated Media	Potentially Exposed Populations	Exposure Route (Human Health)	Pathway Selected for Evaluation	Rationale
Future					
Residential	Groundwater	Residents - Adults and Children	Ingestion, dermal contact, and inhalation	Yes	Groundwater is not currently used on-site as a water supply and the site is not expected to be developed for residential use; however, the residential scenario (including inhalation of volatiles while showering) is included for a conservative evaluation of unrestricted land use.
Industrial or Residential	Groundwater	Construction Worker	Dermal contact and inhalation	Yes	Construction worker may contact and/or inhale vapors from groundwater during excavation activities.

Table 4
Summary of RME Cancer Risks and Hazard Indices
Site 2, Allegany Ballistics Laboratory

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks >10^{-4}	Chemicals with Cancer Risks >10^{-5} and <10^{-4}	Chemicals with Cancer Risks >10^{-6} and <10^{-5}	Hazard Index	Chemicals with HI>1
Future Resident Adult	Alluvial Groundwater	Ingestion	NA				1.1	
		Dermal Contact	NA				0.098	
		Inhalation	NA				0.0010	
		Total	NA				1.2	
Future Resident Child	Alluvial Groundwater	Ingestion	NA				2.7	Manganese
		Dermal Contact	NA				0.29	
		Inhalation	NA				NA	
		Total	NA				2.9	Manganese
Future Resident Child/Adult	Alluvial Groundwater	Ingestion	5.7E-05		Vinyl chloride		NA	
		Dermal Contact	3.1E-06			Vinyl chloride	NA	
		Inhalation	3.9E-07				NA	
		Total	6.1E-05		Vinyl chloride		NA	
Future Construction Worker Adult	Alluvial Groundwater	Ingestion	NA				NA	
		Dermal Contact	1.4E-08				0.20	
		Inhalation	3.7E-10				0.000037	
		Total	1.4E-08				0.20	
Future Resident Adult	Bedrock Groundwater	Ingestion	NA				0.056	
		Dermal Contact	NA				0.0011	
		Inhalation	NA				NA	
		Total	NA				0.057	
Future Resident Child	Bedrock Groundwater	Ingestion	NA				0.13	
		Dermal Contact	NA				0.0027	
		Inhalation	NA				NA	
		Total	NA				0.13	
Future Resident Child/Adult	Bedrock Groundwater	Ingestion	1.8E-07				NA	
		Dermal Contact	1.2E-08				NA	
		Inhalation	4.8E-08				NA	
		Total	2.4E-07				NA	

NA - Not applicable, pathway incomplete.

Table 5
Summary of CTE Cancer Risks and Hazard Indices
Site 2, Allegany Ballistics Laboratory

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks >10^{-4}	Chemicals with Cancer Risks >10^{-5} and <10^{-4}	Chemicals with Cancer Risks >10^{-6} and <10^{-5}	Hazard Index	Chemicals with HI>1
Future Resident Adult	Alluvial Groundwater	Ingestion	NA				0.30	
		Dermal Contact	NA				0.015	
		Inhalation	NA				0.00044	
		Total	NA				0.32	
Future Resident Child	Alluvial Groundwater	Ingestion	NA				1.0	
		Dermal Contact	NA				0.034	
		Inhalation	NA				NA	
		Total	NA				1.0	
Future Resident Child/Adult	Alluvial Groundwater	Ingestion	3.2E-05			Vinyl chloride	NA	
		Dermal Contact	9.4E-07				NA	
		Inhalation	1.6E-07				NA	
		Total	3.3E-05			Vinyl chloride	NA	

NA - Not applicable, pathway incomplete.

Table 6
Effect of Use of Draft 2001 TCE Toxicity Values on Human Health Risk Assessment Results
Site 2, Allegany Ballistics Laboratory

Receptor	Media	Pre-2001		Draft-2001	
		Cancer Risk	Hazard Index	Cancer Risk	Hazard Index
Future Resident - Adult	Alluvial Aquifer Groundwater	NA	1.2E+00	NA	1.4E+00
Future Resident - Child	Alluvial Aquifer Groundwater	NA	2.9E+00	NA	3.4E+00
Future Resident - Adult/Child	Alluvial Aquifer Groundwater	6.1E-05	NA	8.0E-05	NA
Future Construction Worker - Adult	Alluvial Aquifer Groundwater	1.4E-08	2.0E-01	5.6E-08	2.1E-01
Future Resident - Adult	Bedrock Aquifer Groundwater	NA	5.7E-02	NA	1.7E-01
Future Resident - Child	Bedrock Aquifer Groundwater	NA	1.3E-01	NA	3.9E-01
Future Resident - Adult/Child	Bedrock Aquifer Groundwater	2.4E-07	NA	1.0E-05	NA

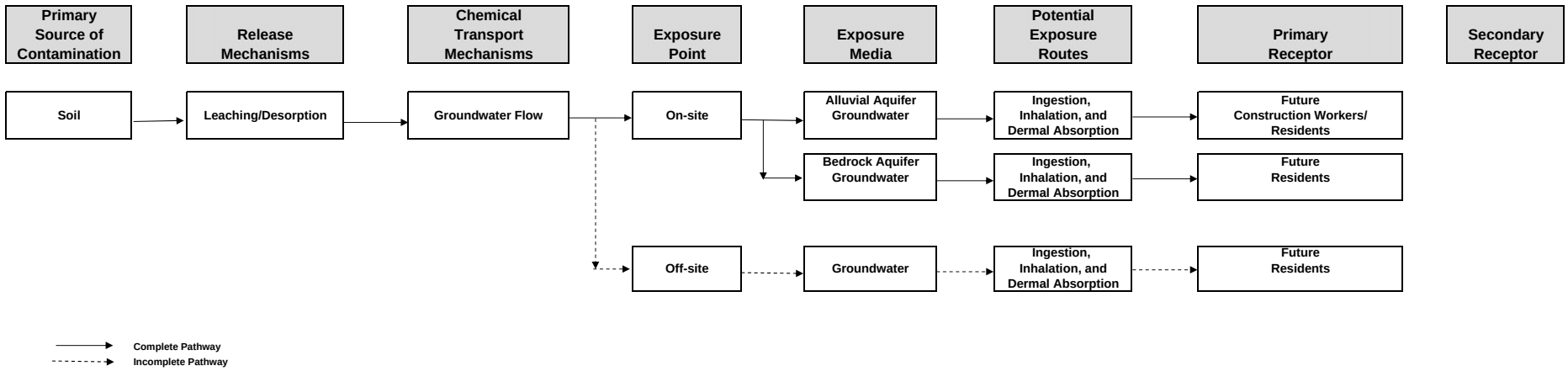


Figure 1
Conceptual Site Model for Potential Human Exposures-Site 2 Groundwater
Allegany Ballistics Laboratory

Attachment 1
HHRA Tables

TABLE 1

SELECTION OF EXPOSURE PATHWAYS

Site 2, Allegany Ballistics Laboratory

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Groundwater	Groundwater	Alluvial Aquifer - Tap Water	Resident	Adult	Dermal Absorption	On-site	Quant	Although unlikely, groundwater may be used as future potable water supply. Child is assumed to bathe and adult is assumed to shower.
						Ingestion	On-site	Quant	Although unlikely, groundwater may be used as future potable water supply.
					Child	Dermal Absorption	On-site	Quant	Although unlikely, groundwater may be used as future potable water supply. Child is assumed to bathe and adult is assumed to shower.
						Ingestion	On-site	Quant	Although unlikely, groundwater may be used as future potable water supply.
					Child/Adult	Ingestion	On-site	Quant	Although unlikely, groundwater may be used as future potable water supply. Child/Adult evaluated for cancer risk only.
			Alluvial Aquifer - Water in Excavation Pit	Construction Worker	Adult	Ingestion	On-site	None	Construction worker not expected to ingest significant amount of groundwater during excavation activities.
						Dermal Absorption	On-site	Quant	Construction woker may contact groundwater during excavation activites.
		Air	Alluvial Aquifer - Water Vapors at Showerhead	Resident	Adult	Inhalation	On-site	Quant	Although unlikely, groundwater may be used as future potable water supply. Adu resident many inhale VOCs while showering.
		Air	Alluvial Aquifer - Volatilization from Water in Excavation Pit	Construction Worker	Adult	Inhalation	On-site	Quant	Construction worker may be exposed to VOCs from groundwater during construction activities.
	Groundwater	Groundwater	Bedrock Aquifer - Tap Water	Resident	Adult	Dermal Absorption	On-site	Quant	Although unlikely, groundwater may be used as future potable water supply. Child is assumed to bathe and adult is assumed to shower.
						Ingestion	On-site	Quant	Although unlikely, groundwater may be used as future potable water supply.
					Child	Dermal Absorption	On-site	Quant	Although unlikely, groundwater may be used as future potable water supply. Child is assumed to bathe and adult is assumed to shower.
						Ingestion	On-site	Quant	Although unlikely, groundwater may be used as future potable water supply.
					Child/Adult	Ingestion	On-site	Quant	Although unlikely, groundwater may be used as future potable water supply. Child/Adult evaluated for cancer risk only.
		Air	Bedrock Aquifer - Water Vapors at Showerhead	Resident	Adult	Inhalation	On-site	Quant	Although unlikely, groundwater may be used as future potable water supply. Adu resident many inhale VOCs while showering.

Table 2.1

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Site 2 - Allegheny Ballistics Laboratory

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Allluvial Aquifer Tap Water	76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	6.6E+00	2.8E+01	UG/L	2GW01-0404	2/2	0.5 - 1	2.8E+01	1.3E+00	5.9E+03 N	N/A	N/A	NO	BSL
	75-71-8	Dichlorodifluoromethane (Freon-12)	4.3E+00	4.3E+00	UG/L	2GW01-0404	1/2	0.5 - 0.5	4.3E+00	2.5E-01	3.5E+01 N	N/A	N/A	NO	BSL
	79-01-6	Trichloroethene	5.5E-01	2.0E+00	UG/L	2GW02-0404	2/2	0.5 - 0.5	2.0E+00	2.6E+00	2.6E-02 C	5.0E+00	MCL	YES	ASL
	75-01-4	Vinyl chloride	9.7E-01	9.7E-01	UG/L	2GW01-0404	1/2	0.5 - 0.5	9.7E-01	2.5E-01	1.5E-02 C	2.0E+00	MCL	YES	ASL
	156-59-2	cis-1,2-Dichloroethene	3.9E-01 J	3.9E-01 J	UG/L	2GW01-0404	1/2	0.5 - 0.5	3.9E-01	1.5E+00	6.1E+00 N	7.0E+01	MCL	NO	BSL
	14797-73-0	Perchlorate	1.8E+00	1.8E+00	UG/L	2GW02-0404	1/2	1 - 1	1.8E+00	5.0E-01	2.6E+00 N	N/A	N/A	NO	BSL
	7440-36-0	Antimony	4.7E+00 J	4.7E+00 J	UG/L	2GW02-0404	1/2	60 - 60	4.7E+00	2.1E+00	1.5E+00 N	6.0E+00	MCL	YES	ASL
	7440-39-3	Barium	8.5E+01 J	2.7E+02	UG/L	2GW01-0404	2/2	200 - 200	2.7E+02	1.8E+02	7.3E+02 N	2.0E+03	MCL	NO	BSL
	7440-70-2	Calcium	5.1E+04	5.8E+04	UG/L	2GW01-0404	2/2	5000 - 5000	5.8E+04	5.9E+04	N/A	N/A	N/A	NO	NUT
	7439-89-6	Iron	3.9E+03	3.9E+03	UG/L	2GW01-0404	1/2	100 - 100	3.9E+03	8.0E+02	1.1E+03 N	3.0E+02	SMCL	YES	ASL
	7439-95-4	Magnesium	9.0E+03 K	1.5E+04	UG/L	2GW01-0404	2/2	5000 - 5000	1.5E+04	1.8E+03	N/A	N/A	N/A	NO	NUT
	7439-96-5	Manganese	4.7E+02	4.7E+02	UG/L	2GW01-0404	1/2	15 - 15	4.7E+02	5.0E-02	7.3E+01 N	5.0E+01	SMCL	YES	ASL
	7440-02-0	Nickel	3.6E+00 J	3.6E+00 J	UG/L	2GW02-0404	1/2	40 - 40	3.6E+00	2.7E+00	7.3E+01 N	N/A	N/A	NO	BSL
	7440-09-7	Potassium	1.0E+03 J	1.5E+03 J	UG/L	2GW01-0404	2/2	5000 - 5000	1.5E+03	1.1E+03	N/A	N/A	N/A	NO	NUT
	7782-49-2	Selenium	2.4E+00 J	2.4E+00 J	UG/L	2GW02-0404	1/2	5 - 5	2.4E+00	1.2E+00	1.8E+01 N	5.0E+01	MCL	NO	BSL
	7440-23-5	Sodium	1.3E+04	1.6E+04	UG/L	2GW01-0404	2/2	5000 - 5000	1.6E+04	1.6E+04	N/A	N/A	N/A	NO	NUT
	7440-66-6	Zinc	7.6E+00 J	7.6E+00 J	UG/L	2GW02-0404	1/2	20 - 20	7.6E+00	5.2E+00	1.1E+03 N	5.0E+03	SMCL	NO	BSL

Dissolved inorganic data used for groundwater because total inorganic data is order of magnitude higher.

[1] Minimum/Maximum detected concentrations.

[2] Maximum concentration is used for screening.

[3] Background values from wells 2GW08 and 2GW09.

[4] Risk-Based Concentration Table, October 31, 2006, U.S. EPA Region III, Jennifer Hubbard. Tap Water RBC
RBC value for manganese-nonfood used as surrogate for manganese.

[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)

Deletion Reason: No Toxicity Information (NTX)
Essential Nutrient (NUT)
Below Screening Level (BSL)

COPC = Chemical of Potential Concern

ARAR/TBC = Applicable or Relevant and Appropriate Requirement/
To Be Considered

J = Estimated Value

K = Biased High

C = Carcinogenic

N = Noncarcinogenic

MCL = Maximum Contaminant Level, Primary Drinking Water Standards, Winter 2004

SMCL = Secondary Maximum Contaminant Level, Primary Drinking Water Standards.

Table 2.2

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Site 2 - Allegheny Ballistics Laboratory

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Allluvial Aquifer Water in Excavation Pit	76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	6.6E+00	2.8E+01	UG/L	2GW01-0404	2/2	0.5 - 1	2.8E+01	1.3E+00	5.9E+03 N	N/A	N/A	NO	BSL
	75-71-8	Dichlorodifluoromethane (Freon-12)	4.3E+00	4.3E+00	UG/L	2GW01-0404	1/2	0.5 - 0.5	4.3E+00	2.5E-01	3.5E+01 N	N/A	N/A	NO	BSL
	79-01-6	Trichloroethene	5.5E-01	2.0E+00	UG/L	2GW02-0404	2/2	0.5 - 0.5	2.0E+00	2.6E+00	2.6E-02 C	5	MCL	YES	ASL
	75-01-4	Vinyl chloride	9.7E-01	9.7E-01	UG/L	2GW01-0404	1/2	0.5 - 0.5	9.7E-01	2.5E-01	1.5E-02 C	2	MCL	YES	ASL
	156-59-2	cis-1,2-Dichloroethene	3.9E-01 J	3.9E-01 J	UG/L	2GW01-0404	1/2	0.5 - 0.5	3.9E-01	1.5E+00	6.1E+00 N	70	MCL	NO	BSL
	14797-73-0	Perchlorate	1.8E+00	1.8E+00	UG/L	2GW02-0404	1/2	1 - 1	1.8E+00	5.0E-01	2.6E+00 N	N/A	N/A	NO	BSL
	7429-90-5	Aluminum	1.6E+03 K	7.6E+03 K	UG/L	2GW01-0404	2/2	200 - 200	7.6E+03	1.6E+04	3.7E+03 N	50 - 200	SMCL	YES	ASL
	7440-39-3	Barium	1.0E+02 K	3.6E+02 K	UG/L	2GW01-0404	2/2	200 - 200	3.6E+02	3.3E+02	7.3E+02 N	200	MCL	NO	BSL
	7440-70-2	Calcium	5.2E+04 K	5.9E+04 K	UG/L	2GW01-0404	2/2	5000 - 5000	5.9E+04	6.1E+04	N/A	N/A	N/A	NO	NUT
	7440-47-3	Chromium	9.2E+00 J	1.4E+01	UG/L	2GW02-0404	2/2	10 - 10	1.4E+01	3.1E+01	1.1E+01 N	100	MCL	YES	ASL
	7439-89-6	Iron	2.4E+03 J	3.1E+04	UG/L	2GW01-0404	2/2	100 - 100	3.1E+04	2.4E+04	1.1E+03 N	300	SMCL	YES	ASL
	7439-92-1	Lead	6.1E+00	1.9E+01	UG/L	2GW02-0404	2/2	3 - 3	1.9E+01	1.1E+01	1.5E+01	15	MCL	YES	ASL
	7439-95-4	Magnesium	9.3E+03	1.6E+04	UG/L	2GW01-0404	2/2	5000 - 5000	1.6E+04	1.1E+04	N/A	N/A	N/A	NO	NUT
	7439-96-5	Manganese	1.4E+02	5.7E+02	UG/L	2GW01-0404	2/2	15 - 15	5.7E+02	2.4E+03	7.3E+01 N	50	SMCL	YES	ASL
	7440-02-0	Nickel	8.2E+00	1.2E+01	UG/L	2GW02-0404	2/2	40 - 40	1.2E+01	5.0E-02	7.3E+01 N	N/A	N/A	NO	BSL
	7440-09-7	Potassium	1.4E+03	3.2E+03	UG/L	2GW01-0404	2/2	5000 - 5000	3.2E+03	2.9E+01	N/A	N/A	N/A	NO	NUT
	7782-49-2	Selenium	2.7E+00	2.7E+00	UG/L	2GW01-0404	1/2	5 - 5	2.7E+00	4.3E+03	1.8E+01 N	50	MCL	NO	BSL
	7440-23-5	Sodium	1.4E+04	1.6E+04	UG/L	2GW01-0404	2/2	5000 - 5000	1.6E+04	1.7E+04	N/A	N/A	N/A	NO	NUT
	7440-62-2	Vanadium	3.2E+00 J	1.4E+01 J	UG/L	2GW01-0404	2/2	50 - 50	1.4E+01	2.8E+01	3.7E+00 N	N/A	N/A	YES	ASL
	7440-66-6	Zinc	1.5E+01 J	2.3E+01 J	UG/L	2GW01-0404	2/2	20 - 20	2.3E+01	5.6E+01	1.1E+03 N	5000	SMCL	NO	BSL

Total inorganic data for groundwater used because construction worker would be exposed to the water in the excavation that has not been filtered.

[1] Minimum/Maximum detected concentrations.

[2] Maximum concentration is used for screening.

[3] Background values from wells 2GW08 and 2GW09.

[4] Risk-Based Concentration Table, October 31, 2006, U.S. EPA Region III, Jennifer Hubbard. Tap Water RBC

Aluminum was withdrawn from October 2005 RBC Table due to expiration of NCEA provisional toxicity values. Value is from the April 2005 RBC table.

RBC value for hexavalent chromium used for total chromium.

The tap water value of 15 ug/L for lead is the action level provided in the Drinking Water Regulations and Health Advisories.

RBC value for manganese-nonfood used as surrogate for manganese.

[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)

Deletion Reason: No Toxicity Information (NTX)
Essential Nutrient (NUT)
Below Screening Level (BSL)

COPC = Chemical of Potential Concern

ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered

J = Estimated Value

K = Biased High

C = Carcinogenic

N = Noncarcinogenic

MCL = Maximum Contaminant Level, Primary Drinking Water Standards, Winter 2004

SMCL = Secondary Maximum Contaminant Level, Primary Drinking Water Standards.

