SOILS RISK ASSESSMENT
FORMER YORK NAVAL ORDNANCE PLANT
1425 EDEN ROAD
YORK, PA 17402

Prepared for:

Harley-Davidson Motor Company
Operations, Inc.
York, PA

March 2012

Prepared by:

Groundwater Sciences Corporation

2601 Market Place Street, Suite 310
Harrisburg, PA 17110-9340

560 Route 52, Suite 202
Beacon, NY 12508-1248

1108 Vestal Parkway East, Suite 2
Vestal, NY 13850-1750

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Reviewed by:

Stephen M. Snyder
Senior Associate

Kathy Zvarick
Senior Project Manager

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List of Acronyms

95% UCL	95% Upper Confidence Limit of the Mean Concentration
ABS	Dermal absorption fraction
Act 2	PADEP's Land Recycling and Environmental Remediation Standards Act
$ADAF_{6-16}$	Age-dependent adjustment factor for adolescents aged 6 to 16 years
$ADAF_{16-17}$	Age-dependent adjustment factor for adolescents aged 16 to 17 years
ADF_{adj}	Age-adjusted dermal factor
AED	Age-adjusted exposure duration
AFs	Gastrointestinal absorption fraction
AH	Soil adherence factor
AH_a	Adherence factor for adolescents aged 16 to 17 years
AH_c	Adherence factor for adolescents aged 6 to 16 years
AIF_{adj}	Age-adjusted ingestion factor
ALM	Adult Lead Methodology
AMF	American Machine and Foundry Company
AT	Averaging Time
AT_c	Carcinogenic Averaging Time
AT_n	Noncarcinogenic Averaging Time
bgs	below ground surface
BKSF	Biokinetic slope factor
BW	Body weight
BW_{16-17}	Body weight for adolescents aged 16 to 17 years
BW_{6-16}	Body weight for adolescents aged 6 to 16 years
CF	Conversion factor
COCs	Chemicals of Concern
COPCs	Constituents of Potential Concern
Cs	Constituent concentration in soil
CSF	Cancer Slope Factor
CSM	Conceptual Site Model
DLs	Detection Limits
ED	Exposure duration
ED_{6-16}	Exposure duration for adolescents aged 6 to 16 years
ED_{16-17}	Exposure duration for adolescents aged 16 to 17 years
EF	Exposure frequency
EI	Environmental Indicator
ET	Exposure time
fYNOP	Former York Naval Ordnance Plant
GI	Gastrointestinal
GSD_i	Geometric standard deviation
HHRA	Human Health Risk Assessment
HI	Hazard Index
HQ	Hazard Quotient
IEUBK	Integrated Exposure Uptake Biokinetic
IngR	Soil ingestion rate
$IngR_c$	Soil ingestion rate for adolescents aged 6 to 16 years

List of Acronyms, continued

$IngR_a$	Soil ingestion rate for adolescents aged 16 to 17 years
IRs	Soil intake rate
IRIS	Integrated Risk Information System
IUR	Inhalation Unit Risk
Langan	Langan Engineering and Environmental Services
MSCs	Medium-Specific Concentrations
NIR	Notification of intent to remediate
NPBA	North Property Boundary Area
PADEP	Pennsylvania Department of Environmental Protection
PAHs	Polycyclic Aromatic Hydrocarbons
$PbB_{adult,0}$	Typical blood lead concentration
$PbB_{adult,central}$	Central estimate of blood lead concentrations
PbS	Soil lead concentration
PCBs	Polychlorinated Biphenyls
PEF	Particulate Emission Factor
$R_{fetal/maternal}$	Constant of proportionality between fetal blood lead concentration at birth and maternal blood lead concentration
RfC	Reference Concentration
RfDs	Reference Doses
RI	Remedial Investigation
RLs	Reporting Limits
RSLs	Regional Screening Levels
SA	Skin surface area available for exposure
SA_a	Skin surface area available for exposure for adolescents aged 16 to 17 years
SA_c	Skin surface area available for exposure for adolescents aged 6 to 16 years
SAIC	Science Applications International Corporation
SPBA	South Property Boundary Area
SVOCs	Semivolatile Organic Compounds
TDS	Total dissolved solids
TF	Transport factor
USEPA	United States Environmental Protection Agency
VF	Volatilization Factor
VOCs	Volatile Organic Compounds
YCIDA	York County Industrial Development Authority
YNOP	York Naval Ordnance Plant