Table 2.3

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Site 2 - Allegheny Ballistics Laboratory

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Allluvial Aquifer	76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	6.6E+00	2.8E+01	UG/L	2GW01-0404	2/2	0.5 - 1	2.8E+01	1.3E+00	5.9E+03 N	N/A	N/A	NO	BSL
Water Vapors	75-71-8	Dichlorodifluoromethane (Freon-12)	4.3E+00	4.3E+00	UG/L	2GW01-0404	1/2	0.5 - 0.5	4.3E+00	2.5E-01	3.5E+01 N	N/A	N/A	NO	BSL
at Showerhead	79-01-6	Trichloroethene	5.5E-01	2.0E+00	UG/L	2GW02-0404	2/2	0.5 - 0.5	2.0E+00	2.6E+00	2.6E-02 C	5.0E+00	MCL	YES	ASL
	75-01-4	Vinyl chloride	9.7E-01	9.7E-01	UG/L	2GW01-0404	1/2	0.5 - 0.5	9.7E-01	2.5E-01	1.5E-02 C	2.0E+00	MCL	YES	ASL
	156-59-2	cis-1,2-Dichloroethene	3.9E-01 J	3.9E-01 J	UG/L	2GW01-0404	1/2	0.5 - 0.5	3.9E-01	1.5E+00	6.1E+00 N	7.0E+01	MCL	NO	BSL

[1] Minimum/Maximum detected concentrations.
[2] Maximum concentration is used for screening.
[3] Background values from wells 2GW08 and 2GW09.
[4] Risk-Based Concentration Table, October 31, 2006, U.S. EPA Region III, Jennifer Hubbard. Tap Water RBC
[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)
Deletion Reason: No Toxicity Information (NTX)
Essential Nutrient (NUT)
Below Screening Level (BSL)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
J = Estimated Value
C = Carcinogenic
N = Noncarcinogenic
MCL = Maximum Contaminant Level, Primary Drinking Water Standards, Winter 2004

Table 2.4

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Site 2 - Allegheny Ballistics Laboratory

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Allluvial Aquifer	76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	6.6E+00	2.8E+01	UG/L	2GW01-0404	2/2	0.5 - 1	2.8E+01	1.3E+00	5.9E+03 N	N/A	N/A	NO	BSL
Volatilization from Water	75-71-8	Dichlorodifluoromethane (Freon-12)	4.3E+00	4.3E+00	UG/L	2GW01-0404	1/2	0.5 - 0.5	4.3E+00	2.5E-01	3.5E+01 N	N/A	N/A	NO	BSL
in Excavation Pit	79-01-6	Trichloroethene	5.5E-01	2.0E+00	UG/L	2GW02-0404	2/2	0.5 - 0.5	2.0E+00	2.6E+00	2.6E-02 C	5	MCL	YES	ASL
	75-01-4	Vinyl chloride	9.7E-01	9.7E-01	UG/L	2GW01-0404	1/2	0.5 - 0.5	9.7E-01	2.5E-01	1.5E-02 C	2	MCL	YES	ASL
	156-59-2	cis-1,2-Dichloroethene	3.9E-01 J	3.9E-01 J	UG/L	2GW01-0404	1/2	0.5 - 0.5	3.9E-01	1.5E+00	6.1E+00 N	70	MCL	NO	BSL

[1] Minimum/Maximum detected concentrations.
[2] Maximum concentration is used for screening.
[3] Background values from wells 2GW08 and 2GW09.
[4] Risk-Based Concentration Table, October 31, 2006, U.S. EPA Region III, Jennifer Hubbard. Tap Water RBC
[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)
Deletion Reason: No Toxicity Information (NTX)
Essential Nutrient (NUT)
Below Screening Level (BSL)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
J = Estimated Value
C = Carcinogenic
N = Noncarcinogenic
MCL = Maximum Contaminant Level, Primary Drinking Water Standards, Winter 2004

Table 2.5

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Site 2 - Allegheny Ballistics Laboratory

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Bedrock Aquifer Tap Water	76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	7.3E+00	7.3E+00	UG/L	2GW07-0404	1/1	0.5 - 0.5	7.3E+00	N/A	5.9E+03 N	N/A	N/A	NO	BSL
	75-71-8	Dichlorodifluoromethane (Freon-12)	5.4E-01	5.4E-01	UG/L	2GW07-0404	1/1	0.5 - 0.5	5.4E-01	N/A	3.5E+01 N	N/A	N/A	NO	BSL
	108-88-3	Toluene	5.4E-01	5.4E-01	UG/L	2GW07-0404	1/1	0.5 - 0.5	5.4E-01	N/A	2.3E+02 N	1.0E+03	MCL	NO	BSL
	79-01-6	Trichloroethene	1.1E+00	1.1E+00	UG/L	2GW07-0404	1/1	0.5 - 0.5	1.1E+00	N/A	2.6E-02 C	5.0E+00	MCL	YES	ASL
	7440-39-3	Barium	5.1E+02	5.1E+02	UG/L	2GW07-0404	1/1	200 - 200	5.1E+02	N/A	7.3E+02 N	2.0E+03	MCL	NO	BSL
	7440-70-2	Calcium	4.6E+04	4.6E+04	UG/L	2GW07-0404	1/1	5000 - 5000	4.6E+04	N/A	N/A	N/A	N/A	NO	NUT
	7439-89-6	Iron	1.3E+03	1.3E+03	UG/L	2GW07-0404	1/1	100 - 100	1.3E+03	N/A	1.1E+03 N	3.0E+02	SMCL	YES	ASL
	7439-95-4	Magnesium	1.4E+04	1.4E+04	UG/L	2GW07-0404	1/1	5000 - 5000	1.4E+04	N/A	N/A	N/A	N/A	NO	NUT
	7439-96-5	Manganese	6.8E+01	6.8E+01	UG/L	2GW07-0404	1/1	15 - 15	6.8E+01	N/A	7.3E+01 N	5.0E+01	SMCL	NO	BSL
	7440-09-7	Potassium	2.5E+03 J	2.5E+03 J	UG/L	2GW07-0404	1/1	5000 - 5000	2.5E+03	N/A	N/A	N/A	N/A	NO	NUT
	7440-23-5	Sodium	3.8E+04	3.8E+04	UG/L	2GW07-0404	1/1	5000 - 5000	3.8E+04	N/A	N/A	N/A	N/A	NO	NUT

Total inorganic data used for groundwater because no significant difference between total and dissolved data.

[1] Minimum/Maximum detected concentrations.

[2] Maximum concentration is used for screening.

[3] Background values not available for bedrock wells.

[4] Risk-Based Concentration Table, October 31, 2006, U.S. EPA Region III, Jennifer Hubbard. Tap Water RBC

[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)

Deletion Reason: No Toxicity Information (NTX)
Essential Nutrient (NUT)
Below Screening Level (BSL)

COPC = Chemical of Potential Concern

ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered

J = Estimated Value

C = Carcinogenic

N = Noncarcinogenic

MCL = Maximum Contaminant Level, Primary Drinking Water Standards, Winter 2004

SMCL = Secondary Maximum Contaminant Level, Primary Drinking Water Standards.

Table 2.6

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Site 2 - Allegheny Ballistics Laboratory

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Bedrock Aquifer	76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	7.3E+00	7.3E+00	UG/L	2GW07-0404	1/1	0.5 - 0.5	7.3E+00	N/A	5.9E+03 N	N/A	N/A	NO	BSL
Water Vapors	75-71-8	Dichlorodifluoromethane (Freon-12)	5.4E-01	5.4E-01	UG/L	2GW07-0404	1/1	0.5 - 0.5	5.4E-01	N/A	3.5E+01 N	N/A	N/A	NO	BSL
at Showerhead	108-88-3	Toluene	5.4E-01	5.4E-01	UG/L	2GW07-0404	1/1	0.5 - 0.5	5.4E-01	N/A	2.3E+02 N	1.0E+03	MCL	NO	BSL
	79-01-6	Trichloroethene	1.1E+00	1.1E+00	UG/L	2GW07-0404	1/1	0.5 - 0.5	1.1E+00	N/A	2.6E-02 C	5.0E+00	MCL	YES	ASL

[1] Minimum/Maximum detected concentrations.
[2] Maximum concentration is used for screening.
[3] Background values not available for bedrock wells.
[4] Risk-Based Concentration Table, October 31, 2006, U.S. EPA Region III, Jennifer Hubbard. Tap Water RBC
[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)
Deletion Reason: No Toxicity Information (NTX)
Essential Nutrient (NUT)
Below Screening Level (BSL)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
J = Estimated Value
C = Carcinogenic
N = Noncarcinogenic
MCL = Maximum Contaminant Level, Primary Drinking Water Standards, Winter 2004

Table 3.1.RME

MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY

Site 2 - Allegheny Ballistics Laboratory

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)		Exposure Point Concentration			
							Value	Units	Statistic	Rationale
Allluvial Aquifer Tap Water	Trichloroethene	UG/L	1.3E+00	NA	2.0E+00		2.0E+00	UG/L	Max	(1)
	Vinyl chloride	UG/L	6.1E-01	NA	9.7E-01		9.7E-01	UG/L	Max	(1)
	Antimony	UG/L	3.4E+00	NA	4.7E+00	J	4.7E+00	UG/L	Max	(1)
	Arsenic	UG/L	1.7E+01	NA	3.2E+01		3.2E+01	UG/L	Max	(1)
	Iron	UG/L	2.0E+03	NA	3.9E+03		3.9E+03	UG/L	Max	(1)
	Manganese	UG/L	2.4E+02	NA	4.7E+02		4.7E+02	UG/L	Max	(1)

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration; for duplicate sample results, the maximum value was used in the calculation.
Statistics: Maximum Detected Value (Max)

(1) Maximum detected concentration used because sample size is less than 5.

NA = not applicable

Table 3.2.RME

MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY

Site 2 - Allegheny Ballistics Laboratory

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)		Exposure Point Concentration			
							Value	Units	Statistic	Rationale
Allluvial Aquifer Water in Excavation Pit	Trichloroethene	UG/L	1.3E+00	NA	2.0E+00		2.0E+00	UG/L	Max	(1)
	Vinyl chloride	UG/L	6.1E-01	NA	9.7E-01		9.7E-01	UG/L	Max	(1)
	Aluminum	UG/L	4.6E+03	NA	7.6E+03	K	7.6E+03	UG/L	Max	(1)
	Arsenic	UG/L	2.1E+02	NA	4.1E+02	K	4.1E+02	UG/L	Max	(1)
	Chromium	UG/L	1.2E+01	NA	1.4E+01		1.4E+01	UG/L	Max	(1)
	Iron	UG/L	1.6E+04	NA	3.1E+04		3.1E+04	UG/L	Max	(1)
	Lead	UG/L	1.2E+01	NA	1.9E+01		1.9E+01	UG/L	Mean-N	(2)
	Manganese	UG/L	3.5E+02	NA	5.7E+02		5.7E+02	UG/L	Max	(1)
	Vanadium	UG/L	8.6E+00	NA	1.4E+01	J	1.4E+01	UG/L	Max	(1)

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration; for duplicate sample results, the maximum value was used in the calculation.

Statistics: Maximum Detected Value (Max), Arithmetic Mean (Mean-N)

(1) Maximum detected concentration used because sample size is less than 5.

(2) Arithemetic mean concentration used as exposure point concentration for lead.

NA = not applicable

Table 3.3.RME
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
Site 2 - Allegheny Ballistics Laboratory

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Allluvial Aquifer Water Vapors at Showerhead	Trichloroethene	UG/L	1.3E+00	NA	2.0E+00	2.0E+00	UG/L	Max	(1)
	Vinyl chloride	UG/L	6.1E-01	NA	9.7E-01	9.7E-01	UG/L	Max	(1)

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration; for duplicate sample results, the maximum value was used in the calculation.
Statistics: Maximum Detected Value (Max)

(1) Maximum detected concentration used because sample size is less than 5.

NA = not applicable

Table 3.4.RME

MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY

Site 2 - Allegheny Ballistics Laboratory

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Allluvial Aquifer Volatilization from Water in Excavation Pit	Trichloroethene	UG/L	1.3E+00	NA	2.0E+00	2.0E+00	UG/L	Max	(1)
	Vinyl chloride	UG/L	6.1E-01	NA	9.7E-01	9.7E-01	UG/L	Max	(1)

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration; for duplicate sample results, the maximum value was used in the calculation.
Statistics: Maximum Detected Value (Max)

(1) Maximum detected concentration used because sample size is less than 5.

NA = not applicable

Table 3.5

MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY

Site 2 - Allegheny Ballistics Laboratory

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Bedrock Aquifer Tap Water	Trichloroethene	UG/L	1.1E+00	NA	1.1E+00	1.1E+00	UG/L	Max	(1)
	Iron	UG/L	1.3E+03	NA	1.3E+03	1.3E+03	UG/L	Max	(1)

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration; for duplicate sample results, the maximum value was used in the calculation.
Statistics: Maximum Detected Value (Max)

(1) Maximum detected concentration used because sample size is less than 5, only 1 bedrock sample.

NA = not applicable

Table 3.6

MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY

Site 2 - Allegheny Ballistics Laboratory

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Bedrock Aquifer Water Vapors at Showerhead	Trichloroethene	UG/L	1.1E+00	NA	1.1E+00	1.1E+00	UG/L	Max	(1)

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration; for duplicate sample results, the maximum value was used in the calculation.
Statistics: Maximum Detected Value (Max)

(1) Maximum detected concentration used because sample size is less than 5, only 1 bedrock sample.

NA = not applicable

Table 3.1.CTE

MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY

Site 2 - Allegheny Ballistics Laboratory

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)		Exposure Point Concentration			
							Value	Units	Statistic	Rationale
Allluvial Aquifer Tap Water	Trichloroethene	UG/L	1.3E+00	NA	2.0E+00		1.3E+00	UG/L	Mean-N	(1)
	Vinyl chloride	UG/L	6.1E-01	NA	9.7E-01		6.1E-01	UG/L	Mean-N	(1)
	Antimony	UG/L	3.4E+00	NA	4.7E+00	J	3.4E+00	UG/L	Mean-N	(1)
	Arsenic	UG/L	1.7E+01	NA	3.2E+01		1.7E+01	UG/L	Mean-N	(1)
	Iron	UG/L	2.0E+03	NA	3.9E+03		2.0E+03	UG/L	Mean-N	(1)
	Manganese	UG/L	2.4E+02	NA	4.7E+02		2.4E+02	UG/L	Mean-N	(1)

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration; for duplicate sample results, the maximum value was used in the calculation.

Statistics: Mean of data assuming normal distribution (Mean-N)

(1) Mean value used because sample size is less than 5.

(2) Mean exceeds maximum detected concentration. Therefore, maximum concentration used for EPC.

NA = not applicable

Table 3.2.CTE
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
Site 2 - Allegheny Ballistics Laboratory

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)		Exposure Point Concentration			
							Value	Units	Statistic	Rationale
Allluvial Aquifer Water in Excavation Pit	Trichloroethene	UG/L	1.3E+00	NA	2.0E+00		1.3E+00	UG/L	Mean-N	(1)
	Vinyl chloride	UG/L	6.1E-01	NA	9.7E-01		6.1E-01	UG/L	Mean-N	(1)
	Aluminum	UG/L	4.6E+03	NA	7.6E+03	K	4.6E+03	UG/L	Mean-N	(1)
	Arsenic	UG/L	2.1E+02	NA	4.1E+02	K	2.1E+02	UG/L	Mean-N	(1)
	Chromium	UG/L	1.2E+01	NA	1.4E+01		1.2E+01	UG/L	Mean-N	(1)
	Iron	UG/L	1.6E+04	NA	3.1E+04		1.6E+04	UG/L	Mean-N	(1)
	Manganese	UG/L	3.5E+02	NA	5.7E+02		3.5E+02	UG/L	Mean-N	(1)
	Vanadium	UG/L	8.6E+00	NA	1.4E+01	J	8.6E+00	UG/L	Mean-N	(1)

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration; for duplicate sample results, the maximum value was used in the calculation.
Statistics: Maximum Detected Value (Max)

(1) Maximum detected concentration used because sample size is less than 5.

NA = not applicable

Table 3.3.CTE
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
Site 2 - Allegheny Ballistics Laboratory

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Allluvial Aquifer Water Vapors at Showerhead	Trichloroethene	UG/L	1.3E+00	NA	2.0E+00	1.3E+00	UG/L	Mean-N	(1)
	Vinyl chloride	UG/L	6.1E-01	NA	9.7E-01	6.1E-01	UG/L	Mean-N	(1)

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration; for duplicate sample results, the maximum value was used in the calculation.
Statistics: Maximum Detected Value (Max)

(1) Maximum detected concentration used because sample size is less than 5.

NA = not applicable

Table 3.4.CTE
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
Site 2 - Allegheny Ballistics Laboratory

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Allluvial Aquifer									
Volatilization from Water in Excavation Pit	Trichloroethene	UG/L	1.3E+00	NA	2.0E+00	1.3E+00	UG/L	Mean-N	(1)
	Vinyl chloride	UG/L	6.1E-01	NA	9.7E-01	6.1E-01	UG/L	Mean-N	(1)

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration; for duplicate sample results, the maximum value was used in the calculation.
Statistics: Maximum Detected Value (Max)

(1) Maximum detected concentration used because sample size is less than 5.

NA = not applicable

TABLE 4.1.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Site 2 - Allegany Ballistics Laboratory

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	Alluvial Aquifer - Tap Water	CW	Chemical Concentration in Water	See Table 3.1.RME	µg/l	- -	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-W	Ingestion Rate of Water	2	liters/day	EPA, 1997	CW x IR-W x EF x ED x CF2 x 1/BW x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
				CF2	Conversion Factor 2	0.001	mg/µg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
		Child	Alluvial Aquifer - Tap Water	CW	Chemical Concentration in Water	See Table 3.1.RME	µg/l	- -	CDI (mg/kg-day) =
				IR-W	Ingestion Rate of Water	1	liters/day	EPA, 1997	CW x IR-W x EF x ED x CF2 x 1/BW x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	6	years	EPA, 1991	
				CF2	Conversion Factor 2	0.001	mg/µg	- -	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
		Child/Adult	Alluvial Aquifer - Tap Water	CW	Chemical Concentration in Water	See Table 3.1.RME	µg/l	- -	CDI (mg/kg-day) =
				IR-W-A	Ingestion Rate of Water, Adult	2	liters/day	EPA, 1997	CW x IR-W-Adj x EF x CF2 x 1/AT
				IR-W-C	Ingestion Rate of Water, Child	1	liters/day	EPA, 1997	
				IR-W-Adj	Ingestion Rate of Water, Age-adjusted	1.09	liter-year/kg-day	calculated	IR-W-Adj (liter-year/kd-day) =
				EF	Exposure Frequency	350	days/year	EPA, 1991	(ED-C x IR-W-C / BW-C) +
				ED-A	Exposure Duration, Adult	24	years	EPA, 1991	(ED-A x IR-W-A / BW-A)
				ED-C	Exposure Duration, Child	6	years	EPA, 1991	
				CF2	Conversion Factor 2	0.001	mg/µg	- -	
				BW-A	Body Weight , Adult	70	kg	EPA, 1991	
				BW-C	Body Weight, Child	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	

TABLE 4.1.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Site 2 - Allegany Ballistics Laboratory

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Resident	Adult	Alluvial Aquifer - Tap Water	CW	Chemical Concentration in Water	See Table 3.1.RME	µg/l	- -	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2004	
				K_p	Permeability Coefficient	chemical specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF2 x CF3
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific	dimensionless	EPA, 2004	Organics :
				t_{event}	Event Time	0.58	hr/event	EPA, 2004	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	18,000	cm^2	EPA, 2004	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				EV	Event Frequency	1	events/day	EPA, 2004	x CF2 x CF3
				EF	Exposure Frequency	350	days/year	EPA, 2004	
				ED	Exposure Duration	24	years	EPA, 2004	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	70	kg	EPA, 1991	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF2 x CF3
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
				CF2	Conversion Factor 2	0.001	mg/µg	- -	
				CF3	Conversion Factor 3	0.001	l/cm^3	- -	
		Child	Alluvial Aquifer - Tap Water	CW	Chemical Concentration in Water	See Table 3.1.RME	µg/l	- -	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2004	
				K_p	Permeability Coefficient	chemical specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF2 x CF3
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific	dimensionless	EPA, 2004	Organics :
				t_{event}	Event Time	1.0	hr/event	EPA, 2004	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	6,600	cm^2	EPA, 2004	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				EV	Event Frequency	1	events/day	EPA, 2004	x CF2 x CF3
				EF	Exposure Frequency	350	days/year	EPA, 2004	
				ED	Exposure Duration	6	years	EPA, 2004	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	15	kg	EPA, 1991	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF2 x CF3
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
				CF2	Conversion Factor 2	0.001	mg/µg	- -	
				CF3	Conversion Factor 3	0.001	l/cm^3	- -	

TABLE 4.1.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Site 2 - Allegany Ballistics Laboratory

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Resident	Child/Adult	Alluvial Aquifer - Tap Water	CW	Chemical Concentration in Water	See Table 3.1.RME	µg/l	- -	CDI (mg/kg-day) = DA-Adj x EF x 1/AT
				DAevent-A	Dermally Absorbed Dose per Event, Adult	calculated	mg/cm^2-event	calculated	
				DAevent-C	Dermally Absorbed Dose per Event, Child	calculated	mg/cm^2-event	calculated	DA-Adj = (Daevent-A x SA-A x ED-A x 1/BW-A)
				DA-Adj	Dermally Absorbed Dose, Age-adjusted	calculated	mg-year/event-kg	calculated	+ (Daevent-C x SA-C x ED-C x 1/BW-C)
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2004	
				K_p	Permeability Coefficient	chemical specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF2 x CF3
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific	dimensionless	EPA, 2004	Organics :
				t_{event}-A	Event Time, Adult	0.58	hr/event	EPA, 2004	t_{event}<t*: DAevent (mg/cm^2-event) =
				t_{event}-C	Event Time, Child	1.0	hr/event	EPA, 2004	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				SA-A	Skin Surface Area, Adult	18,000	cm^2	EPA, 2004	x CF2 x CF3
				SA-C	Skin Surface Area, Child	6,600	cm^2	EPA, 2004	
				EV	Event Frequency	1	events/day	EPA, 2004	t_{event}>t*: DAevent (mg/cm^2-event) =
				EF	Exposure Frequency	350	days/year	EPA, 2004	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				ED-A	Exposure Duration, Adult	24	years	EPA, 2004	((1 + 3B + 3B^2)/(1+B)^2)) x CF2 x CF3
				ED-C	Exposure Duration, Child	6	years	EPA, 2004	
				BW-A	Body Weight, Adult	70	kg	EPA, 1991	
				BW-C	Body Weight, Child	15	ke	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				CF2	Conversion Factor 2	0.001	mg/µg	- -	
				CF3	Conversion Factor 3	0.001	l/cm^3	- -	
	Construction Worker	Adult	Alluvial Aquifer - Water in Excavation Pit	CW	Chemical Concentration in Water	See Table 3.2.RME	µg/l	- -	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2004	
				K_p	Permeability Coefficient	chemical specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF2 x CF3
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific	dimensionless	EPA, 2004	Organics :
				t_{event}	Event Time	8	hr/day	(1)	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	5,700	cm^2	EPA, 2004, (3)	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				EV	Event Frequency	1	events/day	EPA, 2004	x CF2 x CF3
				EF	Exposure Frequency	125	days/year	(2)	
				ED	Exposure Duration	1	years	EPA, 1991	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	70	kg	EPA, 1991	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + 3B^2)/(1+B)^2)) x CF2 x CF3

TABLE 4.1.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Site 2 - Allegany Ballistics Laboratory

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal (cont.)	Construction Worker (cont.)	Adult	Alluvial Aquifer - Water in Excavation Pit	AT-N	Averaging Time (Non-Cancer)	365	days	EPA, 1989	
				CF2	Conversion Factor 2	0.001	mg/µg	- -	
				CF3	Conversion Factor 3	0.001	l/cm^3	- -	

(1) Professional Judgement based on construction activities that would occur 8 hrs per day for the RME.

(2) Assumed duration of construction project may be 1/2 a year.

(3) Skin surface area in contact with groundwater assumed to be hands, forearms, lower legs, and feet.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

EPA, 2004 . Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment (Final). EPA/540/R/99/005. July 2004.

TABLE 4.2.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Site 2 - Allegany Ballistics Laboratory

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Resident	Adult	Alluvial Aquifer - Water Vapors at Showerhead	CW	Chemical Concentration in Water	See Table 3.3.RME	µg/l	See Table 3.3.RME	Chronic Daily Intake (CDI) (mg/kg-day) =
				InhExp	Inhalation Exposure per Shower	calculated	mg/kg-shower		InhExp x EF x ED x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 1991	Foster & Chrostowski Shower Inhalation Model
				ED	Exposure Duration	24	years	EPA, 1991	for InhExp (parameters used in the model are shown in the
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	table 7s where the model is used)
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
	Construction Worker	Adult	Alluvial Aquifer - Volatilization from Water in Excavation Pit	CW	Chemical Concentration in Water	See Table 3.4.RME	µg/l	See Table 3.4.RME	Chronic Daily Intake (CDI) (mg/kg-day) =
				CA	Chemical Concentration in Air	calculated	mg/m^3		CA x IN x ET x EF x ED x 1/BW x 1/AT
				IN	Inhalation Rate	2.5	m^3/hour	EPA, 1997 (1)	
				ET	Exposure Time	8	hr/day	(2)	CA calculated using two-film model
				EF	Exposure Frequency	125	days/year	(3)	
				ED	Exposure Duration	1	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	EPA, 1989	

Notes:

(1) Inhalation rate is for adults working outdoors performing heavy activities.

(2) Professional Judgement based on construction activities that would occur 8 hrs per day for the RME.

(3) Assumed duration of construction project may be 1/2 a year.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

TABLE 4.3.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Site 2 - Allegany Ballistics Laboratory

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	Bedrock Aquifer - Tap Water	CW	Chemical Concentration in Water	See Table 3.5.RME	µg/l	- -	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-W	Ingestion Rate of Water	2	liters/day	EPA, 1997	CW x IR-W x EF x ED x CF2 x 1/BW x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
				CF2	Conversion Factor 2	0.001	mg/µg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
		Child	Bedrock Aquifer - Tap Water	CW	Chemical Concentration in Water	See Table 3.5.RME	µg/l	- -	CDI (mg/kg-day) =
				IR-W	Ingestion Rate of Water	1	liters/day	EPA, 1997	CW x IR-W x EF x ED x CF2 x 1/BW x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	6	years	EPA, 1991	
				CF2	Conversion Factor 2	0.001	mg/µg	- -	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
		Child/Adult	Bedrock Aquifer - Tap Water	CW	Chemical Concentration in Water	See Table 3.5.RME	µg/l	- -	CDI (mg/kg-day) =
				IR-W-A	Ingestion Rate of Water, Adult	2	liters/day	EPA, 1997	CW x IR-W-Adj x EF x CF2 x 1/AT
				IR-W-C	Ingestion Rate of Water, Child	1	liters/day	EPA, 1997	
				IR-W-Adj	Ingestion Rate of Water, Age-adjusted	1.09	liter-year/kg-day	calculated	IR-W-Adj (liter-year/kd-day) =
				EF	Exposure Frequency	350	days/year	EPA, 1991	(ED-C x IR-W-C / BW-C) +
				ED-A	Exposure Duration, Adult	24	years	EPA, 1991	(ED-A x IR-W-A / BW-A)
				ED-C	Exposure Duration, Child	6	years	EPA, 1991	
				CF2	Conversion Factor 2	0.001	mg/µg	- -	
				BW-A	Body Weight , Adult	70	kg	EPA, 1991	
				BW-C	Body Weight, Child	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	

TABLE 4.3.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Site 2 - Allegany Ballistics Laboratory

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Resident	Adult	Bedrock Aquifer - Tap Water	CW	Chemical Concentration in Water	See Table 3.5.RME	µg/l	- -	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2004	
				K_p	Permeability Coefficient	chemical specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF2 x CF3
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific	dimensionless	EPA, 2004	Organics :
				t_{event}	Event Time	0.58	hr/event	EPA, 2004	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	18,000	cm^2	EPA, 2004	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				EV	Event Frequency	1	events/day	EPA, 2004	x CF2 x CF3
				EF	Exposure Frequency	350	days/year	EPA, 2004	
				ED	Exposure Duration	24	years	EPA, 2004	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	70	kg	EPA, 1991	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF2 x CF3
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
				CF2	Conversion Factor 2	0.001	mg/µg	- -	
				CF3	Conversion Factor 3	0.001	l/cm^3	- -	
		Child	Bedrock Aquifer - Tap Water	CW	Chemical Concentration in Water	See Table 3.5.RME	µg/l	- -	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2004	
				K_p	Permeability Coefficient	chemical specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF2 x CF3
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific	dimensionless	EPA, 2004	Organics :
				t_{event}	Event Time	1.0	hr/event	EPA, 2004	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	6,600	cm^2	EPA, 2004	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				EV	Event Frequency	1	events/day	EPA, 2004	x CF2 x CF3
				EF	Exposure Frequency	350	days/year	EPA, 2004	
				ED	Exposure Duration	6	years	EPA, 2004	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	15	kg	EPA, 1991	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF2 x CF3
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
				CF2	Conversion Factor 2	0.001	mg/µg	- -	
				CF3	Conversion Factor 3	0.001	l/cm^3	- -	

TABLE 4.3.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Site 2 - Allegany Ballistics Laboratory

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Resident	Child/Adult	Bedrock Aquifer - Tap Water	CW	Chemical Concentration in Water	See Table 3.5.RME	µg/l	- -	CDI (mg/kg-day) = DA-Adj x EF x 1/AT
				DAevent-A	Dermally Absorbed Dose per Event, Adult	calculated	mg/cm^2-event	calculated	
				DAevent-C	Dermally Absorbed Dose per Event, Child	calculated	mg/cm^2-event	calculated	DA-Adj = (Daevent-A x SA-A x ED-A x 1/BW-A)
				DA-Adj	Dermally Absorbed Dose, Age-adjusted	calculated	mg-year/event-kg	calculated	+ (Daevent-C x SA-C x ED-C x 1/BW-C)
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2004	
				K_p	Permeability Coefficient	chemical specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF2 x CF3
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific	dimensionless	EPA, 2004	Organics :
				t_{event}-A	Event Time, Adult	0.58	hr/event	EPA, 2004	t_{event}<t*: DAevent (mg/cm^2-event) =
				t_{event}-C	Event Time, Child	1.0	hr/event	EPA, 2004	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				SA-A	Skin Surface Area, Adult	18,000	cm^2	EPA, 2004	x CF2 x CF3
				SA-C	Skin Surface Area, Child	6,600	cm^2	EPA, 2004	
				EV	Event Frequency	1	events/day	EPA, 2004	t_{event}>t*: DAevent (mg/cm^2-event) =
				EF	Exposure Frequency	350	days/year	EPA, 2004	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				ED-A	Exposure Duration, Adult	24	years	EPA, 2004	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF2 x CF3
				ED-C	Exposure Duration, Child	6	years	EPA, 2004	
				BW-A	Body Weight, Adult	70	kg	EPA, 1991	
				BW-C	Body Weight, Child	15	ke	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				CF2	Conversion Factor 2	0.001	mg/µg	- -	
				CF3	Conversion Factor 3	0.001	l/cm^3	- -	

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

EPA, 2004 . Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment (Final). EPA/540/R/99/005. July 2004.

TABLE 4.4.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Site 2 - Allegany Ballistics Laboratory

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Resident	Adult	Bedrock Aquifer - Water Vapors at Showerhead	CW	Chemical Concentration in Water	See Table 3.6.RME	µg/l	See Table 3.6.RME	Chronic Daily Intake (CDI) (mg/kg-day) =
				InhExp	Inhalation Exposure per Shower	calculated	mg/kg-shower		InhExp x EF x ED x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 1991	Foster & Chrostowski Shower Inhalation Model
				ED	Exposure Duration	24	years	EPA, 1991	for InhExp (parameters used in the model are shown in the
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	table 7s where the model is used)
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	

Notes:

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

TABLE 4.1.CTE
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY
Site 2 - Allegany Ballistics Laboratory

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	Alluvial Aquifer - Tap Water	CW	Chemical Concentration in Water	See Table 3.1.CTE	µg/l	- -	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-W	Ingestion Rate of Water	1.4	liters/day	EPA, 1993	CW x IR-W x EF x ED x CF2 x 1/BW x 1/AT
				EF	Exposure Frequency	234	days/year	EPA, 1993	
				ED	Exposure Duration	9	years	EPA, 1993	
				CF2	Conversion Factor 2	0.001	mg/µg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	
		Child	Alluvial Aquifer - Tap Water	CW	Chemical Concentration in Water	See Table 3.1.CTE	µg/l	- -	CDI (mg/kg-day) =
				IR-W	Ingestion Rate of Water	1	liters/day	EPA, 1997	CW x IR-W x EF x ED x CF2 x 1/BW x 1/AT
				EF	Exposure Frequency	234	days/year	EPA, 1993	
				ED	Exposure Duration	6	years	EPA, 1991	
				CF2	Conversion Factor 2	0.001	mg/µg	- -	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
		Child/Adult	Alluvial Aquifer - Tap Water	CW	Chemical Concentration in Water	See Table 3.1.CTE	µg/l	- -	CDI (mg/kg-day) =
				IR-W-A	Ingestion Rate of Water, Adult	1.4	liters/day	EPA, 1993	CW x IR-W-Adj x EF x CF2 x 1/AT
				IR-W-C	Ingestion Rate of Water, Child	1	liters/day	EPA, 1997	
				IR-W-Adj	Ingestion Rate of Water, Age-adjusted	0.58	liter-year/kg-day	calculated	IR-W-Adj (liter-year/kd-day) =
				EF	Exposure Frequency	234	days/year	EPA, 1993	(ED-C x IR-W-C / BW-C) +
				ED-A	Exposure Duration, Adult	9	years	EPA, 1993	(ED-A x IR-W-A / BW-A)
				ED-C	Exposure Duration, Child	6	years	EPA, 1991	
				CF2	Conversion Factor 2	0.001	mg/µg	- -	
				BW-A	Body Weight , Adult	70	kg	EPA, 1991	
				BW-C	Body Weight, Child	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	

TABLE 4.1.CTE
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY
Site 2 - Allegany Ballistics Laboratory

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Resident	Adult	Alluvial Aquifer - Tap Water	CW	Chemical Concentration in Water	See Table 3.1.CTE	µg/l	- -	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	Calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	Chemical specific	dimensionless	EPA, 2004	
				K_p	Permeability Coefficient	Chemical specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	Chemical specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF2 x CF3
				t*	Time to Reach Steady-state	Chemical specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	Chemical specific	dimensionless	EPA, 2004	Organics :
				t_{event}	Event Time	0.25	hr/event	EPA, 2004	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	18,000	cm^2	EPA, 2004	2 x FA x Kp x CW x (sqrt((6 xτ x t_{event})/π))
				EV	Event Frequency	1	events/day	EPA, 2004	x CF2 x CF3
				EF	Exposure Frequency	234	days/year	EPA, 1993	
				ED	Exposure Duration	9	years	EPA, 2004	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	70	kg	EPA, 1991	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF2 x CF3
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	
				CF2	Conversion Factor 2	0.001	mg/µg	- -	
				CF3	Conversion Factor 3	0.001	l/cm^3	- -	
		Child	Alluvial Aquifer - Tap Water	CW	Chemical Concentration in Water	See Table 3.1.CTE	µg/l	- -	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	Calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	Chemical specific	dimensionless	EPA, 2004	
				K_p	Permeability Coefficient	Chemical specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	Chemical specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF2 x CF3
				t*	Time to Reach Steady-state	Chemical specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	Chemical specific	dimensionless	EPA, 2004	Organics :
				t_{event}	Event Time	0.33	hr/event	EPA, 2004	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	6,600	cm^2	EPA, 2004	2 x FA x Kp x CW x (sqrt((6 xτ x t_{event})/π))
				EV	Event Frequency	1	events/day	EPA, 2004	x CF2 x CF3
				EF	Exposure Frequency	234	days/year	EPA, 1993	
				ED	Exposure Duration	6	years	EPA, 1991	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	15	kg	EPA, 1991	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF2 x CF3
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
				CF2	Conversion Factor 2	0.001	mg/µg	- -	
				CF3	Conversion Factor 3	0.001	l/cm^3	- -	

TABLE 4.1.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY

Site 2 - Allegany Ballistics Laboratory

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Resident	Child/Adult	Alluvial Aquifer - Tap Water	CW	Chemical Concentration in Water	See Table 3.1.CTE	µg/l	- -	CDI (mg/kg-day) = DA-Adj x EF x 1/AT
				DAevent-A	Dermally Absorbed Dose per Event, Adult	Calculated	mg/cm^2-event	calculated	
				DAevent-C	Dermally Absorbed Dose per Event, Child	Calculated	mg/cm^2-event	calculated	DA-Adj = (Daevent-A x SA-A x ED-A x 1/BW-A)
				DA-Adj	Dermally Absorbed Dose, Age-adjusted	Calculated	mg-year/event-kg	calculated	+ (Daevent-C x SA-C x ED-C x 1/BW-C)
				FA	Fraction absorbed water	Chemical specific	dimensionless	EPA, 2004	
				K_p	Permeability Coefficient	Chemical specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	Chemical specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF2 x CF3
				t*	Time to Reach Steady-state	Chemical specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	Chemical specific	dimensionless	EPA, 2004	Organics :
				t_{event}-A	Event Time, Adult	0.25	hr/event	EPA, 2004	t_{event}<t*: DAevent (mg/cm^2-event) =
				t_{event}-C	Event Time, Child	0.33	hr/event	EPA, 2004	2 x FA x Kp x CW x (sqrt((6 xτ x t_{event})/π))
				SA-A	Skin Surface Area, Adult	18,000	cm^2	EPA, 2004	x CF2 x CF3
				SA-C	Skin Surface Area, Child	6,600	cm^2	EPA, 2004	
				EV	Event Frequency	1	events/day	EPA, 2004	t_{event}>t*: DAevent (mg/cm^2-event) =
				EF	Exposure Frequency	234	days/year	EPA, 1993	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				ED-A	Exposure Duration, Adult	9	years	EPA, 2004	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF2 x CF3
				ED-C	Exposure Duration, Child	6	years	EPA, 1991	
				BW-A	Body Weight, Adult	70	kg	EPA, 1991	
				BW-C	Body Weight, Child	15	ke	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				CF2	Conversion Factor 2	0.001	mg/µg	- -	
				CF3	Conversion Factor 3	0.001	l/cm^3	- -	
	Construction Worker	Adult	Alluvial Aquifer - Water in Excavation Pit	CW	Chemical Concentration in Water	See Table 3.2.CTE	µg/l	- -	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	Calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	Chemical specific	dimensionless	EPA, 2001	
				K_p	Permeability Coefficient	Chemical specific	cm/hr	EPA, 2001	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	Chemical specific	hr/event	EPA, 2001	Kp x CW x t_{event} x CF2 x CF3
				t*	Time to Reach Steady-state	Chemical specific	hours	EPA, 2001	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	Chemical specific	dimensionless	EPA, 2001	Organics :
				t_{event}	Event Time	4	hr/day	(1)	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	5,700	cm^2	EPA, 2004, (3)	2 x FA x Kp x CW x (sqrt((6 xτ x t_{event})/π))
				EV	Event Frequency	1	events/day	EPA, 2001	x CF2 x CF3
				EF	Exposure Frequency	125	days/year	(2)	
				ED	Exposure Duration	1	years	EPA, 1991	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	70	kg	EPA, 1991	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF2 x CF3
				AT-N	Averaging Time (Non-Cancer)	365	days	EPA, 1989	
				CF2	Conversion Factor 2	0.001	mg/µg	- -	
				CF3	Conversion Factor 3	0.001	l/cm^3	- -	

(1) Professional judgement assuming 1/2 RME value for CT.

(2) Assumed duration of construction project may be 1/2 a year.

(3) Skin surface area in contact with groundwater assumed to be hands, forearms, lower legs, and feet.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

EPA, 2004 . Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment (Final). EPA/540/R/99/005. July 2004.

TABLE 4.2.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY

Site 2 - Allegany Ballistics Laboratory

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Resident	Adult	Alluvial Aquifer - Water Vapors at Showerhead	CW	Chemical Concentration in Water	See Table 3.3.CTE	µg/l	See Table 3.3.CTE	Chronic Daily Intake (CDI) (mg/kg-day) =
				InhExp	Inhalation Exposure per Shower	Calculated	mg/kg-shower		InhExp x EF x ED x 1/AT
				EF	Exposure Frequency	234	days/year	EPA, 1993	Foster & Chrostowski Shower Inhalation Model
				ED	Exposure Duration	9	years	EPA, 2001	for InhExp (parameters used in the model are shown in the
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	table 7s where the model is used)
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	
	Construction Worker	Adult	Alluvial Aquifer - Volatilization from Water in Excavation Pit	CW	Chemical Concentration in Water	See Table 3.4.CTE	µg/l	See Table 3.4.CTE	Chronic Daily Intake (CDI) (mg/kg-day) =
				CA	Chemical Concentration in Air	Calculated	mg/m^3		CA x IN x ET x EF x ED x 1/BW x 1/AT
				IN	Inhalation Rate	1.2	m3/hour	EPA, 1997 (1)	
				ET	Exposure Time	4	hr/day	(2)	CA calculated using two-film model
				EF	Exposure Frequency	125	days/year	(3)	
				ED	Exposure Duration	1	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	EPA, 1989	

Notes:

(1) Inhalation rate is for adult outdoor workers performing moderate activities.

(2) Assumed construction workers could spend 4 hours/day near the excavation trench.

(3) Assumed duration of construction project may be 1/2 a year.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

EPA, 2001: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.