EXECUTIVE SUMMARY

A human health risk assessment was developed for soil at the former York Naval Ordnance Plant (fYNOP) located in York, Pennsylvania. The fYNOP property is currently owned by Harley-Davidson Motor Company Operations, Inc. (Harley-Davidson) and is being used as motorcycle manufacturing facility. Harley-Davidson is seeking relief from liability for soil at the site using Pennsylvania's Land Recycling Program (Act 2) and associated Chapter 250 regulations pertaining to the Statewide Health and Site-Specific Standards.

The western portion of the fYNOP property (West Campus) has been subdivided and is in the process of being sold to the York County Industrial Development Authority (YCIDA). Both the West Campus and the remaining eastern portion of the property (East Campus) will be subject to an environmental covenant restricting future land use to commercial and/or industrial purposes.

As a result of historical operations, residual levels of both inorganic and organic regulated substances have been detected in soil at the site. A conceptual site model concluded that potential current and future receptors on both the East Campus and West Campus included maintenance workers exposed to surface soils, construction workers exposed to surface and subsurface soils, and adolescent trespassers exposed to surface soils. East and West Campus exposures were also combined to assess hazards and risks to potential receptors under current site conditions prior to the West Campus divestiture.

Using a combination of Pennsylvania Department of Environmental Protection (PADEP) Medium-Specific Concentrations (MSCs) and United States Environmental Protection Agency (USEPA) Regional Screening Levels (RSLs), data were screened to identify the Constituents of Potential Concern (COPCs) to be carried through the quantitative risk assessment process.

Additionally, detected concentrations of COPCs were screened for the presence of "hot spots" of impacted soils. Some hot spots were identified when screened using values of 100 times the USEPA RSLs, however, no hot spots were determined to be present on the property when data were screened against values of 10 times MSCs. Since the hot spots were not located in areas that may receive high traffic relative to other areas of the site, no additional risk evaluation of the hot spot areas was necessary. Exposures to hot spots were evaluated by incorporating hot spot data into the

exposure-point concentration calculations; therefore, the hazards and risks calculated reflect exposures to hot spots as well as other areas of the site.

The risk assessment yielded noncarcinogenic hazards below PADEP's benchmark hazard index of 1.0 and potential carcinogenic risks that did not exceed PADEP's maximum acceptable cumulative risk for the scenarios evaluated in this assessment, including the East Campus and West Campuses individually and combined. Additionally, modeled exposures to lead in soils resulted in calculated blood lead concentrations that were below USEPA's acceptable level. According to the assumptions and methodologies employed herein, there were no unacceptable exposures to soil at the site under current or future land use assumptions, and this risk assessment demonstrates attainment of the site-specific standard for soils for those COPCs evaluated herein. If, at any time, the fYNOP property is used for purposes other than commercial/industrial applications (*e.g.,* residential, recreational), or additional impacts to soil are discovered, or impervious surfaces are breached or removed, a revised risk assessment and/or remediation may be necessary.

1 INTRODUCTION

The former York Naval Ordnance Plant (fYNOP) is located in Springettsbury Township in York County, Pennsylvania, and is currently an active motorcycle manufacturing facility situated on approximately 230 acres. The Site is bordered on the south by Route 30 and residential properties; on the west by Eden Road, a railroad line, and Codorus Creek; and on the east and north by residential properties. A Site location map is provided on Figure 1. The York facility was constructed in 1941 by the York Safe and Lock Company, a United States government contractor, for the manufacture, assembly, and testing of 40-millimeter (mm) twin and quadruple gun mounts, complete with guns. In 1944, the U.S. government took possession of the York facility and owned and operated the property as the York Naval Ordnance Plant (YNOP) until 1964, switching operations after World War II to overhaul war service weapons; make rocket launchers; and manufacture 3-inch/50-caliber guns, 20-mm aircraft guns, and power drive units for 5-inch/54-caliber guns. In 1964, the U.S. government sold the York facility to American Machine and Foundry Company (AMF), who continued similar manufacturing. In 1969, Harley-Davidson Motor Company (Harley-Davidson) merged with AMF, a long-time producer of leisure products and, in 1973, Harley-Davidson moved its motorcycle manufacturing operations to the Site. On February 26, 1981, thirteen Harley-Davidson senior executives signed a letter of intent to purchase Harley-Davidson Motor Company from AMF. By mid-June 1981, the buy-back was official. Harley-Davidson has continued motorcycle manufacturing operations at the York facility since that time.

Spills, leakage, and disposal of materials and wastes associated with metal degreasing, painting, and plating operations resulted in the distribution of the primary chemicals of concern (COCs) in soil (SAIC, 2010). Accordingly, Harley-Davidson is pursuing relief from liability for soil at the Site under PADEP's Land Recycling and Environmental Remediation Standards Act (Act 2) and the associated Chapter 250 regulations. In order for Harley-Davidson to receive relief from liability, the Site data and an analysis of these data must demonstrate compliance with one or a combination of the three cleanup standards established in Act 2. This demonstration must be performed following procedures and methods published in the Title 25 PA Code Chapter 250 regulations promulgated by the PADEP to administer the Land Recycling Program. As such, Harley-Davidson has submitted a notification of intent to remediate (NIR) that calls for attaining a combination of two of the three standards established in Act 2 for exposures to contaminated soil: the statewide health standard and the site specific standard.

This human health risk assessment (HHRA) was conducted following PADEP's regulations and guidance to:

1. Identify regulated substances present as a result of releases to soil at this Site;
2. Determine the constituents of potential concern (COPCs) by screening out those substances that meet the statewide health standard or are present only at de minimis levels;
3. Perform a site-specific risk assessment to estimate the potential human health hazards and risks associated with hypothetical exposure to the COPCs in soil at the fYNOP property, and
4. Compare the results of that risk assessment to the Act 2 risk-based standards to demonstrate attainment of the site specific standards for soil.

This risk assessment has been prepared in accordance with the requirements of the Pennsylvania Land Recycling and Environmental Remediation Standards Act (Act 2, 1997) and the regulations promulgated by the PADEP under Title 25 PA Code Chapter 250, and is consistent with United States Environmental Protection Agency (USEPA) risk assessment guidance documents, including *Risk Assessment Guidance for Superfund: Volume 1, Human Health Evaluation Manual, (Part A)* (USEPA, 1989).

A risk assessment for human exposures typically includes the following components [Chapter 250 §250.602 (c) (1) – (4)]:

(1) Data collection, including source characterization and development of a conceptual site model, and evaluation to identify constituents of potential concern.

(2) Exposure assessment that considers dermal, ingestion, and inhalation pathways and exposure assumptions based on patterns of land use.

(3) Toxicity assessment that includes the use of toxicity information from sources identified in Chapter 250 §250.605 (relating to sources of toxicity information).

(4) Risk characterization that compares the site specific risks to the human health protection goals specified in Chapter 250 §250.402 (relating to human health and environmental protection goals).

The following sections of this report address each of these components individually. In addition, a characterization of the uncertainty associated with the quantitative assessment of risk estimates is discussed in accordance with §250.602(f) of the Act 2 Regulations.

2 CONCEPTUAL SITE MODEL

A conceptual site model (CSM) identifies potential sources and types of contaminants, affected media, current and potential future receptors, and potential exposure pathways. The CSM is used as the foundation on which risk assessment exposure models and assumptions are based. Current and known land use or reasonable potential future land use plays a significant role in the development of the CSM. Land use must be determined before receptor populations can be identified.