TABLE 4.3.CTE
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY
Site 2 - Allegany Ballistics Laboratory

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	Bedrock Aquifer - Tap Water	CW	Chemical Concentration in Water	See Table 3.4.CT	µg/l	See Table 3.4.CT	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-W	Ingestion Rate of Water	1.4	liters/day	EPA, 1993	CW x IR-W x EF x ED x CF2 x 1/BW x 1/AT
				EF	Exposure Frequency	234	days/year	EPA, 1993	
				ED	Exposure Duration	9	years	EPA, 1993	
				CF2	Conversion Factor 2	0.001	mg/µg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	
		Child	Bedrock Aquifer - Tap Water	CW	Chemical Concentration in Water	See Table 3.4.CT	µg/l	See Table 3.4.CT	CDI (mg/kg-day) =
				IR-W	Ingestion Rate of Water	1	liters/day	EPA, 1997	CW x IR-W x EF x ED x CF2 x 1/BW x 1/AT
				EF	Exposure Frequency	234	days/year	EPA, 1993	
				ED	Exposure Duration	6	years	EPA, 1991	
				CF2	Conversion Factor 2	0.001	mg/µg	- -	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
		Child/Adult	Bedrock Aquifer - Tap Water	CW	Chemical Concentration in Water	See Table 3.4.CT	µg/l	See Table 3.4.CT	CDI (mg/kg-day) =
				IR-W-A	Ingestion Rate of Water, Adult	1.4	liters/day	EPA, 1993	CW x IR-W-Adj x EF x CF2 x 1/AT
				IR-W-C	Ingestion Rate of Water, Child	1	liters/day	EPA, 1997	
				IR-W-Adj	Ingestion Rate of Water, Age-adjusted	0.58	liter-year/kg-day	calculated	IR-W-Adj (liter-year/kd-day) =
				EF	Exposure Frequency	234	days/year	EPA, 1993	(ED-C x IR-W-C / BW-C) +
				ED-A	Exposure Duration, Adult	9	years	EPA, 1993	(ED-A x IR-W-A / BW-A)
				ED-C	Exposure Duration, Child	6	years	EPA, 1991	
				CF2	Conversion Factor 2	0.001	mg/µg	- -	
				BW-A	Body Weight , Adult	70	kg	EPA, 1991	
				BW-C	Body Weight, Child	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	

TABLE 4.3.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY

Site 2 - Allegany Ballistics Laboratory

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Resident	Adult	Bedrock Aquifer - Tap Water	CW	Chemical Concentration in Water	See Table 3.4.CT	µg/l	See Table 3.4.CT	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	Calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	Chemical specific	dimensionless	EPA, 2001	
				K_p	Permeability Coefficient	Chemical specific	cm/hr	EPA, 2001	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	Chemical specific	hr/event	EPA, 2001	Kp x CW x t_{event} x CF2 x CF3
				t*	Time to Reach Steady-state	Chemical specific	hours	EPA, 2001	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	Chemical specific	dimensionless	EPA, 2001	Organics :
				t_{event}	Event Time	0.25	hr/event	EPA, 2001	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	18,000	cm^2	EPA, 2001	2 x FA x Kp x CW x (sqrt((6 xτ x t_{event})/π))
				EV	Event Frequency	1	events/day	EPA, 2001	x CF2 x CF3
				EF	Exposure Frequency	234	days/year	EPA, 1993	
				ED	Exposure Duration	9	years	EPA, 2001	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	70	kg	EPA, 1991	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF2 x CF3
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	
				CF2	Conversion Factor 2	0.001	mg/µg	- -	
				CF3	Conversion Factor 3	0.001	l/cm^3	- -	
		Child	Bedrock Aquifer - Tap Water	CW	Chemical Concentration in Water	See Table 3.4.CT	µg/l	See Table 3.4.CT	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	Calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	Chemical specific	dimensionless	EPA, 2001	
				K_p	Permeability Coefficient	Chemical specific	cm/hr	EPA, 2001	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	Chemical specific	hr/event	EPA, 2001	Kp x CW x t_{event} x CF2 x CF3
				t*	Time to Reach Steady-state	Chemical specific	hours	EPA, 2001	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	Chemical specific	dimensionless	EPA, 2001	Organics :
				t_{event}	Event Time	0.33	hr/event	EPA, 2001	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	6,600	cm^2	EPA, 2001	2 x FA x Kp x CW x (sqrt((6 xτ x t_{event})/π))
				EV	Event Frequency	1	events/day	EPA, 2001	x CF2 x CF3
				EF	Exposure Frequency	234	days/year	EPA, 1993	
				ED	Exposure Duration	6	years	EPA, 2001	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	15	kg	EPA, 1991	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF2 x CF3
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
				CF2	Conversion Factor 2	0.001	mg/µg	- -	
				CF3	Conversion Factor 3	0.001	l/cm^3	- -	

TABLE 4.3.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY

Site 2 - Allegany Ballistics Laboratory

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Resident	Child/Adult	Bedrock Aquifer - Tap Water	CW	Chemical Concentration in Water	See Table 3.4.CT	µg/l	See Table 3.4.CT	CDI (mg/kg-day) = DA-Adj x EF x 1/AT
				DAevent-A	Dermally Absorbed Dose per Event, Adult	Calculated	mg/cm^2-event	calculated	
				DAevent-C	Dermally Absorbed Dose per Event, Child	Calculated	mg/cm^2-event	calculated	DA-Adj = (Daevent-A x SA-A x ED-A x 1/BW-A)
				DA-Adj	Dermally Absorbed Dose, Age-adjusted	Calculated	mg-year/event-kg	calculated	+ (Daevent-C x SA-C x ED-C x 1/BW-C)
				FA	Fraction absorbed water	Chemical specific	dimensionless	EPA, 2001	
				K_p	Permeability Coefficient	Chemical specific	cm/hr	EPA, 2001	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	Chemical specific	hr/event	EPA, 2001	Kp x CW x t_{event} x CF2 x CF3
				t*	Time to Reach Steady-state	Chemical specific	hours	EPA, 2001	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	Chemical specific	dimensionless	EPA, 2001	Organics :
				t_{event}-A	Event Time, Adult	0.25	hr/event	EPA, 2001	t_{event}<t*: DAevent (mg/cm^2-event) =
				t_{event}-C	Event Time, Child	0.33	hr/event	EPA, 2001	2 x FA x Kp x CW x (sqrt((6 xτ x t_{event})/π))
				SA-A	Skin Surface Area, Adult	18,000	cm^2	EPA, 2001	x CF2 x CF3
				SA-C	Skin Surface Area, Child	6,600	cm^2	EPA, 2001	
				EV	Event Frequency	1	events/day	EPA, 2001	t_{event}>t*: DAevent (mg/cm^2-event) =
				EF	Exposure Frequency	234	days/year	EPA, 1993	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				ED-A	Exposure Duration, Adult	9	years	EPA, 2001	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF2 x CF3
				ED-C	Exposure Duration, Child	6	years	EPA, 2001	
				BW-A	Body Weight, Adult	70	kg	EPA, 1991	
				BW-C	Body Weight, Child	15	ke	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				CF2	Conversion Factor 2	0.001	mg/µg	- -	
				CF3	Conversion Factor 3	0.001	l/cm^3	- -	

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

EPA, 2001: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.

TABLE 4.4.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY

Site 2 - Allegany Ballistics Laboratory

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Resident	Adult	Bedrock Aquifer - Water Vapors at Showerhead	CW	Chemical Concentration in Water	See Table 3.6.CTE	µg/l	See Table 3.6.CTE	Chronic Daily Intake (CDI) (mg/kg-day) =
				InhExp	Inhalation Exposure per Shower	Calculated	mg/kg-shower		InhExp x EF x ED x 1/AT
				EF	Exposure Frequency	234	days/year	EPA, 1993	Foster & Chrostowski Shower Inhalation Model
				ED	Exposure Duration	9	years	EPA, 2001	for InhExp (parameters used in the model are shown in the
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	table 7s where the model is used)
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

EPA, 2001: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.

TABLE 5.1

NON-CANCER TOXICITY DATA -- ORAL/DERMAL

Site 2 - Allegheny Ballistics Laboratory

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD		Oral Absorption Efficiency for Dermal (1)	Absorbed RfD for Dermal (2)		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfD:Target Organ(s)	
		Value	Units		Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Aluminum	Chronic	1.0E+00	mg/kg-day	NA	1.0E+00	NA	Neurological	100	PPRTV	10/23/06
Antimony	Chronic	4.0E-04	mg/kg-day	15%	6.0E-05	mg/kg-day	Blood	1000/1	IRIS	03/02/07
	Subchronic	2.0E-04	mg/kg-day	15%	3.0E-05	mg/kg-day	Blood	300	PPRTV	06/22/04
Chromium (hexavalent)	Chronic	3.0E-03	mg/kg-day	2.5%	7.5E-05	mg/kg-day	Not identified	300/3	IRIS	03/02/07
	Subchronic	2.0E-02	mg/kg-day	2.5%	5.0E-04	mg/kg-day	Not identified	100	HEAST	07/01/97
Iron	Chronic	7.0E-01	mg/kg-day	NA	7.0E-01	mg/kg-day	Gastrointestinal	1	PPRTV	07/29/05
	Subchronic	7.0E-01	mg/kg/day	N/A	7.0E-01	mg/kg/day	Gastrointestinal	1	PPRTV	07/29/05
Manganese (non-food)	Chronic	2.0E-02	mg/kg-day	4%	8.0E-04	mg/kg-day	CNS	1	IRIS	3/2/2007
Trichloroethene	Chronic	6.0E-03	mg/kg-day	NA	6.0E-03	mg/kg-day	Liver, Kidney, Fetus	3000	NCEA	1997
Vanadium	Chronic	1.0E-03	mg/kg-day	2.6%	2.6E-05	mg/kg-day	Kidney	300	NCEA	5/1/2000
	Subchronic	7.0E-03	mg/kg-day	2.6%	1.8E-04	mg/kg-day	Lifetime	100	HEAST	7/1/1997
Vinyl chloride	Chronic	3.0E-03	mg/kg-day	Generally > 50%	3.0E-03	mg/kg-day	Liver	30/1	IRIS	3/2/2007

Footnote Instructions:

(1) Source: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evalution Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). Section 4.2 and Exhibit 4-1. USEPA recommends that the oral RfD should not be adjusted to estimate the absorbed dose for compounds when the absorption efficiency is greater than 50%. Constituents that do not have oral absorption efficiencies reported on this table were assumed to have an oral absorption efficiency of 100%.

(2) See Risk Assessment text for the derivation of the "Absorbed RfD for Dermal"

Definitions:

NA = Not Available

IRIS = Integrated Risk Information System

HEAST = Health Effects Assessment Summary Tables

NCEA = National Center for Environmental Assessment

RBC = Risk-Based Concentration Table, April 7, 2005, U.S. EPA Region III, Jennifer Hubbard.

PPRTV = Provisional Peer Reviewed Toxicity Values

GI = Gastrointestinal

CNS = Central Nervous System

TABLE 5.2

NON-CANCER TOXICITY DATA -- INHALATION

Site 2 - Allegheny Ballistics Laboratory

Chemical of Potential Concern	Chronic/ Subchronic	Inhalation RfC		Extrapolated RfD (1)		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfC : Target Organ(s)	
		Value	Units	Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Aluminum	NA	5.0E-03	mg/m^3	1.4E-03	mg/kg-day	Neurological	300	PPRTV	10/23/06
Antimony	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium (hexavalent)	Chronic	1.0E-04	mg/m^3	3.0E-05	mg/kg-day	Respiratory System	300/1	IRIS	03/02/07
Iron	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese (non-food)	Chronic	5.0E-05	mg/m^3	1.4E-05	mg/kg/day	CNS	1000/1	IRIS	3/2/2007
Trichloroethene	Chronic	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl chloride	Chronic	1.0E-01	mg/m^3	2.8E-02	mg/kg-day	Liver	30/1	IRIS	3/2/2007

(1) See Risk Assessment text for the derivation of the "Extrapolated RfD".

Definitions:

NA = Not Available

IRIS = Integrated Risk Information System

HEAST = Health Effects Assessment Summary Tables

NCEA = National Center for Environmental Assessment

PPRTV = Provisional Peer Reviewed Toxicity Values

CNS = Central Nervous System

TABLE 6.1
CANCER TOXICITY DATA -- ORAL/DERMAL
Site 2 - Allegheny Ballistics Laboratory

Chemical of Potential Concern	Oral Cancer Slope Factor		Oral Absorption Efficiency for Dermal (1)	Absorbed Cancer Slope Factor for Dermal (2)		Weight of Evidence/ Cancer Guideline Description (3)	Source(s)	Date(s) (MM/DD/YYYY)
	Value	Units		Value	Units			
Aluminum	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	NA	NA	NA	NA	NA	NA	NA	NA
Chromium (hexavalent)	N/A	N/A	N/A	N/A	NA	D	IRIS	6/22/2004
Iron	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	NA	NA	NA	NA	NA	D	IRIS	3/7/2007
Trichloroethene	1.1E-02	1/mg/kg-day	NA	1.1E-02	1/mg/kg-day	NA	NCEA	1997
Vanadium	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl chloride (continuous lifetime exposure from birth)	1.4E+00	1/mg/kg-day	Generally > 50%	1.4E+00	1/mg/kg-day	A	IRIS	3/7/2007
Vinyl chloride (continuous lifetime exposure during adulthood)	7.2E-01	1/mg/kg-day	Generally > 50%	7.2E-01	1/mg/kg-day	A	IRIS	3/7/2007

(1) Source: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evalution Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). Section 4.2 and Exhibit 4-1. USEPA recommends that the oral RfD should not be adjusted to estimate the absorbed dose for compounds when the absorption efficiency is greater than 50%. Constituents that do not have oral absorption efficiencies reported on this table were assumed to have an oral absorption efficiency of 100%.

(2) See Risk Assessment text for the derivation of the "Absorbed RfD for Dermal"

(3) Weight of Evidence definitions:

Group A chemicals (known human carcinogens) are agents for which there is sufficient evidence to support the causal association between exposure to the agents in humans and cancer.

Group B1 chemicals (probable human carcinogens) are agents for which there is limited evidence of possible carcinogenicity in humans.

Group B2 chemicals (probable human carcinogens) are agents for which there is sufficient evidence of carcinogenicity in animals but inadequate or a lack of evidence in humans.

Group C chemicals (possible human carcinogens) are agents for which there is limited evidence of carcinogenicity in animals and inadequate or a lack of human data.

Group D chemicals (not classifiable as to human carcinogenicity) are agents with inadequate human and animal evidence of carcinogenicity or for which no data are available.

Group E chemicals (evidence of noncarcinogenicity in humans) are agents for which there is no evidence of carcinogenicity from human or animal studies, or both.

Definitions:
NA = Not Available
IRIS = Integrated Risk Information System
HEAST = Health Effects Assessment Summary Tables
NCEA = National Center for Environmental Assessment

TABLE 6.2
CANCER TOXICITY DATA -- INHALATION
Site 2 - Allegheny Ballistics Laboratory

Chemical of Potential Concern	Unit Risk		Inhalation Cancer Slope Factor		Weight of Evidence/ Cancer Guideline Description	Source(s)	Date(s) (MM/DD/YYYY)
	Value	Units	Value	Units			
Aluminum	NA	NA	NA	NA	NA	NA	NA
Antimony	NA	NA	NA	NA	NA	NA	NA
Chromium (hexavalent)	1.2E-02	$1/ug/m^3$	4.1E+01	1/mg/kg-day	A	IRIS	3/7/2007
Iron	NA	NA	NA	NA	NA	NA	NA
Manganese	NA	NA	NA	NA	D	IRIS	3/7/2007
Trichloroethene	1.7E-06	$1/ug/m^3$	6.0E-03	1/mg/kg-day	B1	NCEA	1997
Vanadium	NA	NA	NA	NA	NA	NA	NA
Vinyl chloride (continuous lifetime exposure from birth)	8.8E-06	$1/ug/m^3$	3.0E-02	1/mg/kg-day	A	IRIS	3/9/2006
Vinyl chloride (continuous lifetime exposure during adulthood)	4.4E-06	$1/ug/m^3$	1.5E-02	1/mg/kg-day	A	IRIS	3/9/2006

Definitions:
NA = Not Available
IRIS = Integrated Risk Information System
HEAST = Health Effects Assessment Summary Tables
NCEA = National Center for Environmental Assessment
RBC = Risk-Based Concentration Table, April 25, 2003, U.S. EPA Region III, Jennifer Hubbard.

Weight of Evidence definitions:
Group A chemicals (known human carcinogens) are agents for which there is sufficient evidence to support the causal association between exposure to the agents in humans and cancer.
Group B1 chemicals (probable human carcinogens) are agents for which there is limited evidence of possible carcinogenicity in humans.
Group B2 chemicals (probable human carcinogens) are agents for which there is sufficient evidence of carcinogenicity in animals but inadequate or a lack of evidence in humans.
Group C chemicals (possible human carcinogens) are agents for which there is limited evidence of carcinogenicity in animals and inadequate or a lack of human data.
Group D chemicals (not classifiable as to human carcinogenicity) are agents with inadequate human and animal evidence of carcinogenicity or for which no data are available.
Group E chemicals (evidence of noncarcinogenicity in humans) are agents for which there is no evidence of carcinogenicity from human or animal studies, or both.

TABLE 7.1.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Site 2 - Allegany Ballistics Laboratory

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentratio		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Alluvial Aquifer - Tap Water	Ingestion													
				Trichloroethene	2.0E+00	µg/L	NA	NA	NA	NA	NA	5.5E-05	mg/kg/day	6.0E-03	mg/kg/day	9.1E-03
				Vinyl chloride	9.7E-01	µg/L	NA	NA	NA	NA	NA	2.7E-05	mg/kg/day	3.0E-03	mg/kg/day	8.9E-03
				Antimony	4.7E+00	µg/L	NA	NA	NA	NA	NA	1.3E-04	mg/kg/day	4.0E-04	mg/kg/day	3.2E-01
				Iron	3.9E+03	µg/L	NA	NA	NA	NA	NA	1.1E-01	mg/kg/day	7.0E-01	mg/kg/day	1.5E-01
				Manganese	4.7E+02	µg/L	NA	NA	NA	NA	NA	1.3E-02	mg/kg/day	2.0E-02	mg/kg/day	6.4E-01
			Exp. Route Total								NA					1.1E+00
			Dermal	Trichloroethene	2.0E+00	µg/L	NA	NA	NA	NA	NA	9.5E-06	mg/kg/day	6.0E-03	mg/kg/day	1.6E-03
				Vinyl chloride	9.7E-01	µg/L	NA	NA	NA	NA	NA	1.4E-06	mg/kg/day	3.0E-03	mg/kg/day	4.7E-04
				Antimony	4.7E+00	µg/L	NA	NA	NA	NA	NA	6.7E-07	mg/kg/day	6.0E-05	mg/kg/day	1.1E-02
				Iron	3.9E+03	µg/L	NA	NA	NA	NA	NA	5.6E-04	mg/kg/day	7.0E-01	mg/kg/day	8.0E-04
				Manganese	4.7E+02	µg/L	NA	NA	NA	NA	NA	6.7E-05	mg/kg/day	8.0E-04	mg/kg/day	8.4E-02
			Exp. Route Total								NA					9.8E-02
		Exposure Point Total									NA					1.2E+00
	Exposure Medium Total										NA					1.2E+00
	Air	Alluvial Aquifer - Water Vapors at Showerhead	Inhalation													
				Trichloroethene	2.0E+00	µg/L	NA	NA	NA	NA	NA	4.2E-05	mg/kg/day	NA	mg/kg/day	NA
				Vinyl chloride	9.7E-01	µg/L	NA	NA	NA	NA	NA	2.9E-05	mg/kg/day	2.8E-02	mg/kg/day	1.0E-03
			Exp. Route Total								NA					1.0E-03
		Exposure Point Total									NA					1.0E-03
	Exposure Medium Total										NA					1.0E-03
Groundwater Total											NA					1.2E+00
										Total of Receptor Risks Across All Media	NA				Total of Receptor Hazards Across All Media	1.2E+00

Notes-

NA = Not applicable.

DAevent for exposure to groundwater while bathing calculated on Table 7.1.RME Supplement A

Table 7.1.RME Supplement A
Calculation of DAevent
Resident Adult Alluvial Ground Water
Site 2 - Allegany Ballistics Laboratory

Chemical of Potential Concern	Water Concentration (CW) (µg/L)	Permeability Coefficient (Kp) (cm/hr)	B (dimensionless)	Lag Time (τ_{event}) (hr)	t* (hr)	Fraction Absorbed Water (FA) (dimensionless)	Duration of Event (tevent) (hr)	DAevent (mg/cm^2-event)	Eq
Trichloroethene	2.0E+00	1.2E-02	1.0E-01	5.8E-01	1.4E+00	1.0E+00	0.58	3.8E-08	2
Vinyl chloride	9.7E-01	5.6E-03	1.7E-02	2.4E-01	5.7E-01	1.0E+00	0.58	5.7E-09	3
Antimony	4.7E+00	1.0E-03	NA	NA	NA	NA	0.58	2.7E-09	1
Iron	3.9E+03	1.0E-03	NA	NA	NA	NA	0.58	2.3E-06	1
Manganese	4.7E+02	1.0E-03	NA	NA	NA	NA	0.58	2.7E-07	1

Inorganics: DAevent (mg/cm^2-event) =

Kp x CW x t_{event} x 0.001 mg/ug x 0.001 l/cm^3 (eq 1)

Organics: DAevent (mg/cm^2-event) =

If tevent<t*, then DAevent =

2 x FA x Kp x CW x (sqrt((6 x τ_{event} x t_{event})/π)) x 0.001 mg/ug x 0.001 l/cm^3 (eq 2)

If tevent>t*, then DAevent =

FA x Kp x CW x (t_{event}/(1+B) + 2 x τ_{event} x ((1 + 3xB + 3xB^2)/(1+B)^2) x 0.001 mg/ug x 0.001 l/cm^3 (eq 3)

Notes:

NA - Not applicable

Permeability constants from EPA 2004, *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment - Final).* EPA/540/R/99/005. The default value of 0.001 was assigned to inorganics not listed in this document.