The fYNOP site is currently zoned industrial and Harley-Davidson currently operates a motorcycle manufacturing facility on the property. Future use of the site will remain commercial/industrial in accordance with an activity and use limitation placed on the property as part of the Buyer-Seller Agreement dated July 22, 2010 executed between Harley-Davidson and the York County Industrial Development Authority (YCIDA). Under these land-use conditions, current and future on-site maintenance workers (assessed as full-time employees), current and future on-site construction workers, and adolescent trespassers were identified as potential receptors for the site. Given the land-use restrictions in place on the property, residential exposures to soil were not assessed.

Existing buildings and parking lots serve to preclude exposures to underlying surface and subsurface soils thereby rendering associated soil exposure pathways in those areas incomplete. Data collected from beneath buildings and parking lots were, therefore, excluded from this assessment. In the future, should buildings (building slabs) and/or parking lots be removed and underlying impacted soils exposed, an additional risk assessment and/or exposure mitigation measures may be necessary.

On behalf of Harley-Davidson, Langan Engineering and Environmental Services (Langan) has conducted focused evaluations of the fYNOP property for purposes of determining the potential for vapor intrusion to occur both on-site and off-site. These vapor intrusion evaluations have occurred in several phases starting in 2003. While Langan's efforts were focused on groundwater, soil vapor data is applicable to both groundwater and soil vapor intrusion.

In October 2003, Langan collected soil vapor analytical data to determine whether or not the vapor intrusion pathway posed an unacceptable risk to human health at the site as part of a screening assessment (Langan, 2006). Langan's screening assessment followed the USEPA's Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (USEPA,

2002a) and the October 2003 Indoor Vapor Pathway Screening Assessment Workplan that was reviewed and approved by USEPA (Langan, 2006). In a two-phase investigation, Langan conducted soil vapor sampling and analysis to assess the potential vapor intrusion pathway via USEPA's Tier II and Tier III screening process (Langan, 2006). Langan then used the Johnson & Ettinger (1991) model for Subsurface Vapor Intrusion into Buildings to predict indoor air concentrations for inhabited buildings on-site and immediately off-site near the North Property Boundary Area (NPBA) and South Property Boundary Area (SPBA) (Langan, 2006). Based on the soil vapor analytical data and the soil vapor model predictions described in the Indoor Vapor Pathway Screening Assessment, Supplemental RI Report (Langan, 2005), the vapor pathway was not complete and there was no on-site or off-site risk to human health via the vapor intrusion pathway at that time (Langan, 2006). In 2005, USEPA issued a "Yes" determination (indicating that exposures are under control) for the Human Health Environmental Indicator (EI) form that takes into account the vapor intrusion pathway. Despite this determination, in response to Langan's efforts, the USEPA provided several comment letters regarding the vapor intrusion assessment. Langan has addressed USEPA's comments and the conclusions of the vapor intrusion assessment have not substantially changed. Accordingly, vapor intrusion was not considered a complete exposure pathway for this assessment and indoor air vapor intrusion exposures were not evaluated for indoor workers at the property. In the future, should new buildings be constructed on the property or the land use changes, additional investigations and/or risk evaluations of vapor intrusion exposures may be necessary and the conclusions of this vapor intrusion assessment may change.

The fYNOP campus has been subdivided into two parcels, East Campus (172 acres) and West Campus (58 acres), and the West Campus has been sold and is being transferred to the YCIDA. While future use of the West Campus will remain commercial/industrial (in accordance with environmental covenants being placed on the property), the specific nature of the redevelopment of that parcel is unknown at this time. Harley-Davidson will continue to manufacture motorcycles on the East Campus into the foreseeable future. Future land uses may differ between the East Campus and West Campus as they will be under different ownership, although both will remain commercial/industrial. Potential receptors associated with the Harley-Davidson facility will likely be limited to exposures to soils on the East Campus whereas potential receptors associated with the YCIDA property will likely be limited to exposures to soils on the West Campus. It is not likely that, in the future, a given receptor will be accessing both the East and West Campus equally.