B - Dimensionless ratio of the permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis (dimensionless).

t* - Time to reach steady-state

Table 7.1.RME Supplement B
Inhalation Exposure Concentrations from Foster and Chrostowski Shower Model
Site 2 - Allegany Ballistics Laboratory

Chemical	Exposure Point Concentration Cwo (μg/l)	Molecular weight (HH) (g/mole)	Henry's Law Constant (H) (atm-m^3/mole)	Kg (VOC) (cm/hr)	Kl(VOC) (cm/hr)	KL (cm/hr)	Kal (cm/hr)	Cwd (μg/l)	S (μg/m^3 - min)	Calculated Inhalation Exposure (Einh) (mg/kg/shower)
Trichloroethene	2.0E+00	1.3E+02	1.03E-02	1.1E+03	1.2E+01	1.1E+01	1.5E+01	2.4E-01	2.0E-01	4.4E-05
Vinyl chloride	9.7E-01	6.3E+01	2.70E-02	1.6E+03	1.7E+01	1.7E+01	2.2E+01	1.6E-01	1.4E-01	3.0E-05

Variables	Units	Exposure Assumptions
Kg(VOC) = gas-film mass transfer coefficient	cm/hr	Solved by Eq 1
Kl(VOC) = liquid-film mass transfer coefficient	cm/hr	Solved by Eq 2
KL = overall mass transfer coefficient	cm/hr	Solved by Eq 3
Kal = adjusted overall mass transfer coeff.	cm/hr	Solved by Eq 4
Tl = Calibration temp. of water	K (20C +273)	293
Ts = Shower water temperature	k (45C)	318
Us = water viscosity at Ts	centipoise	0.596
Ul = water viscosity at Tl	cp	1.002
Cwd = conc. leaving droplets after time sdt	μg/l	Solved by Eq 5
sdt = shower droplet drop time	sec	0.5
d = shower droplet diameter	mm	1
FR = shower water flow rate	l/min	10
SV = shower room air volume	m^3	12
S = indoor VOC generation rate	μg/m^3-min	Solved by Eq 6
VR = ventilation rate	l/min	13.8
Variables	**Units**	**Exposure Assumptions**
BW = body weight	kg	70
Ds = duration of shower	min	30
Dt = total duration in shower room	min	60
R = air exchange rate	min^{-1}	0.0083
Ca = indoor air concentration of VOCs	μg/m^3	Solved by Eq 7
Einh = inhalation exposure per shower	mg/kg/shower	Solved by Eq 8

Equation 1:	Kg(VOC) =	$3000 * (18 / HH)^{0.5}$	
Equation 2:	Kl(VOC) =	$20 * (44 / HH)^{0.5}$	
Equation 3:	KL =	$((1 / Kl(VOC)) + (0.024 / (Kg (VOC) * H)))^{-1}$	
Equation 4:	Kal =	$(KL * (((Tl * Us) / (Ts * Ul))^{-0.5}))$	
Equation 5:	Cwd =	(Cwo * (1-EXP((-1 * Kal * sdt)/(60 * d))))	
Equation 6:	S =	(Cwd * FR / SV)	
Equation 7:	see time series example on Table I-GW-5		
Equation 8:	Einh =	If t>Ds	(((VR * S) / (BW * R * 1000000)) * ((Ds + (EXP(-R * Dt) / R)-(EXP(R * (Ds - Dt))) / R)))

TABLE 7.2.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Site 2 - Allegany Ballistics Laboratory

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Alluvial Aquifer - Tap Water	Ingestion													
				Trichloroethene	2.0E+00	µg/L	NA	NA	NA	NA	NA	1.3E-04	mg/kg/day	6.0E-03	mg/kg/day	2.1E-02
				Vinyl chloride	9.7E-01	µg/L	NA	NA	NA	NA	NA	6.2E-05	mg/kg/day	3.0E-03	mg/kg/day	2.1E-02
				Antimony	4.7E+00	µg/L	NA	NA	NA	NA	NA	3.0E-04	mg/kg/day	4.0E-04	mg/kg/day	7.5E-01
				Iron	3.9E+03	µg/L	NA	NA	NA	NA	NA	2.5E-01	mg/kg/day	7.0E-01	mg/kg/day	3.6E-01
				Manganese	4.7E+02	µg/L	NA	NA	NA	NA	NA	3.0E-02	mg/kg/day	2.0E-02	mg/kg/day	1.5E+00
			Exp. Route Total								NA					2.7E+00
			Dermal	Trichloroethene	2.0E+00	µg/L	NA	NA	NA	NA	NA	2.1E-05	mg/kg/day	6.0E-03	mg/kg/day	3.6E-03
				Vinyl chloride	9.7E-01	µg/L	NA	NA	NA	NA	NA	3.4E-06	mg/kg/day	3.0E-03	mg/kg/day	1.1E-03
				Antimony	4.7E+00	µg/L	NA	NA	NA	NA	NA	2.0E-06	mg/kg/day	6.0E-05	mg/kg/day	3.3E-02
				Iron	3.9E+03	µg/L	NA	NA	NA	NA	NA	1.7E-03	mg/kg/day	7.0E-01	mg/kg/day	2.4E-03
				Manganese	4.7E+02	µg/L	NA	NA	NA	NA	NA	2.0E-04	mg/kg/day	8.0E-04	mg/kg/day	2.5E-01
			Exp. Route Total								NA					2.9E-01
		Exposure Point Total									NA					2.9E+00
	Exposure Medium Total										NA					2.9E+00
Groundwater Total											NA					2.9E+00
										Total of Receptor Risks Across All Media	NA	Total of Receptor Hazards Across All Media				2.9E+00

Notes-

NA = Not applicable.

DAevent for exposure to groundwater while bathing calculated on Table 7.2.RME Supplement A

Table 7.2.RME Supplement A
Calculation of DAevent
Resident Child Alluvial Ground Water
Site 2 - Allegany Ballistics Laboratory

Chemical of Potential Concern	Water Concentration (CW) (µg/L)	Permeability Coefficient (Kp) (cm/hr)	B (dimensionless)	Lag Time (τ_{event}) (hr)	t* (hr)	Fraction Absorbed Water (FA) (dimensionless)	Duration of Event (tevent) (hr)	DAevent (mg/cm^2-event)	Eq
Trichloroethene	2.0E+00	1.2E-02	1.0E-01	5.8E-01	1.4E+00	1.0E+00	1	5.1E-08	2
Vinyl chloride	9.7E-01	5.6E-03	1.7E-02	2.4E-01	5.7E-01	1.0E+00	1	8.0E-09	3
Antimony	4.7E+00	1.0E-03	NA	NA	NA	NA	1	4.7E-09	1
Iron	3.9E+03	1.0E-03	NA	NA	NA	NA	1	3.9E-06	1
Manganese	4.7E+02	1.0E-03	NA	NA	NA	NA	1	4.7E-07	1

Inorganics: DAevent (mg/cm^2-event) =

Kp x CW x t_{event} x 0.001 mg/ug x 0.001 l/cm^3 (eq 1)

Organics: DAevent (mg/cm^2-event) =

If tevent<t*, then DAevent =

2 x FA x Kp x CW x (sqrt((6 x τ_{event} x t_{event})/π)) x 0.001 mg/ug x 0.001 l/cm^3 (eq 2)

If tevent>t*, then DAevent =

FA x Kp x CW x (t_{event}/(1+B) + 2 x τ_{event} x ((1 + 3xB + 3xB^2)/(1+B)^2) x 0.001 mg/ug x 0.001 l/cm^3 (eq 3)

Notes:

NA - Not applicable

Permeability constants from EPA 2004, *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment - Final).* EPA/540/R/99/005. The default value of 0.001 was assigned to inorganics not listed in this document.

B - Dimensionless ratio of the permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis (dimensionless).

t* - Time to reach steady-state

TABLE 7.3.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Site 2 - Allegany Ballistics Laboratory

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Alluvial Aquifer - Tap Water	Ingestion													
				Trichloroethene	2.0E+00	ug/L	3.0E-05	mg/kg/day	1.1E-02	1/mg/kg-day	3.3E-07	NA	NA	NA	NA	NA
				Vinyl chloride*	9.7E-01	ug/L	N/A		N/A		5.7E-05	NA	NA	NA	NA	NA
				Antimony	4.7E+00	ug/L	7.0E-05	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Iron	3.9E+03	ug/L	5.9E-02	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Manganese	4.7E+02	ug/L	7.0E-03	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
			Exp. Route Total								5.7E-05					NA
			Dermal													
				Trichloroethene	2.0E+00	ug/L	5.1E-06	mg/kg/day	1.1E-02	1/mg/kg-day	5.6E-08	NA	NA	NA	NA	NA
				Vinyl chloride*	9.7E-01	ug/L	N/A		N/A		3.1E-06	NA	NA	NA	NA	NA
				Antimony	4.7E+00	ug/L	4.0E-07	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Iron	3.9E+03	ug/L	3.3E-04	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Manganese	4.7E+02	ug/L	4.0E-05	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
			Exp. Route Total								3.1E-06					NA
		Exposure Point Total									6.0E-05					NA
	Air	Alluvial Aquifer - Water Vapors at Showerhead	Inhalation													
				Trichloroethene	2.0E+00	µg/L	1.4E-05	mg/kg/day	6.0E-03	1/mg/kg-day	8.7E-08	NA	NA	NA	NA	NA
				Vinyl chloride	9.7E-01	µg/L	1.0E-05	mg/kg/day	3.0E-02	1/mg/kg-day	3.0E-07	NA	NA	NA	NA	NA
			Exp. Route Total								3.9E-07					NA
		Exposure Point Total									3.9E-07					NA
	Exposure Medium Total										3.9E-07					NA
Groundwater Total											6.1E-05					NA
										Total of Receptor Risks Across All Media	6.1E-05			Total of Receptor Hazards Across All Media		NA

Notes-

NA = Not applicable.

DAevent for exposure to groundwater while bathing calculated on Tables 7.1.RME Supplement A and 7.2.RME Supplement A.

Inhalation of water vapors at showerhead calculated for adult resident only. Children assumed to bathe, not shower, and inhalation exposure would be lower.

* Vinyl chloride risks calculated following methodology in EPA Region III's *Derivation of Vinyl Chloride RBCs*, May 6, 2001.

TABLE 7.4.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Site 2 - Allegany Ballistics Laboratory

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Alluvial Aquifer - Water in Excavation Pit	Dermal	Trichloroethene	2.0E+00	µg/L	8.2E-08	mg/kg/day	1.1E-02	1/mg/kg-day	9.0E-10	5.7E-06	mg/kg/day	6.0E-03	mg/kg/day	9.5E-04
				Vinyl chloride	9.7E-01	µg/L	1.8E-08	mg/kg/day	7.2E-01	1/mg/kg-day	1.3E-08	1.3E-06	mg/kg/day	3.0E-03	mg/kg/day	4.2E-04
				Aluminum	7.6E+03	µg/L	2.4E-05	mg/kg/day	NA	NA	NA	1.7E-03	mg/kg/day	1.0E+00	mg/kg/day	1.7E-03
				Chromium	1.4E+01	µg/L	4.5E-08	mg/kg/day	NA	NA	NA	3.1E-06	mg/kg/day	5.0E-04	mg/kg/day	6.2E-03
				Iron	3.1E+04	µg/L	9.8E-05	mg/kg/day	NA	NA	NA	6.8E-03	mg/kg/day	7.0E-01	mg/kg/day	9.8E-03
				Manganese	5.7E+02	µg/L	1.8E-06	mg/kg/day	NA	NA	NA	1.3E-04	mg/kg/day	8.0E-04	mg/kg/day	1.6E-01
				Vanadium	1.4E+01	µg/L	4.5E-08	mg/kg/day	NA	NA	NA	3.1E-06	mg/kg/day	1.8E-04	mg/kg/day	1.7E-02
			Exp. Route Total								1.4E-08					2.0E-01
		Exposure Point Total									1.4E-08					2.0E-01
	Exposure Medium Total										1.4E-08					2.0E-01
	Air	Alluvial Aquifer - Volatilization from Water in Excavation Pit	Inhalation	Trichloroethene	2.0E+00	µg/L	2.5E-08	mg/kg/day	6.0E-03	1/mg/kg-day	1.5E-10	1.8E-06	mg/kg/day	NA	mg/kg/day	NA
				Vinyl chloride	9.7E-01	µg/L	1.5E-08	mg/kg/day	1.5E-02	1/mg/kg-day	2.2E-10	1.0E-06	mg/kg/day	2.8E-02	mg/kg/day	3.7E-05
			Exp. Route Total								3.7E-10					3.7E-05
		Exposure Point Total									3.7E-10					3.7E-05
	Exposure Medium Total										3.7E-10					3.7E-05
Groundwater Total											1.4E-08					2.0E-01
										Total of Receptor Risks Across All Media	1.4E-08				Total of Receptor Hazards Across All Media	2.0E-01

Notes-
NA = Not applicable.
Subcronic RfD values used when available

DAevent for exposure to shallow aquifer groundwater during excavation activities calculated on Table 7.4.RME Supplement A.
EPC for inhalation of volatiles from shallow aquifer groundwater from excavation pit calculated on Table 7.4.RME Supplement B.

Table 7.4.RME Supplement A
Calculation of DAevent
Construction Worker
Site 2 - Allegany Ballistics Laboratory

Chemical of Potential Concern	Water Concentration (CW) (µg/L)	Permeability Coefficient (Kp) (cm/hr)	B (dimensionless)	Lag Time (τ_{event}) (hr)	t* (hr)	Fraction Absorbed Water (FA) (dimensionless)	Duration of Event (tevent) (hr)	DAevent (mg/cm^2-event)	Eq
Trichloroethene	2.0E+00	1.2E-02	1.0E-01	5.8E-01	1.4E+00	1.0E+00	8	2.1E-07	3
Vinyl chloride	9.7E-01	5.6E-03	1.7E-02	2.4E-01	5.7E-01	1.0E+00	8	4.5E-08	3
Aluminum	7.6E+03	1.0E-03	NA	NA	NA	NA	8	6.1E-05	1
Chromium	1.4E+01	1.0E-03	NA	NA	NA	NA	8	1.1E-07	1
Iron	3.1E+04	1.0E-03	NA	NA	NA	NA	8	2.4E-04	1
Manganese	5.7E+02	1.0E-03	NA	NA	NA	NA	8	4.6E-06	1
Vanadium	1.4E+01	1.0E-03	NA	NA	NA	NA	8	1.1E-07	1

Inorganics: DAevent (mg/cm2-event) =
Kp x CW x tevent x 0.001 mg/ug x 0.001 l/cm^3 (eq 1)

Organics: DAevent (mg/cm2-event) =
If tevent<t*, then DAevent =
2 x FA x Kp x CW x (sqrt((6 x τ_{event} x t_{event})/π)) x 0.001 mg/ug x 0.001 l/cm^3 (eq 2)

If tevent>t*, then DAevent =
FA x Kp x CW x (t_{event}/(1+B) + 2 x τ_{event} x ((1 + 3xB + $3xB^2$)/$(1+B)^2$) x 0.001 mg/ug x 0.001 l/cm^3 (eq 3)

Notes:
NA - Not applicable
Permeability constants from EPA 2004, *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment - Final).* EPA/540/R/99/005. The default value of 0.001 was assigned to inorganics not listed in this document.
B - Dimensionless ratio of the permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis (dimensionless).
t* - Time to reach steady-state

Table 7.4.RME Supplement B
Inhalation of Volatiles from Groundwater During Construction
Inhalation Exposure Concentrations Calculated Using a Two-Film Volatilization Model
Future Construction Worker Senario
Site 2 - Allegany Ballistics Laboratory

Chemical	Cw (µg/L)	MW (mol/gram)	KH (unitless)	kl (cm/hr)	kg (cm/hr)	Kv (cm/hr)	ER (mg/hr)	ERa (g/sec-m2)	Ca (mg/m3)
Trichloroethene	2.00E+00	1.31E+02	4.22E-01	3.09E+00	1.88E+03	3.08E+00	6.16E+00	6.34E-10	1.80E-05
Vinyl chloride	9.70E-01	6.30E+01	1.11E+00	3.71E+00	2.25E+03	3.71E+00	3.60E+00	3.70E-10	1.05E-05

Equations

Equation 1	$Kv = 1/(1/k_l + 1/K_H{*}K_g)$
Equation 2	$k_g = 700(18/MW)^{1/4}V$
Equation 3	$k_l = (32/MW)^{1/4}Ka'$
Equation 4	ER = Kv * Cw * L/1000 cm^3 * mg/1000 µg
Equation 5	ERa = ER * g/1000 mg * hr/60 min * min/60 sec * 1/A

Variables	Units	Exposure Assumptions
Cw = groundwater concentration	(µg/L)	chem-specific
MW = molecular weight	(mol/gram)	chem-specific
K_H - Henry's Law Constant	(unitless)	chem-specific
Kv = volatilization rate	(cm/hr)	Solved by Eq 1
k_g = gas phase transfer coefficient	(cm/hr)	Solved by Eq 2
k_l = liquid phase transfer coefficient	(cm/hr)	Solved by Eq 3
V = wind speed	(m/s)	4.4
Ka' = aeration rate	(cm/hr)	0.0633
ER = emission rate	(mg/hr)	Solved by Eq 4
A = area of excavation (utility ditch)	(m^2)	2,700
Era = area emission rate	(g/sec-m^2)	Solved by Eq 5
Ca = air concentration	(mg/m^3)	Solved using SCREEN3 model

Note: aeration rate based on aeration rate for small pond (0.1/day) multiplied by depth of water in excavation (1/2 ft)

TABLE 7.5.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Site 2 - Allegany Ballistics Laboratory

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	take/Exposure Concentratio		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Bedrock Aquifer - Tap Water	Ingestion	Trichloroethene	1.1E+00	µg/L	NA	NA	NA	NA	NA	3.0E-05	mg/kg/day	6.0E-03	mg/kg/day	5.0E-03
				Iron	1.3E+03	µg/L	NA	NA	NA	NA	NA	3.6E-02	mg/kg/day	7.0E-01	mg/kg/day	5.1E-02
			Exp. Route Total								NA					5.6E-02
			Dermal	Trichloroethene	1.1E+00	µg/L	NA	NA	NA	NA	NA	5.2E-06	mg/kg/day	6.0E-03	mg/kg/day	8.7E-04
				Iron	1.3E+03	µg/L	NA	NA	NA	NA	NA	1.9E-04	mg/kg/day	7.0E-01	mg/kg/day	2.7E-04
			Exp. Route Total								NA					1.1E-03
		Exposure Point Total									NA					5.7E-02
	Exposure Medium Total										NA					5.7E-02
	Air	Alluvial Aquifer - Water Vapors at Showerhead	Inhalation	Trichloroethene	1.1E+00	µg/L	NA	NA	NA	NA	NA	2.3E-05	mg/kg/day	NA	mg/kg/day	NA
			Exp. Route Total								NA					0.0E+00
		Exposure Point Total									NA					0.0E+00
	Exposure Medium Total										NA					0.0E+00
Groundwater Total											NA					5.7E-02
										Total of Receptor Risks Across All Media	NA	l of Receptor Hazards Across All Media				5.7E-02

Notes-

NA = Not applicable.

DAevent for exposure to groundwater while bathing calculated on Table 7.5.RME Supplement A.

Table 7.5.RME Supplement A
Calculation of DAevent
Resident Adult Bedrock Ground Water
Site 2 - Allegany Ballistics Laboratory

Chemical of Potential Concern	Water Concentration (CW) (µg/L)	Permeability Coefficient (Kp) (cm/hr)	B (dimensionless)	Lag Time (τ_{event}) (hr)	t* (hr)	Fraction Absorbed Water (FA) (dimensionless)	Duration of Event (tevent) (hr)	DAevent (mg/cm²-event)	Eq
Trichloroethene	1.1E+00	1.2E-02	1.0E-01	5.8E-01	1.4E+00	1.0E+00	0.58	2.1E-08	2
Iron	1.3E+03	1.0E-03	NA	NA	NA	NA	0.58	7.6E-07	1

Inorganics: DAevent (mg/cm^2-event) =

Kp x CW x t_{event} x 0.001 mg/ug x 0.001 l/cm^3 (eq 1)

Organics: DAevent (mg/cm^2-event) =

If tevent<t*, then DAevent =

2 x FA x Kp x CW x (sqrt((6 x τ_{event} x t_{event})/π)) x 0.001 mg/ug x 0.001 l/cm^3 (eq 2)

If tevent>t*, then DAevent =

FA x Kp x CW x (t_{event}/(1+B) + 2 x τ_{event} x ((1 + 3xB + 3xB^2)/$(1+B)^2$) x 0.001 mg/ug x 0.001 l/cm^3 (eq 3)

Notes:

NA - Not applicable

Permeability constants from EPA 2004, *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment - Final).* EPA/540/R/99/005. The default value of 0.001 was assigned to inorganics not listed in this document.

B - Dimensionless ratio of the permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis (dimensionless).

t* - Time to reach steady-state

Table 7.5.RME Supplement B
Inhalation Exposure Concentrations from Foster and Chrostowski Shower Model
Site 2 - Allegany Ballistics Laboratory

Chemical	Exposure Point Concentration Cwo (μg/l)	Molecular weight (HH) (g/mole)	Henry's Law Constant (H) (atm-m^3/mole)	Kg (VOC) (cm/hr)	Kl(VOC) (cm/hr)	KL (cm/hr)	Kal (cm/hr)	Cwd (μg/l)	S (μg/m^3 - min)	Calculated Inhalation Exposure (Einh) (mg/kg/shower)
Trichloroethene	1.1E+00	1.3E+02	1.03E-02	1.1E+03	1.2E+01	1.1E+01	1.5E+01	1.3E-01	1.1E-01	2.4E-05

Variables	Units	Exposure Assumptions
Kg(VOC) = gas-film mass transfer coefficient	cm/hr	Solved by Eq 1
Kl(VOC) = liquid-film mass transfer coefficient	cm/hr	Solved by Eq 2
KL = overall mass transfer coefficient	cm/hr	Solved by Eq 3
Kal = adjusted overall mass transfer coeff.	cm/hr	Solved by Eq 4
Tl = Calibration temp. of water	K (20C +273)	293
Ts = Shower water temperature	k (45C)	318
Us = water viscosity at Ts	centipoise	0.596
Ul = water viscosity at Tl	cp	1.002
Cwd = conc. leaving droplets after time sdt	μg/l	Solved by Eq 5
sdt = shower droplet drop time	sec	0.5
d = shower droplet diameter	mm	1
FR = shower water flow rate	l/min	10
SV = shower room air volume	m^3	12
S = indoor VOC generation rate	μg/m^3-min	Solved by Eq 6
VR = ventilation rate	l/min	13.8
Variables	**Units**	**Exposure Assumptions**
BW = body weight	kg	70
Ds = duration of shower	min	30
Dt = total duration in shower room	min	60
R = air exchange rate	min^{-1}	0.0083
Ca = indoor air concentration of VOCs	μg/m^3	Solved by Eq 7
Einh = inhalation exposure per shower	mg/kg/shower	Solved by Eq 8

Equation 1:	Kg(VOC) =	$3000 * (18 / HH)^{0.5}$	
Equation 2:	Kl(VOC) =	$20 * (44 / HH)^{0.5}$	
Equation 3:	KL =	$((1 / Kl(VOC)) + (0.024 / (Kg (VOC) * H)))^{-1}$	
Equation 4:	Kal =	$(KL * (((Tl * Us) / (Ts * Ul))^{-0.5}))$	
Equation 5:	Cwd =	(Cwo * (1-EXP((-1 * Kal * sdt)/(60 * d))))	
Equation 6:	S =	(Cwd * FR / SV)	
Equation 7:	see time series example on Table I-GW-5		
Equation 8:	Einh =	If t>Ds	(((VR * S) / (BW * R * 1000000)) * ((Ds + (EXP(-R * Dt) / R)-(EXP(R * (Ds - Dt))) / R)))

TABLE 7.6.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Site 2 - Allegany Ballistics Laboratory

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Bedrock Aquifer - Tap Water	Ingestion	Trichloroethene	1.1E+00	µg/L	NA	NA	NA	NA	NA	7.0E-05	mg/kg/day	6.0E-03	mg/kg/day	1.2E-02
				Iron	1.3E+03	µg/L	NA	NA	NA	NA	NA	8.4E-02	mg/kg/day	7.0E-01	mg/kg/day	1.2E-01
			Exp. Route Total								NA					1.3E-01
			Dermal	Trichloroethene	1.1E+00	µg/L	NA	NA	NA	NA	NA	1.2E-05	mg/kg/day	6.0E-03	mg/kg/day	2.0E-03
				Iron	1.3E+03	µg/L	NA	NA	NA	NA	NA	5.5E-04	mg/kg/day	7.0E-01	mg/kg/day	7.9E-04
			Exp. Route Total								NA					2.7E-03
		Exposure Point Total									NA					1.3E-01
	Exposure Medium Total										NA					1.3E-01
Groundwater Total											NA					1.3E-01
Total of Receptor Risks Across All Media											NA	Total of Receptor Hazards Across All Media				1.3E-01

Notes-

NA = Not applicable.

DAevent for exposure to groundwater while bathing calculated on Table 7.6.RME Supplement A.

Table 7.6.RME Supplement A
Calculation of DAevent
Resident Child Bedrock Ground Water
Site 2 - Allegany Ballistics Laboratory

Chemical of Potential Concern	Water Concentration (CW) (µg/L)	Permeability Coefficient (Kp) (cm/hr)	B (dimensionless)	Lag Time (τ_{event}) (hr)	t* (hr)	Fraction Absorbed Water (FA) (dimensionless)	Duration of Event (tevent) (hr)	DAevent (mg/cm^2-event)	Eq
Trichloroethene	1.1E+00	1.2E-02	1.0E-01	5.8E-01	1.4E+00	1.0E+00	1	2.8E-08	2
Iron	1.3E+03	1.0E-03	NA	NA	NA	NA	1	1.3E-06	1

Inorganics: DAevent (mg/cm^2-event) =

Kp x CW x t_{event} x 0.001 mg/ug x 0.001 l/cm^3 (eq 1)

Organics: DAevent (mg/cm^2-event) =

If tevent<t*, then DAevent =

2 x FA x Kp x CW x (sqrt((6 x τ_{event} x t_{event})/π)) x 0.001 mg/ug x 0.001 l/cm^3 (eq 2)

If tevent>t*, then DAevent =

FA x Kp x CW x (t_{event}/(1+B) + 2 x τ_{event} x ((1 + 3xB + 3xB^2)/(1+B)^2) x 0.001 mg/ug x 0.001 l/cm^3 (eq 3)

Notes:

NA - Not applicable

Permeability constants from EPA 2004, *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment - Final).* EPA/540/R/99/005. The default value of 0.001 was assigned to inorganics not listed in this document.

B - Dimensionless ratio of the permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis (dimensionless).

t* - Time to reach steady-state

TABLE 7.7.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Site 2 - Allegany Ballistics Laboratory

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Bedrock Aquifer - Tap Water	Ingestion													
				Trichloroethene	1.1E+00	ug/L	1.6E-05	mg/kg/day	1.1E-02	1/mg/kg-day	1.8E-07	NA	NA	NA	NA	NA
				Iron	1.3E+03	ug/L	2.0E-02	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
			Exp. Route Total								1.8E-07					NA
			Dermal													
				Trichloroethene	1.1E+00	ug/L	1.1E-06	mg/kg/day	1.1E-02	1/mg/kg-day	1.2E-08	NA	NA	NA	NA	NA
				Iron	1.3E+03	ug/L	5.0E-05	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
			Exp. Route Total								1.2E-08					NA
		Exposure Point Total									1.9E-07					NA
	Air	Bedrock Aquifer - Water Vapors at Showerhead	Inhalation	Trichloroethene	1.1E+00	µg/L	8.0E-06	mg/kg/day	6.0E-03	1/mg/kg-day	4.8E-08	NA	NA	NA	NA	NA
			Exp. Route Total								4.8E-08					NA
		Exposure Point Total									4.8E-08					NA
	Exposure Medium Total										4.8E-08					NA
Groundwater Total											2.4E-07					NA
							Total of Receptor Risks Across All Media				2.4E-07	Total of Receptor Hazards Across All Media				NA

Notes-

NA = Not applicable.

DAevent for exposure to groundwater while bathing calculated on Tables 7.5.RME Supplement A and 7.6.RME Supplement A.

TABLE 7.1.CTE

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EXPOSURE

Site 2 - Allegany Ballistics Laboratory

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentratio		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Alluvial Aquifer - Tap Water	Ingestion													
				Trichloroethene	1.3E+00	µg/L	NA	NA	NA	NA	NA	1.6E-05	mg/kg/day	6.0E-03	mg/kg/day	2.7E-03
				Vinyl chloride	6.1E-01	µg/L	NA	NA	NA	NA	NA	7.8E-06	mg/kg/day	3.0E-03	mg/kg/day	2.6E-03
				Antimony	3.4E+00	µg/L	NA	NA	NA	NA	NA	4.3E-05	mg/kg/day	4.0E-04	mg/kg/day	1.1E-01
				Iron	2.0E+03	µg/L	NA	NA	NA	NA	NA	2.5E-02	mg/kg/day	7.0E-01	mg/kg/day	3.6E-02
				Manganese	2.4E+02	µg/L	NA	NA	NA	NA	NA	3.0E-03	mg/kg/day	2.0E-02	mg/kg/day	1.5E-01
			Exp. Route Total								NA					3.0E-01
			Dermal	Trichloroethene	1.3E+00	µg/L	NA	NA	NA	NA	NA	2.7E-06	mg/kg/day	6.0E-03	mg/kg/day	4.4E-04
				Vinyl chloride	6.1E-01	µg/L	NA	NA	NA	NA	NA	3.8E-07	mg/kg/day	3.0E-03	mg/kg/day	1.3E-04
				Antimony	3.4E+00	µg/L	NA	NA	NA	NA	NA	1.4E-07	mg/kg/day	6.0E-05	mg/kg/day	2.3E-03
				Iron	2.0E+03	µg/L	NA	NA	NA	NA	NA	8.2E-05	mg/kg/day	7.0E-01	mg/kg/day	1.2E-04
				Manganese	2.4E+02	µg/L	NA	NA	NA	NA	NA	9.8E-06	mg/kg/day	8.0E-04	mg/kg/day	1.2E-02
			Exp. Route Total								NA					1.5E-02
		Exposure Point Total									NA					3.2E-01
	Exposure Medium Total										NA					3.2E-01
	Air	Alluvial Aquifer - Water Vapors at Showerhead	Inhalation													
				Trichloroethene	1.3E+00	µg/L	NA	NA	NA	NA	NA	1.8E-05	mg/kg/day	NA	mg/kg/day	NA
				Vinyl chloride	6.1E-01	µg/L	NA	NA	NA	NA	NA	1.2E-05	mg/kg/day	2.8E-02	mg/kg/day	4.4E-04
			Exp. Route Total								NA					4.4E-04
		Exposure Point Total									NA					4.4E-04
	Exposure Medium Total										NA					4.4E-04
Groundwater Total											NA					3.2E-01
										Total of Receptor Risks Across All Media	NA				al of Receptor Hazards Across All Media	3.2E-01

Notes-

NA = Not applicable.

DAevent for exposure to groundwater while bathing calculated on Table 7.1.CTE Supplement A .

Table 7.1.CTE Supplement A
Calculation of DAevent
Resident Adult Alluvial Ground Water
Site 2 - Allegany Ballistics Laboratory

Chemical of Potential Concern	Water Concentration (CW) (µg/L)	Permeability Coefficient (Kp) (cm/hr)	B (dimensionless)	Lag Time (τ_{event}) (hr)	t* (hr)	Fraction Absorbed Water (FA) (dimensionless)	Duration of Event (tevent) (hr)	DAevent (mg/cm^2-event)	Eq
Trichloroethene	1.3E+00	1.2E-02	1.0E-01	5.8E-01	1.4E+00	1.0E+00	0.25	1.6E-08	2
Vinyl chloride	6.1E-01	5.6E-03	1.7E-02	2.4E-01	5.7E-01	1.0E+00	0.25	2.3E-09	2
Antimony	3.4E+00	1.0E-03	NA	NA	NA	NA	0.25	8.4E-10	1
Iron	2.0E+03	1.0E-03	NA	NA	NA	NA	0.25	5.0E-07	1
Manganese	2.4E+02	1.0E-03	NA	NA	NA	NA	0.25	5.9E-08	1

Inorganics: DAevent (mg/cm^2-event) =

Kp x CW x t_{event} x 0.001 mg/ug x 0.001 l/cm^3 (eq 1)

Organics: DAevent (mg/cm^2-event) =

If tevent<t*, then DAevent =

2 x FA x Kp x CW x (sqrt((6 x τ_{event} x t_{event})/π)) x 0.001 mg/ug x 0.001 l/cm^3 (eq 2)

If tevent>t*, then DAevent =

FA x Kp x CW x (t_{event}/(1+B) + 2 x τ_{event} x ((1 + 3xB + 3xB^2)/(1+B)^2) x 0.001 mg/ug x 0.001 l/cm^3 (eq 3)

Notes:

NA - Not applicable

Permeability constants from EPA 2004, *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment - Final).* EPA/540/R/99/005. The default value of 0.001 was assigned to inorganics not listed in this document.

B - Dimensionless ratio of the permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis (dimensionless).

t* - Time to reach steady-state

Table 7.1.CTE Supplement B
Inhalation Exposure Concentrations from Foster and Chrostowski Shower Model
Site 2 - Allegany Ballistics Laboratory

Chemical	Exposure Point Concentration Cwo (μg/l)	Molecular weight (HH) (g/mole)	Henry's Law Constant (H) (atm-m^3/mole)	Kg (VOC) (cm/hr)	Kl(VOC) (cm/hr)	KL (cm/hr)	Kal (cm/hr)	Cwd (μg/l)	S (μg/m^3 - min)	Calculated Inhalation Exposure (Einh) (mg/kg/shower)
Trichloroethene	1.3E+00	1.3E+02	1.03E-02	1.1E+03	1.2E+01	1.1E+01	1.5E+01	1.5E-01	1.3E-01	2.8E-05
Vinyl chloride	6.1E-01	6.3E+01	2.70E-02	1.6E+03	1.7E+01	1.7E+01	2.2E+01	1.0E-01	8.6E-02	1.9E-05

Variables	Units	Exposure Assumptions
Kg(VOC) = gas-film mass transfer coefficient	cm/hr	Solved by Eq 1
Kl(VOC) = liquid-film mass transfer coefficient	cm/hr	Solved by Eq 2
KL = overall mass transfer coefficient	cm/hr	Solved by Eq 3
Kal = adjusted overall mass transfer coeff.	cm/hr	Solved by Eq 4
Tl = Calibration temp. of water	K (20C +273)	293
Ts = Shower water temperature	k (45C)	318
Us = water viscosity at Ts	centipoise	0.596
Ul = water viscosity at Tl	cp	1.002
Cwd = conc. leaving droplets after time sdt	μg/l	Solved by Eq 5
sdt = shower droplet drop time	sec	0.5
d = shower droplet diameter	mm	1
FR = shower water flow rate	l/min	10
SV = shower room air volume	m^3	12
S = indoor VOC generation rate	μg/m^3-min	Solved by Eq 6
VR = ventilation rate	l/min	13.8
Variables	**Units**	**Exposure Assumptions**
BW = body weight	kg	70
Ds = duration of shower	min	30
Dt = total duration in shower room	min	60
R = air exchange rate	min^{-1}	0.0083
Ca = indoor air concentration of VOCs	μg/m^3	Solved by Eq 7
Einh = inhalation exposure per shower	mg/kg/shower	Solved by Eq 8

Equation 1:	Kg(VOC) =	$3000 * (18 / HH)^{0.5}$	
Equation 2:	Kl(VOC) =	$20 * (44 / HH)^{0.5}$	
Equation 3:	KL =	$((1 / Kl(VOC)) + (0.024 / (Kg (VOC) * H)))^{-1}$	
Equation 4:	Kal =	$(KL * (((Tl * Us) / (Ts * Ul))^{-0.5}))$	
Equation 5:	Cwd =	(Cwo * (1-EXP((-1 * Kal * sdt)/(60 * d))))	
Equation 6:	S =	(Cwd * FR / SV)	
Equation 7:	see time series example on Table I-GW-5		
Equation 8:	Einh =	If t>Ds	(((VR * S) / (BW * R * 1000000)) * ((Ds + (EXP(-R * Dt) / R)-(EXP(R * (Ds - Dt))) / R)))

TABLE 7.2.CTE

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EXPOSURE

Site 2 - Allegany Ballistics Laboratory

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Alluvial Aquifer - Tap Water	Ingestion													
				Trichloroethene	1.3E+00	µg/L	NA	NA	NA	NA	NA	5.4E-05	mg/kg/day	6.0E-03	mg/kg/day	9.1E-03
				Vinyl chloride	6.1E-01	µg/L	NA	NA	NA	NA	NA	2.6E-05	mg/kg/day	3.0E-03	mg/kg/day	8.7E-03
				Antimony	3.4E+00	µg/L	NA	NA	NA	NA	NA	1.4E-04	mg/kg/day	4.0E-04	mg/kg/day	3.6E-01
				Iron	2.0E+03	µg/L	NA	NA	NA	NA	NA	8.5E-02	mg/kg/day	7.0E-01	mg/kg/day	1.2E-01
				Manganese	2.4E+02	µg/L	NA	NA	NA	NA	NA	1.0E-02	mg/kg/day	2.0E-02	mg/kg/day	5.1E-01
			Exp. Route Total								NA					1.0E+00
			Dermal	Trichloroethene	1.3E+00	µg/L	NA	NA	NA	NA	NA	5.2E-06	mg/kg/day	6.0E-03	mg/kg/day	8.7E-04
				Vinyl chloride	6.1E-01	µg/L	NA	NA	NA	NA	NA	7.5E-07	mg/kg/day	3.0E-03	mg/kg/day	2.5E-04
				Antimony	3.4E+00	µg/L	NA	NA	NA	NA	NA	3.1E-07	mg/kg/day	6.0E-05	mg/kg/day	5.2E-03
				Iron	2.0E+03	µg/L	NA	NA	NA	NA	NA	1.8E-04	mg/kg/day	7.0E-01	mg/kg/day	2.6E-04
				Manganese	2.4E+02	µg/L	NA	NA	NA	NA	NA	2.2E-05	mg/kg/day	8.0E-04	mg/kg/day	2.8E-02
			Exp. Route Total								NA					3.4E-02
		Exposure Point Total									NA					1.0E+00
	Exposure Medium Total										NA					1.0E+00
Groundwater Total											NA					1.0E+00
										Total of Receptor Risks Across All Media	NA	Total of Receptor Hazards Across All Media				1.0E+00

Notes-

NA = Not applicable.

DAevent for exposure to groundwater while bathing calculated on Table 7.2.CTE Supplement A .

Table 7.2.CTE Supplement A
Calculation of DAevent
Resident Child Alluvial Ground Water
Site 2 - Allegany Ballistics Laboratory

Chemical of Potential Concern	Water Concentration (CW) (µg/L)	Permeability Coefficient (Kp) (cm/hr)	B (dimensionless)	Lag Time (τ_{event}) (hr)	t* (hr)	Fraction Absorbed Water (FA) (dimensionless)	Duration of Event (tevent) (hr)	DAevent (mg/cm^2-event)	Eq
Trichloroethene	1.3E+00	1.2E-02	1.0E-01	5.8E-01	1.4E+00	1.0E+00	0.33	1.9E-08	2
Vinyl chloride	6.1E-01	5.6E-03	1.7E-02	2.4E-01	5.7E-01	1.0E+00	0.33	2.7E-09	2
Antimony	3.4E+00	1.0E-03	NA	NA	NA	NA	0.33	1.1E-09	1
Iron	2.0E+03	1.0E-03	NA	NA	NA	NA	0.33	6.5E-07	1
Manganese	2.4E+02	1.0E-03	NA	NA	NA	NA	0.33	7.8E-08	1

Inorganics: DAevent (mg/cm^2-event) =

Kp x CW x t_{event} x 0.001 mg/ug x 0.001 l/cm^3 (eq 1)

Organics: DAevent (mg/cm^2-event) =

If tevent<t*, then DAevent =

2 x FA x Kp x CW x (sqrt((6 x τ_{event} x t_{event})/π)) x 0.001 mg/ug x 0.001 l/cm^3 (eq 2)

If tevent>t*, then DAevent =

FA x Kp x CW x (t_{event}/(1+B) + 2 x τ_{event} x ((1 + 3xB + 3xB^2)/(1+B)^2) x 0.001 mg/ug x 0.001 l/cm^3 (eq 3)

Notes:

NA - Not applicable

Permeability constants from EPA 2004, *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment - Final).* EPA/540/R/99/005. The default value of 0.001 was assigned to inorganics not listed in this document.