Accordingly, for purposes of this risk assessment, the fYNOP property has been divided into two exposure units, East Campus and West Campus, so that exposures on each parcel may be assessed independently to be consistent with future land use (Figure 2).

An on-site maintenance worker was considered to be a full-time employee located on either campus. This receptor represents one of the most maximally exposed individuals on the properties because he/she was assumed to be an outdoor worker in direct contact with soils on a very frequent basis during the course of a long-term (*e.g.,* 25-year) employment tenure. Other employees, such as indoor workers, would not likely come into direct contact with impacted soils on any regular basis, and certainly not as frequently as that assumed for the maintenance worker scenario. For these reasons, the maintenance worker scenario was considered protective of other worker scenarios relative to exposures relating to direct contact with soil. The on-site maintenance worker on both the East and West Campus may potentially be exposed to constituents of concern in shallow soils (0-2 feet below ground surface [bgs]) through the dermal, oral, and inhalation exposure routes. Inhalation exposures may occur to both volatile constituent vapors in ambient air and to non-volatile constituents entrained onto dust particles in ambient air. These complete pathways were evaluated herein.

Construction workers were assumed to be contractors with temporary access to the property during short-term (i.e., less than one year) construction projects. Construction workers on both the East and West Campus may be exposed to both surface and subsurface soils during excavation and construction activities through the dermal, oral, and inhalation (of both volatile vapors and dust-entrained non-volatiles) exposure routes. These complete pathways were evaluated herein for the soil depth of zero to 15 feet bgs. It was appropriate to combine the zero to 2 feet bgs and 2 to 15 feet bgs soil depth intervals into a single zero to 15 feet bgs depth interval because construction workers would necessarily contact soils in the zero to 2 feet bgs range in the process of gaining access to the soils at the 2 to 15 feet bgs depth. Accordingly, the appropriate soil depth range to use for the construction workers scenarios was zero to 15 feet bgs.

The adolescent trespasser represents an individual, aged 6 to 17 years, who may be trespassing or otherwise visiting the East or West Campus on an infrequent basis. This individual may be exposed to surface soils (0 to 2 feet bgs) through the dermal, oral, and inhalation exposure routes. As with the other receptors described above, inhalation exposures may occur to both volatile constituent

vapors in ambient air and to non-volatile constituents entrained onto dust particles in ambient air. These exposure routes were assessed herein.

In summary, the following exposure scenarios were evaluated in this assessment:

- Maintenance Worker exposures to surface soil – East Campus
- Maintenance Worker exposures to surface soil – West Campus
- Construction Worker exposures to surface and subsurface soil – East Campus
- Construction Worker exposures to surface and subsurface soil – West Campus
- Adolescent Trespasser exposures to surface soil – East Campus
- Adolescent Trespasser exposures to surface soil – West Campus

Figure 3 presents a graphical version of the Conceptual Site Model.

3 DATA ANALYSIS

Based on the outcome of the conceptual site model, soil data from the fYNOP property were divided into four data sets: surface soil from zero to 2 feet bgs in the East Campus, surface and subsurface soil from zero to 15 feet bgs in the East Campus, surface soil from zero to 2 feet bgs in the West Campus, and surface and subsurface soil from zero to 15 feet bgs in the West Campus.

Soil data collected between 1987 and 2008 were evaluated for this assessment. Details of the soil samples used in the data analysis are presented on Plate 1. In some instances, due to the age of the data, sample reporting limits (RL) and/or detection limits (DL) were not available for non-detect results. In these cases, professional judgment was used to select an RL or DL for those samples based on existing RLs or DLs from the same data set for non-detect results of the same analyte. An effort was made to select reliable RLs or DLs that were relatively high to be conservative while avoiding RLs and DLs that may have been elevated as a result of analytical issues. The surrogate RLs/DLs were only used on those samples and COPCs for which these values were not available in the project database; not all COPCs required the use of surrogate RLs/DLs. The selected surrogate RLs/DLs used for affected COPCs in each data set are presented in Appendix A.

Existing buildings and parking lots serve to preclude exposures to underlying surface and subsurface soils thereby rendering associated exposure pathways in those areas incomplete. Data collected from beneath buildings and parking lots were, therefore, excluded from this assessment. Current demolition plans for the North Plant area of the property, including small portions of both the East and West Campus, are resulting in the removal of the Quonset buildings and associated macadam. As a result, some sample locations under impervious surfaces in this area will no longer be under cover. These sample locations are identified in Figure 4 and have been added to the East and West Campus data sets for evaluation in the risk assessment.

3.1 COPC Screening

A screening process was employed to determine which regulated substances from each data set should be carried through the quantitative human health risk assessment. The purpose of the screening process was to identify those regulated substances that may potentially contribute a large majority of the health hazard or risk (COPCs) for each receptor while eliminating those substances that are not likely to contribute significantly to overall hazard and risk calculations. The first step of

the screening process eliminated from each of the four data sets those substances corresponding to analytes that were not detected in the data set.

The next step of the screening process compared the maximum detected concentrations of each regulated substance in each data set to PADEP medium-specific concentrations (MSCs). The MSCs used in this assessment reflect the regulatory revisions made to Chapter 250 effective January 8, 2011. To determine the comparative MSCs for soils, a non-residential, used aquifer with total dissolved solids (TDS) less than 2500 mg/kg was assumed. While this risk assessment only addresses human exposures to soil at the site, the PADEP requires that the soil screening process include soil-to-groundwater MSCs as described below. Direct and indirect exposures to site groundwater will be addressed in a risk assessment report submitted under separate cover.

Under the non-residential, used aquifer with TDS less than 2500 mg/kg groundwater use category, the soil-to-groundwater MSC was selected using the greater of the soil-to-groundwater generic MSC and 100 times the groundwater MSC. Then, the lesser of the identified soil-to-groundwater MSC and the direct contact non-residential MSC was selected as the comparative MSC for soil. Regulated substances with maximum detected concentrations that exceed the comparative MSC were retained for additional screening. Regulated substances with maximum detected concentrations that were less than the comparative MSC were eliminated from the quantitative risk assessment process.

For those substances that were retained after the MSC screen, maximum detected concentrations were then compared to the USEPA's health-based Regional Screening Levels (RSLs) for industrial scenarios. This additional level of screening was employed in an effort to eliminate from the risk assessment those constituents that may have been retained during the MSC screen because of relatively low soil-to-groundwater MSCs but that otherwise may not present significant risks to human health as a result of direct contact with soils.

The most current RSLs, published in November 2011 (USEPA, 2011b), were used. If the maximum detected concentration exceeded the RSL, that substance was retained for the quantitative risk assessment. If the maximum detected concentration was less than the RSL, that substance was eliminated from the risk assessment process. This process was conducted for each of the four data sets, and the resulting COPCs identified in each data set were as follows:

East Campus Soils 0-2 feet bgs
Tetrachloroethene

West Campus Soils 0-2 feet bgs
Arsenic
Cadmium
Chromium
Lead
Thallium
Dimethylphthalate
Tetrachloroethene
Trichloroethene

East Campus Soils 0-15 feet bgs
Arsenic
Chromium
Hexavalent chromium
Lead
Thallium
1,2-Dichloroethane
Tetrachloroethane
Vinyl Chloride

West Campus Soils 0-15 feet bgs
Antimony
Arsenic
Cadmium
Chromium
Lead
Thallium
Zinc
Aroclor 1254
Benzo(a)pyrene
Dimethylphthalate
Hexachlorobenzene
Tetrachloroethene
Trichloroethene

Tables 1 through 4 summarize the screening process.