B - Dimensionless ratio of the permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis (dimensionless).

t* - Time to reach steady-state

TABLE 7.3.CTE

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EXPOSURE

Site 2 - Allegany Ballistics Laboratory

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Alluvial Aquifer - Tap Water	Ingestion													
				Trichloroethene	1.3E+00	ug/L	6.8E-06	mg/kg/day	1.1E-02	1/mg/kg-day	7.4E-08	NA	NA	NA	NA	NA
				Vinyl chloride*	6.1E-01	ug/L	N/A	N/A	NA	N/A	3.2E-05	NA	NA	NA	NA	NA
				Antimony	3.4E+00	ug/L	1.8E-05	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Iron	2.0E+03	ug/L	1.1E-02	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Manganese	2.4E+02	ug/L	1.3E-03	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
			Exp. Route Total								3.2E-05					NA
			Dermal													
				Trichloroethene	1.3E+00	ug/L	1.4E-06	mg/kg/day	1.1E-02	1/mg/kg-day	1.5E-08	NA	NA	NA	NA	NA
				Vinyl chloride*	6.1E-01	ug/L	N/A	N/A	NA	N/A	9.2E-07	NA	NA	NA	NA	NA
				Antimony	3.4E+00	ug/L	7.5E-08	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Iron	2.0E+03	ug/L	4.4E-05	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Manganese	2.4E+02	ug/L	5.2E-06	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
			Exp. Route Total								9.4E-07					NA
		Exposure Point Total									3.3E-05					NA
	Air	Alluvial Aquifer - Water Vapors at Showerhead	Inhalation													
				Trichloroethene	1.3E+00	µg/L	6.2E-06	mg/kg/day	6.0E-03	1/mg/kg-day	3.7E-08	NA	NA	NA	NA	NA
				Vinyl chloride	6.1E-01	µg/L	4.2E-06	mg/kg/day	3.0E-02	1/mg/kg-day	1.3E-07	NA	NA	NA	NA	NA
			Exp. Route Total								1.6E-07					NA
		Exposure Point Total									1.6E-07					NA
	Exposure Medium Total										1.6E-07					NA
Groundwater Total											3.3E-05					NA
										Total of Receptor Risks Across All Media	3.3E-05			Total of Receptor Hazards Across All Media		NA

Notes-

NA = Not applicable.

DAevent for exposure to groundwater while bathing calculated on Tables 7.1.CTE Supplement A and 7.2.CTE Supplement A.

Inhalation of water vapors at showerhead calculated for adult resident only. Children assumed to bathe, not shower, and inhalation exposure would be lower.

* Vinyl chloride risks calculated following methodology in EPA Region III's *Derivation of Vinyl Chloride RBCs*, May 6, 2001.

TABLE 9.1.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Site 2 - Allegany Ballistics Laboratory

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Alluvial Aquifer - Tap Water										
			Trichloroethene	NA	NA	NA	0.0E+00	Liver, Kidney, Fetus	9.1E-03	NA	1.6E-03	1.1E-02
			Vinyl chloride	NA	NA	NA	0.0E+00	Liver	8.9E-03	NA	4.7E-04	9.3E-03
			Antimony	NA	NA	NA	0.0E+00	Blood	3.2E-01	NA	1.1E-02	3.3E-01
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	1.5E-01	NA	8.0E-04	1.5E-01
			Manganese	NA	NA	NA	0.0E+00	CNS	6.4E-01	NA	8.4E-02	7.3E-01
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		1.1E+00	0.0E+00	9.8E-02	1.2E+00
		Exposure Point Total					0.0E+00					1.2E+00
	Exposure Medium Total						0.0E+00					1.2E+00
	Air	Alluvial Aquifer - Water Vapors at Showerhead										
			Trichloroethene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Vinyl chloride	NA	NA	NA	0.0E+00	Liver	NA	1.0E-03	NA	1.0E-03
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	1.0E-03	0.0E+00	1.0E-03
		Exposure Point Total					0.0E+00					1.0E-03
	Exposure Medium Total						0.0E+00					1.2E+00
Receptor Total							0.0E+00				Receptor HI Total	1.2E+00

HI - Hazard Index

CNS - Central Nervous System

Total Liver HI Across All Media =	2.1E-02
Total Kidney HI Across All Media =	1.1E-02
Total Fetus HI Across All Media =	1.1E-02
Total Blood HI Across All Media =	3.3E-01
Total Gastrointestinal HI Across All Media =	1.5E-01
Total CNS HI Across All Media =	7.3E-01

TABLE 9.2.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Site 2 - Allegany Ballistics Laboratory

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Alluvial Aquifer - Tap Water										
			Trichloroethene	NA	NA	NA	0.0E+00	Liver, Kidney, Fetus	2.1E-02	NA	3.6E-03	2.5E-02
			Vinyl chloride	NA	NA	NA	0.0E+00	Liver	2.1E-02	NA	1.1E-03	2.2E-02
			Antimony	NA	NA	NA	0.0E+00	Blood	7.5E-01	NA	3.3E-02	7.8E-01
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	3.6E-01	NA	2.4E-03	3.6E-01
			Manganese	NA	NA	NA	0.0E+00	CNS	1.5E+00	NA	2.5E-01	1.8E+00
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		2.7E+00	0.0E+00	2.9E-01	2.9E+00
		Exposure Point Total					0.0E+00					2.9E+00
	Exposure Medium Total						0.0E+00					2.9E+00
Receptor Total							0.0E+00				Receptor HI Total	2.9E+00

HI - Hazard Index

CNS - Central Nervous System

Total Liver HI Across All Media =	4.7E-02
Total Kidney HI Across All Media =	2.5E-02
Total Fetus HI Across All Media =	2.5E-02
Total Blood HI Across All Media =	7.8E-01
Total Gastrointestinal HI Across All Media =	3.6E-01
Total CNS HI Across All Media =	1.8E+00

TABLE 9.3.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Site 2 - Allegany Ballistics Laboratory

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Alluvial Aquifer - Tap Water										
			Trichloroethene	3.3E-07	NA	5.6E-08	3.8E-07	Liver, Kidney, Fetus	NA	NA	NA	0.0E+00
			Vinyl chloride	5.7E-05	NA	3.1E-06	6.0E-05	Liver	NA	NA	NA	0.0E+00
			Antimony	NA	NA	NA	0.0E+00	Blood	NA	NA	NA	0.0E+00
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	NA	NA	NA	0.0E+00
			Manganese	NA	NA	NA	0.0E+00	CNS	NA	NA	NA	0.0E+00
			Chemical Total	5.7E-05	0.0E+00	3.1E-06	6.0E-05		0.0E+00	0.0E+00	0.0E+00	0.0E+00
		Exposure Point Total					6.0E-05					0.0E+00
	Exposure Medium Total						6.0E-05					0.0E+00
	Air	Alluvial Aquifer - Water Vapors at Showerhead										
			Trichloroethene	NA	8.7E-08	NA	8.7E-08	NA	NA	NA	NA	0.0E+00
			Vinyl chloride	NA	3.0E-07	NA	3.0E-07	Liver	NA	NA	NA	0.0E+00
			Chemical Total	0.0E+00	3.9E-07	0.0E+00	3.9E-07		0.0E+00	0.0E+00	0.0E+00	0.0E+00
		Exposure Point Total					3.9E-07					0.0E+00
	Exposure Medium Total						3.9E-07					0.0E+00
Receptor Total							6.1E-05				Receptor HI Total	0.0E+00

HI - Hazard Index

CNS - Central Nervous System

TABLE 9.4.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Site 2 - Allegany Ballistics Laboratory

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Alluvial Aquifer - Tap Water										
			Trichloroethene	NA	NA	9.0E-10	9.0E-10	Liver, Kidney, Fetus	NA	NA	9.5E-04	9.5E-04
			Vinyl chloride	NA	NA	1.3E-08	1.3E-08	Liver	NA	NA	4.2E-04	4.2E-04
			Aluminum	NA	NA	NA	0.0E+00	Neurological	NA	NA	1.7E-03	1.7E-03
			Chromium	NA	NA	NA	0.0E+00	Not identified	NA	NA	6.2E-03	6.2E-03
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	NA	NA	9.8E-03	9.8E-03
			Manganese	NA	NA	NA	0.0E+00	CNS	NA	NA	1.6E-01	1.6E-01
			Vanadium	NA	NA	NA	0.0E+00	Lifetime	NA	NA	1.7E-02	1.7E-02
			Chemical Total	0.0E+00	0.0E+00	1.4E-08	1.4E-08		0.0E+00	0.0E+00	2.0E-01	2.0E-01
		Exposure Point Total					1.4E-08					2.0E-01
	Exposure Medium Total						1.4E-08					2.0E-01
	Air	Alluvial Aquifer - Water Vapors at Showerhead										
			Trichloroethene	NA	1.5E-10	NA	1.5E-10	NA	NA	NA	NA	0.0E+00
			Vinyl chloride	NA	2.2E-10	NA	2.2E-10	Liver	NA	3.7E-05	NA	3.7E-05
			Chemical Total	0.0E+00	3.7E-10	0.0E+00	3.7E-10		0.0E+00	3.7E-05	0.0E+00	3.7E-05
		Exposure Point Total					3.7E-10					3.7E-05
	Exposure Medium Total						3.7E-10					2.0E-01
Receptor Total							1.4E-08				Receptor HI Total	2.0E-01

HI - Hazard Index

CNS - Central Nervous System

Total Liver HI Across All Media =	1.4E-03
Total Kidney HI Across All Media =	9.5E-04
Total Fetus HI Across All Media =	9.5E-04
Total Gastrointestinal HI Across All Media =	9.8E-03
Total CNS/Neurological HI Across All Media =	1.6E-01
Total Lifetime HI Across All Media =	1.7E-02

TABLE 9.5.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Site 2 - Allegany Ballistics Laboratory

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Bedrock Aquifer - Tap Water	Trichloroethene	NA	NA	NA	0.0E+00	Liver, Kidney, Fetus	5.0E-03	NA	8.7E-04	5.9E-03
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	5.1E-02	NA	2.7E-04	5.2E-02
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		5.6E-02	0.0E+00	1.1E-03	5.7E-02
		Exposure Point Total					0.0E+00					5.7E-02
	Exposure Medium Total						0.0E+00					5.7E-02
	Air	Bedrock Aquifer - Water Vapors at Showerhead	Trichloroethene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	0.0E+00	0.0E+00	0.0E+00
		Exposure Point Total					0.0E+00					0.0E+00
	Exposure Medium Total						0.0E+00					5.7E-02
Receptor Total							0.0E+00				Receptor HI Total	5.7E-02

HI - Hazard Index

CNS - Central Nervous System

Total Liver HI Across All Media =	5.9E-03
Total Kidney HI Across All Media =	5.9E-03
Total Fetus HI Across All Media =	5.9E-03
Total Gastrointestinal HI Across All Media =	5.2E-02

TABLE 9.6.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Site 2 - Allegany Ballistics Laboratory

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Bedrock Aquifer - Tap Water										
			Trichloroethene	NA	NA	NA	0.0E+00	Liver, Kidney, Fetus	1.2E-02	NA	2.0E-03	1.4E-02
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	1.2E-01	NA	7.9E-04	1.2E-01
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		1.3E-01	0.0E+00	2.7E-03	1.3E-01
		Exposure Point Total					0.0E+00					1.3E-01
	Exposure Medium Total						0.0E+00					1.3E-01
Receptor Total							0.0E+00				Receptor HI Total	1.3E-01

HI - Hazard Index

CNS - Central Nervous System

Total Liver HI Across All Media =	1.4E-02
Total Kidney HI Across All Media =	1.4E-02
Total Fetus HI Across All Media =	1.4E-02
Total Gastrointestinal HI Across All Media =	1.2E-01

TABLE 9.7.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Site 2 - Allegany Ballistics Laboratory

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Bedrock Aquifer - Tap Water	Trichloroethene	1.8E-07	NA	1.2E-08	1.9E-07	Liver, Kidney, Fetus	NA	NA	NA	0.0E+00
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	NA	NA	NA	0.0E+00
			Chemical Total	1.8E-07	0.0E+00	1.2E-08	1.9E-07		0.0E+00	0.0E+00	0.0E+00	0.0E+00
		Exposure Point Total					1.9E-07					0.0E+00
	Exposure Medium Total						1.9E-07					0.0E+00
	Air	Bedrock Aquifer - Water Vapors at Showerhead	Trichloroethene	NA	4.8E-08	NA	4.8E-08	NA	NA	NA	NA	0.0E+00
			Chemical Total	0.0E+00	4.8E-08	0.0E+00	4.8E-08		0.0E+00	0.0E+00	0.0E+00	0.0E+00
		Exposure Point Total					4.8E-08					0.0E+00
	Exposure Medium Total						4.8E-08					0.0E+00
Receptor Total							2.4E-07				Receptor HI Total	0.0E+00

HI - Hazard Index

TABLE 9.1.CTE

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

CENTRAL TENDENCY EXPOSURE

Site 2 - Allegany Ballistics Laboratory

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Alluvial Aquifer - Tap Water										
			Trichloroethene	NA	NA	NA	0.0E+00	Liver, Kidney, Fetus	2.7E-03	NA	4.4E-04	3.2E-03
			Vinyl chloride	NA	NA	NA	0.0E+00	Liver	2.6E-03	NA	1.3E-04	2.7E-03
			Antimony	NA	NA	NA	0.0E+00	Blood	1.1E-01	NA	2.3E-03	1.1E-01
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	3.6E-02	NA	1.2E-04	3.6E-02
			Manganese	NA	NA	NA	0.0E+00	CNS	1.5E-01	NA	1.2E-02	1.6E-01
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		3.0E-01	0.0E+00	1.5E-02	3.2E-01
		Exposure Point Total					0.0E+00					3.2E-01
	Exposure Medium Total						0.0E+00					3.2E-01
	Air	Alluvial Aquifer - Water Vapors at Showerhead										
			Trichloroethene	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Vinyl chloride	NA	NA	NA	0.0E+00	Liver	NA	4.4E-04	NA	4.4E-04
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	4.4E-04	0.0E+00	4.4E-04
		Exposure Point Total					0.0E+00					4.4E-04
	Exposure Medium Total						0.0E+00					3.2E-01
Receptor Total							0.0E+00				Receptor HI Total	3.2E-01

HI - Hazard Index

CNS - Central Nervous System

Total Liver HI Across All Media =	6.3E-03
Total Kidney HI Across All Media =	3.2E-03
Total Fetus HI Across All Media =	3.2E-03
Total Blood HI Across All Media =	1.1E-01
Total Gastrointestinal HI Across All Media =	3.6E-02
Total CNS HI Across All Media =	1.6E-01

TABLE 9.2.CTE

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

CENTRAL TENDENCY EXPOSURE

Site 2 - Allegany Ballistics Laboratory

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Alluvial Aquifer - Tap Water										
			Trichloroethene	NA	NA	NA	0.0E+00	Liver, Kidney, Fetus	9.1E-03	NA	8.7E-04	1.0E-02
			Vinyl chloride	NA	NA	NA	0.0E+00	Liver	8.7E-03	NA	2.5E-04	8.9E-03
			Antimony	NA	NA	NA	0.0E+00	Blood	3.6E-01	NA	5.2E-03	3.7E-01
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	1.2E-01	NA	2.6E-04	1.2E-01
			Manganese	NA	NA	NA	0.0E+00	CNS	5.1E-01	NA	2.8E-02	5.3E-01
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		1.0E+00	0.0E+00	3.4E-02	1.0E+00
		Exposure Point Total					0.0E+00					1.0E+00
	Exposure Medium Total						0.0E+00					1.0E+00
Receptor Total							0.0E+00				Receptor HI Total	1.0E+00

HI - Hazard Index

CNS - Central Nervous System

Total Liver HI Across All Media =	1.9E-02
Total Kidney HI Across All Media =	1.0E-02
Total Fetus HI Across All Media =	1.0E-02
Total Blood HI Across All Media =	3.7E-01
Total Gastrointestinal HI Across All Media =	1.2E-01
Total CNS HI Across All Media =	5.3E-01

TABLE 9.3.CTE

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

CENTRAL TENDENCY EXPOSURE

Site 2 - Allegany Ballistics Laboratory

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Alluvial Aquifer - Tap Water										
			Trichloroethene	7.4E-08	NA	1.5E-08	8.9E-08	Liver, Kidney, Fetus	NA	NA	NA	0.0E+00
			Vinyl chloride	3.2E-05	NA	9.2E-07	3.3E-05	Liver	NA	NA	NA	0.0E+00
			Antimony	NA	NA	NA	0.0E+00	Blood	NA	NA	NA	0.0E+00
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	NA	NA	NA	0.0E+00
			Manganese	NA	NA	NA	0.0E+00	CNS	NA	NA	NA	0.0E+00
			Chemical Total	3.2E-05	0.0E+00	9.4E-07	3.3E-05		0.0E+00	0.0E+00	0.0E+00	0.0E+00
		Exposure Point Total					3.3E-05					0.0E+00
	Exposure Medium Total						3.3E-05					0.0E+00
	Air	Alluvial Aquifer - Water Vapors at Showerhead										
			Trichloroethene	NA	3.7E-08	NA	3.7E-08	NA	NA	NA	NA	0.0E+00
			Vinyl chloride	NA	1.3E-07	NA	1.3E-07	Liver	NA	NA	NA	0.0E+00
			Chemical Total	0.0E+00	1.6E-07	0.0E+00	1.6E-07		0.0E+00	0.0E+00	0.0E+00	0.0E+00
		Exposure Point Total					1.6E-07					0.0E+00
	Exposure Medium Total						1.6E-07					0.0E+00
Receptor Total							3.3E-05				Receptor HI Total	0.0E+00

HI - Hazard Index

TABLE 10.1.RME
RISK ASSESSMENT SUMMARY
REASONABLE MAXIMUM EXPOSURE
Site 2 - Allegany Ballistics Laboratory

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Alluvial Aquifer - Tap Water										
			Antimony	NA	NA	NA	0.0E+00	Blood	3.2E-01	NA	1.1E-02	3.3E-01
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	1.5E-01	NA	8.0E-04	1.5E-01
			Manganese	NA	NA	NA	0.0E+00	CNS	6.4E-01	NA	8.4E-02	7.3E-01
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		1.1E+00	0.0E+00	9.6E-02	1.2E+00
		Exposure Point Total					0.0E+00					1.2E+00
	Exposure Medium Total						0.0E+00					1.2E+00
Receptor Total							0.0E+00				Receptor HI Total	1.2E+00

HI - Hazard Index
CNS - Central Nervous System

Total Blood HI Across All Media =	3.3E-01
Total Gastrointestinal HI Across All Media =	1.5E-01
Total CNS HI Across All Media =	7.3E-01

TABLE 10.2.RME
RISK ASSESSMENT SUMMARY
REASONABLE MAXIMUM EXPOSURE
Site 2 - Allegany Ballistics Laboratory

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Alluvial Aquifer - Tap Water										
			Antimony	NA	NA	NA	0.0E+00	Blood	7.5E-01	NA	3.3E-02	7.8E-01
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	3.6E-01	NA	2.4E-03	3.6E-01
			Manganese	NA	NA	NA	0.0E+00	CNS	1.5E+00	NA	2.5E-01	1.8E+00
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		2.6E+00	0.0E+00	2.8E-01	2.9E+00
		Exposure Point Total					0.0E+00					2.9E+00
	Exposure Medium Total						0.0E+00					2.9E+00
Receptor Total							0.0E+00				Receptor HI Total	2.9E+00

HI - Hazard Index
CNS - Central Nervous System

Total Blood HI Across All Media =	7.8E-01
Total Gastrointestinal HI Across All Media =	3.6E-01
Total CNS HI Across All Media =	1.8E+00

TABLE 10.3.RME
RISK ASSESSMENT SUMMARY
REASONABLE MAXIMUM EXPOSURE
Site 2 - Allegany Ballistics Laboratory

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Alluvial Aquifer - Tap Water	Vinyl chloride	5.7E-05	NA	3.1E-06	6.0E-05	Liver	NA	NA	NA	0.0E+00
			Chemical Total	5.7E-05	0.0E+00	3.1E-06	6.0E-05		0.0E+00	0.0E+00	0.0E+00	0.0E+00
		Exposure Point Total					6.0E-05					0.0E+00
	Exposure Medium Total						6.0E-05					0.0E+00
Receptor Total							6.0E-05				Receptor HI Total	0.0E+00

HI - Hazard Index

TABLE 10.1.CTE
RISK ASSESSMENT SUMMARY
CENTRAL TENDENCY EXPOSURE
Site 2 - Allegany Ballistics Laboratory

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Alluvial Aquifer - Tap Water										
			Antimony	NA	NA	NA	0.0E+00	Blood	1.1E-01	NA	2.3E-03	1.1E-01
			Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	0.0E+00	NA	0.0E+00	0.0E+00
			Manganese	NA	NA	NA	0.0E+00	CNS	1.5E-01	NA	1.2E-02	1.6E-01
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		2.6E-01	0.0E+00	1.5E-02	2.7E-01
		Exposure Point Total					0.0E+00					2.7E-01
	Exposure Medium Total						0.0E+00					2.7E-01
Receptor Total							0.0E+00				Receptor HI Total	2.7E-01

HI - Hazard Index
CNS - Central Nervous System

Total Blood HI Across All Media =	1.1E-01
Total Skin HI Across All Media =	0.0E+00
Total Vascular HI Across All Media =	0.0E+00
Total CNS HI Across All Media =	1.6E-01

TABLE 10.2.CTE
RISK ASSESSMENT SUMMARY
CENTRAL TENDENCY EXPOSURE
Site 2 - Allegany Ballistics Laboratory

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Alluvial Aquifer - Tap Water										
			Antimony	NA	NA	NA	0.0E+00	Blood	3.6E-01	NA	5.2E-03	3.7E-01
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	1.2E-01	NA	2.6E-04	1.2E-01
			Manganese	NA	NA	NA	0.0E+00	CNS	5.1E-01	NA	2.8E-02	5.3E-01
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		9.9E-01	0.0E+00	3.3E-02	1.0E+00
		Exposure Point Total					0.0E+00					1.0E+00
	Exposure Medium Total						0.0E+00					1.0E+00
Receptor Total							0.0E+00				Receptor HI Total	1.0E+00

HI - Hazard Index
CNS - Central Nervous System

Total Blood HI Across All Media =	3.7E-01
Total Gastrointestinal HI Across All Media =	1.2E-01
Total CNS HI Across All Media =	5.3E-01

TABLE 10.3.CTE
RISK ASSESSMENT SUMMARY
CENTRAL TENDENCY EXPOSURE
Site 2 - Allegany Ballistics Laboratory

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Alluvial Aquifer - Tap Water	Vinyl chloride	3.2E-05	NA	9.2E-07	3.3E-05	Liver	NA	NA	NA	0.0E+00
			Chemical Total	3.2E-05	0.0E+00	9.2E-07	3.3E-05		0.0E+00	0.0E+00	0.0E+00	0.0E+00
		Exposure Point Total					3.3E-05					0.0E+00
	Exposure Medium Total						3.3E-05					0.0E+00
Receptor Total							3.3E-05				Receptor HI Total	0.0E+00

HI - Hazard Index

Attachment 2
Raw Analytical Groundwater Data

Table 1
Raw Analytical Groundwater Data - April 2004
Human Health Risk Addendum - Site 2
Allegany Ballistics Laboratory

Station ID	2GW01	2GW02	2GW07	2GW08	2GW09
Sample ID	2GW01-0404	2GW02-0404	2GW07-0404	2GW08-0404	2GW09-0404
Sample Date	04/06/04	04/06/04	04/06/04	04/06/04	04/06/04
Chemical Name					
Volatile Organic Compounds (UG/L)					
1,1,1-Trichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2,2-Tetrachloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	28	6.6	7.3	0.8	1.7
1,1,2-Trichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1-Dichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1-Dichloroethene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2,3-Trichlorobenzene	0.5 U	0.5 U	0.5 U	0.86	0.5 U
1,2,4-Trichlorobenzene	0.5 U	0.5 U	0.5 U	0.48 J	0.5 U
1,2-Dibromo-3-chloropropane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dibromoethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dichloropropane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,3-Dichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,4-Dichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
2-Butanone	10 R	5 R	5 R	5 R	5 R
2-Hexanone	5 U	5 U	5 U	5 U	5 U
4-Methyl-2-pentanone	5 U	5 U	5 U	5 U	5 U
Acetone	10 R	5 R	5 R	5 R	3.7 B
Benzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Bromochloromethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Bromodichloromethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Bromoform	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Bromomethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Carbon disulfide	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Carbon tetrachloride	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chloroform	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chloromethane	0.48 B	0.52 B	0.47 B	0.48 B	0.47 B
Cyclohexane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Dibromochloromethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Dichlorodifluoromethane (Freon-12)	4.3	0.5 U	0.54	0.5 U	0.5 U
Ethylbenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Isopropylbenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Methyl acetate	1 R	0.5 R	0.5 R	0.5 R	0.5 R
Methyl-tert-butyl ether (MTBE)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Methylcyclohexane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Methylene chloride	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Styrene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Tetrachloroethene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Toluene	0.5 U	0.5 U	0.54	0.59	0.5 U
Trichloroethene	0.55	2	1.1	2.9	2.3
Trichlorofluoromethane(Freon-11)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Vinyl chloride	0.97	0.5 U	0.5 U	0.5 U	0.5 U
Xylene, total	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
cis-1,2-Dichloroethene	0.39 J	0.5 U	0.5 U	1.5	1.4
cis-1,3-Dichloropropene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
trans-1,2-Dichloroethene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U

Table 1
Raw Analytical Groundwater Data - April 2004
Human Health Risk Addendum - Site 2
Allegany Ballistics Laboratory

Station ID	2GW01	2GW02	2GW07	2GW08	2GW09
Sample ID	2GW01-0404	2GW02-0404	2GW07-0404	2GW08-0404	2GW09-0404
Sample Date	04/06/04	04/06/04	04/06/04	04/06/04	04/06/04
Chemical Name					
trans-1,3-Dichloropropene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Semi-volatile Organic Compounds (UG/L)					
1,1-Biphenyl	5.3 U	5 U	5 U	5.1 U	5.2 U
1,2,4,5-Tetrachlorobenzene	5.3 U	5 U	5 U	5.1 U	5.2 U
2,2'-Oxybis(1-chloropropane)	5.3 U	5 U	5 U	5.1 U	5.2 U
2,4,5-Trichlorophenol	21 U	20 U	20 U	20 U	21 U
2,4,6-Trichlorophenol	5.3 U	5 U	5 U	5.1 U	5.2 U
2,4-Dichlorophenol	5.3 U	5 U	5 U	5.1 U	5.2 U
2,4-Dimethylphenol	5.3 U	5 U	5 U	5.1 U	5.2 U
2,4-Dinitrophenol	21 U	20 U	20 U	20 U	21 U
2,4-Dinitrotoluene	5.3 U	5 U	5 U	5.1 U	5.2 U
2,6-Dinitrotoluene	5.3 U	5 U	5 U	5.1 U	5.2 U
2-Chloronaphthalene	5.3 U	5 U	5 U	5.1 U	5.2 U
2-Chlorophenol	5.3 U	5 U	5 U	5.1 U	5.2 U
2-Methylnaphthalene	5.3 U	5 U	5 U	5.1 U	5.2 U
2-Methylphenol	5.3 U	5 U	5 U	5.1 U	5.2 U
2-Nitroaniline	21 U	20 U	20 U	20 U	21 U
2-Nitrophenol	5.3 U	5 U	5 U	5.1 U	5.2 U
3,3'-Dichlorobenzidine	5.3 U	5 U	5 U	5.1 U	5.2 U
3-Nitroaniline	21 U	20 U	20 U	20 U	21 U
4,6-Dinitro-2-methylphenol	21 U	20 U	20 U	20 U	21 U
4-Bromophenyl-phenylether	5.3 U	5 U	5 U	5.1 U	5.2 U
4-Chloro-3-methylphenol	5.3 U	5 U	5 U	5.1 U	5.2 U
4-Chloroaniline	5.3 U	5 U	5 U	5.1 U	5.2 U
4-Chlorophenyl-phenylether	5.3 U	5 U	5 U	5.1 U	5.2 U
4-Methylphenol	5.3 U	5 U	5 U	5.1 U	5.2 U
4-Nitroaniline	21 U	20 U	20 U	20 U	21 U
4-Nitrophenol	21 U	20 U	20 U	20 U	21 U
Acenaphthene	5.3 U	5 U	5 U	5.1 U	5.2 U
Acenaphthylene	5.3 U	5 U	5 U	5.1 U	5.2 U
Acetophenone	5.3 U	5 U	5 U	5.1 U	5.2 U
Anthracene	5.3 U	5 U	5 U	5.1 U	5.2 U
Atrazine	5.3 U	5 U	5 U	5.1 U	5.2 U
Benzaldehyde	5.3 UJ	5 UJ	5 UJ	5.1 UJ	5.2 UJ
Benzo(a)anthracene	5.3 U	5 U	5 U	5.1 U	5.2 U
Benzo(a)pyrene	5.3 U	5 U	5 U	5.1 U	5.2 U
Benzo(b)fluoranthene	5.3 U	5 U	5 U	5.1 U	5.2 U
Benzo(g,h,i)perylene	5.3 U	5 U	5 U	5.1 U	5.2 U
Benzo(k)fluoranthene	5.3 U	5 U	5 U	5.1 U	5.2 U
Butylbenzylphthalate	5.3 U	5 U	5 U	5.1 U	5.2 U
Caprolactam	5.3 U	5 U	5 U	5.1 U	5.2 U
Chrysene	5.3 U	5 U	5 U	5.1 U	5.2 U
Di-n-butylphthalate	5.3 U	5 U	5 U	5.1 U	5.2 U
Di-n-octylphthalate	5.3 U	5 U	5 U	5.1 U	5.2 U
Dibenz(a,h)anthracene	5.3 U	5 U	5 U	5.1 U	5.2 U
Dibenzofuran	5.3 U	5 U	5 U	5.1 U	5.2 U
Diethylphthalate	5.3 U	5 U	5 U	5.1 U	5.2 U
Dimethyl phthalate	5.3 U	5 U	5 U	5.1 U	5.2 U
Fluoranthene	5.3 U	5 U	5 U	5.1 U	5.2 U
Fluorene	5.3 U	5 U	5 U	5.1 U	5.2 U

Table 1
Raw Analytical Groundwater Data - April 2004
Human Health Risk Addendum - Site 2
Allegany Ballistics Laboratory

Station ID	2GW01	2GW02	2GW07	2GW08	2GW09
Sample ID	2GW01-0404	2GW02-0404	2GW07-0404	2GW08-0404	2GW09-0404
Sample Date	04/06/04	04/06/04	04/06/04	04/06/04	04/06/04
Chemical Name					
Hexachlorobenzene	5.3 U	5 U	5 U	5.1 U	5.2 U
Hexachlorobutadiene	5.3 U	5 U	5 U	5.1 U	5.2 U
Hexachlorocyclopentadiene	5.3 U	5 U	5 U	5.1 U	5.2 U
Hexachloroethane	5.3 U	5 U	5 U	5.1 U	5.2 U
Indeno(1,2,3-cd)pyrene	5.3 U	5 U	5 U	5.1 U	5.2 U
Isophorone	5.3 U	5 U	5 U	5.1 U	5.2 U
Naphthalene	5.3 U	5 U	5 U	5.1 U	5.2 U
Nitrobenzene	5.3 U	5 U	5 U	5.1 U	5.2 U
Pentachlorophenol	5.3 U	5 U	5 U	5.1 U	5.2 U
Phenanthrene	5.3 U	5 U	5 U	5.1 U	5.2 U
Phenol	5.3 U	5 U	5 U	5.1 U	5.2 U
Pyrene	5.3 U	5 U	5 U	5.1 U	5.2 U
bis(2-Chloroethoxy)methane	5.3 U	5 U	5 U	5.1 U	5.2 U
bis(2-Chloroethyl)ether	5.3 U	5 U	5 U	5.1 U	5.2 U
bis(2-Ethylhexyl)phthalate	5.3 U	5 U	5 U	3.2 B	5.2 U
n-Nitroso-di-n-propylamine	5.3 U	5 U	5 U	5.1 U	5.2 U
n-Nitrosodiphenylamine	5.3 U	5 U	5 U	5.1 U	5.2 U
Explosives (UG/L)					
1,3,5-Trinitrobenzene	0.26 U	0.26 U	0.26 U	0.26 U	NA
1,3-Dinitrobenzene	0.26 U	0.26 U	0.26 U	0.26 U	NA
2,4,6-Trinitrotoluene	0.26 U	0.26 U	0.26 U	0.26 U	NA
2,4-Dinitrotoluene	0.26 U	0.26 U	0.26 U	0.26 U	NA
2,6-Dinitrotoluene	0.26 U	0.26 U	0.26 U	0.26 U	NA
2-Amino-4,6-dinitrotoluene	0.26 U	0.26 U	0.26 U	0.26 U	NA
2-Nitrotoluene	0.52 U	0.52 U	0.52 U	0.52 U	NA
3-Nitrotoluene	0.52 U	0.52 U	0.52 U	0.52 U	NA
4-Amino-2,6-dinitrotoluene	0.26 U	0.26 U	0.26 U	0.26 U	NA
4-Nitrotoluene	0.52 U	0.52 U	0.52 U	0.52 U	NA
HMX	0.52 U	0.52 U	0.52 U	0.52 U	NA
Nitrobenzene	0.26 U	0.26 U	0.26 U	0.26 U	NA
Nitroglycerin	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U
Perchlorate	1 U	1.8	1 U	1 U	1 U
RDX	0.52 U	0.52 U	0.52 U	0.52 U	NA
Tetryl	0.52 UL	0.52 UL	0.52 UL	0.52 UL	NA
Total Metals (UG/L)					
Aluminum	7,630 K	1,590 K	55.7 B	28,200 K	2,840 K
Antimony	4.1 U	4.1 U	4.1 U	5 J	4.1 U
Arsenic	409	3.4 U	3.4 U	31.9	3.4 U
Barium	362	101 J	509	462	191 J
Beryllium	0.55 B	0.1 U	0.1 U	1.3 J	0.1 U
Cadmium	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U
Calcium	58,900	51,600	45,900	61,700	60,000
Chromium	9.2 J	14	0.91 B	50.8	10.4
Cobalt	2.9 B	1.5 B	1.1 B	19.7 J	2.2 B
Copper	9.1 B	7.1 B	2.7 B	34	6 B
Iron	30,600	2,370	1,310	44,800	3,440
Lead	6.1	18.7	1.7 U	21.1	1.7 U
Magnesium	15,600	9,310 K	13,500	13,500	9,240 K
Manganese	573	135	68.2	2,570	2,210

Table 1
Raw Analytical Groundwater Data - April 2004
Human Health Risk Addendum - Site 2
Allegany Ballistics Laboratory

Station ID	2GW01	2GW02	2GW07	2GW08	2GW09
Sample ID	2GW01-0404	2GW02-0404	2GW07-0404	2GW08-0404	2GW09-0404
Sample Date	04/06/04	04/06/04	04/06/04	04/06/04	04/06/04
Chemical Name					
Mercury	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Nickel	8.2 J	11.6 J	1.3 U	48.6	8.6 J
Potassium	3,190 J	1,400 J	2,450 J	6,850	1,730 J
Selenium	2.7 J	2.3 U	2.3 U	2.3 U	2.3 U
Silver	0.9 U	0.9 U	0.9 U	0.9 U	0.9 U
Sodium	16,000	13,700	38,400	12,500	20,500
Thallium	4.1 U	4.1 U	4.1 U	5.3 J	4.1 U
Vanadium	14 J	3.2 J	1.2 U	51.2	4.8 J
Zinc	22.9 K	14.7 J	1.8 B	102	10.7 J
Dissolved Metals (UG/L)					
Aluminum	61 B	79.9 B	42 B	456 B	152 B
Antimony	4.1 U	4.7 J	4.1 U	4.1 U	4.1 U
Arsenic	32.3	3.4 U	3.4 U	3.4 U	4.3 J
Barium	272	85.2 J	496	191 J	160 J
Beryllium	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Cadmium	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U
Calcium	57,700	50,800	44,700	60,500	57,700
Chromium	0.7 U	2.2 B	0.7 U	0.7 U	0.7 U
Cobalt	0.9 U	1 B	0.9 U	2.7 B	1.5 B
Copper	1.1 B	4 B	7.9 B	3.2 B	3.4 B
Iron	3,920	98.1 B	993	573	1,020
Lead	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U
Magnesium	14,700	9,000 K	13,200	10,200	8,870 K
Manganese	470	7.2 B	64.5	1,430	2,180
Mercury	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Nickel	1.3 U	3.6 J	1.3 U	3.1 J	2.3 J
Potassium	1,480 J	1,000 J	2,400 J	1,220 J	1,050 J
Selenium	2.3 U	2.4 J	2.3 U	2.3 U	2.3 U
Silver	0.9 U	0.9 U	0.9 U	0.9 U	0.9 U
Sodium	16,100	13,400	37,500	12,500	19,400
Thallium	4.1 U	4.1 U	4.1 U	4.1 U	4.1 U
Vanadium	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U
Zinc	0.86 B	7.6 J	1.8 B	6.2 J	4.1 B

Notes:
NA - Not analyzed
U - Analyte not detected
J - Result may be estimated
B - Possible blank contamination
R - Unreliable result
K - Reported value may be biased high
UJ - Analyte not detected, result may be estimated
UL - Analyte not detected, quantitation limit is probably higher

Table 2
Detected Analytical Groundwater Data - April 2004
Human Health Risk Assessment Addendum - Site 2
Allegany Ballistics Laboratory

Station ID	2GW01	2GW02	2GW07	2GW08	2GW09
Sample ID	2GW01-0404	2GW02-0404	2GW07-0404	2GW08-0404	2GW09-0404
Sample Date	04/06/04	04/06/04	04/06/04	04/06/04	04/06/04
Chemical Name					
Volatile Organic Compounds (UG/L)					
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	28	6.6	7.3	0.8	1.7
1,2,3-Trichlorobenzene	0.5 U	0.5 U	0.5 U	0.86	0.5 U
1,2,4-Trichlorobenzene	0.5 U	0.5 U	0.5 U	0.48 J	0.5 U
Dichlorodifluoromethane (Freon-12)	4.3	0.5 U	0.54	0.5 U	0.5 U
Toluene	0.5 U	0.5 U	0.54	0.59	0.5 U
Trichloroethene	0.55	2	1.1	2.9	2.3
Vinyl chloride	0.97	0.5 U	0.5 U	0.5 U	0.5 U
cis-1,2-Dichloroethene	0.39 J	0.5 U	0.5 U	1.5	1.4
Explosives (UG/L)					
Perchlorate	1 U	1.8	1 U	1 U	1 U
Total Metals (UG/L)					
Aluminum	7,630 K	1,590 K	55.7 B	28,200 K	2,840 K
Antimony	4.1 U	4.1 U	4.1 U	5 J	4.1 U
Arsenic	409	3.4 U	3.4 U	31.9	3.4 U
Barium	362	101 J	509	462	191 J
Beryllium	0.55 B	0.1 U	0.1 U	1.3 J	0.1 U
Calcium	58,900	51,600	45,900	61,700	60,000
Chromium	9.2 J	14	0.91 B	50.8	10.4
Cobalt	2.9 B	1.5 B	1.1 B	19.7 J	2.2 B
Copper	9.1 B	7.1 B	2.7 B	34	6 B
Iron	30,600	2,370	1,310	44,800	3,440
Lead	6.1	18.7	1.7 U	21.1	1.7 U
Magnesium	15,600	9,310 K	13,500	13,500	9,240 K
Manganese	573	135	68.2	2,570	2,210
Nickel	8.2 J	11.6 J	1.3 U	48.6	8.6 J
Potassium	3,190 J	1,400 J	2,450 J	6,850	1,730 J
Selenium	2.7 J	2.3 U	2.3 U	2.3 U	2.3 U
Sodium	16,000	13,700	38,400	12,500	20,500
Thallium	4.1 U	4.1 U	4.1 U	5.3 J	4.1 U
Vanadium	14 J	3.2 J	1.2 U	51.2	4.8 J
Zinc	22.9 K	14.7 J	1.8 B	102	10.7 J
Dissolved Metals (UG/L)					
Antimony	4.1 U	4.7 J	4.1 U	4.1 U	4.1 U
Arsenic	32.3	3.4 U	3.4 U	3.4 U	4.3 J
Barium	272	85.2 J	496	191 J	160 J
Calcium	57,700	50,800	44,700	60,500	57,700
Iron	3,920	98.1 B	993	573	1,020
Magnesium	14,700	9,000 K	13,200	10,200	8,870 K
Manganese	470	7.2 B	64.5	1,430	2,180
Nickel	1.3 U	3.6 J	1.3 U	3.1 J	2.3 J
Potassium	1,480 J	1,000 J	2,400 J	1,220 J	1,050 J
Selenium	2.3 U	2.4 J	2.3 U	2.3 U	2.3 U
Sodium	16,100	13,400	37,500	12,500	19,400
Zinc	0.86 B	7.6 J	1.8 B	6.2 J	4.1 B

Notes:
U - Analyte not detected
J - Result may be estimated
B - Possible blank contamination
R - Unreliable result
K - Reported value may be biased high
UJ - Analyte not detected, result may be estimated
UL - Analyte not detected, quantitation limit is probably higher
Shading represents detect

Table 3
Raw Analytical Groundwater Data - June 2008
Human Health Risk Addendum - Site 2
Allegany Ballistics Laboratory

Station ID	2GW02	2GW10	2GW11		ABL-QC	
Sample ID	AS02-2GW02-0608	AS02-2GW10-0608	AS02-2GW11-0608	AS02-2GW11P-0608	AS02-EB060708	AS02-FB060708
Sample Date	06/07/08	06/07/08	06/07/08	06/07/08	06/07/08	06/07/08
Chemical Name						
Total Metals (UG/L)						
Arsenic	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U
Dissolved Metals (UG/L)						
Arsenic	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U	NA

Notes:

NA - Not analyzed
U - The material was analyed for, but not detected
UG/L - Micrograms per liter