Once the COPCs were identified, a statistical analysis was conducted on each COPC to determine the exposure-point concentration to be used in the risk assessment. The exposure-point concentration is the concentration of a constituent in a medium (*e.g.*, soil) that is reasonably expected to be contacted by an individual over time and is assumed to be universally present throughout the site (USEPA, 1989). As a result of the uncertainty associated with estimates of exposures concentrations, the 95% upper confidence limit of the mean concentration (95% UCL) is typically used for this variable (USEPA, 1989). In instances where detected data are very limited, it may be appropriate to use the maximum detected concentration as the exposure point concentration in the absence of a 95% UCL.

Summary statistics and 95% UCLs were calculated for each COPC in each data set using USEPA's Pro UCL software (version 4.00.05). The ProUCL outputs are presented in Appendix B.

Table 5 summarizes the maximum detected concentration, the mean concentration, the 95% UCL, the percentage of data that were non-detect, the estimated data distribution, and the exposure point concentration for each COPC in each data set. Due to the paucity of detected results for dimethylphthalate and hexachlorobenzene in West Campus soils, the maximum detected concentrations of these substances were used as the exposure-point concentrations in the absence of 95% UCLs.

For lead in soils, the average concentration of lead was used as the exposure-point concentration in accordance with USEPA guidance (USEPA, 2003). The lead exposure point concentrations are also presented on Table 5.

3.2 Hot Spot Evaluation

In some cases, environmental contamination may be unevenly distributed across a site resulting in "hot spots" or areas of elevated COPC concentrations relative to the rest of the site (USEPA, 1989). These areas may require further risk evaluation, characterization, and/or remediation, depending on their location and concentration as well as future site use and development and existing remediation plans. .Accordingly, a hot spot evaluation was conducted for surface and subsurface soils (zero to 15 feet bgs) to determine if hot spots are present on the property.

In the absence of USEPA or PADEP guidance on defining or identifying hot spots, for this analysis, hot spots were determined to be those areas where detected COPC concentrations exceeded 10 times the PADEP Direct Contact soil MSC for non-residential scenarios or 100 times the USEPA's industrial soil RSL. The hot spot screening levels of 10 times the Direct Contact MSC and 100 times the RSL are equivalent to screening the detected results against a health-based criterion that corresponds to a risk level of $1x10^{-4}$ or a hazard level greater than 1.0. Exceedances of these hazard and risk levels would be deemed unacceptable to both the PADEP and USEPA and, as such, the use of these values as hot spot screening levels was determined to be a reasonable and appropriate approach to defining hot spots.

Detected concentrations of those COPCs identified through the COPC screening process (see the previous section) for both the East Campus and West Campus were first screened against the

USEPA hot spot screening levels discussed above. The reported results from the following sample locations exceeded 100 times the USEPA's industrial soil RSL:

East Campus Soils from 0-15 feet bgs:

Sample ID	Depth	COPC	Result (mg/kg)	Date Sampled
SB-13-6	6 ft	Tetrachloroethene	660	10/2/2002
NTT-SG25a	0.5 – 1 ft	Tetrachloroethene	403	12/21/1999

West Campus Soils from 0-15 feet bgs:

Sample ID	Depth	COPC	Result (mg/kg)	Date Sampled
HD-WPL-SB-095-05-0	0.5 – 2.5 ft	Aroclor 1254	270	4/26/2007
WPL-SG-33a	2- 2.5 ft	Arsenic	221	12/29/1999
WPL TP-5	3 – 3.5 ft	Benzo (a) pyrene	74	11/26/1999
BPA TP-1a	6.5 – 7 ft	Benzo (a) pyrene	21.3	12/7/1999
HD-B4ND-SB-014-15-0	13 – 15 ft	Tetrachlorethene	1400	7/23/2007
WPL-15-B-3	6 ft	Chromium*	8200	7/23/1991
HD-WPL-TP-037-05-0	5 ft	Chromium*	6860	2/27/2004
HD-WPL-SB-024-02-0	0.5 – 2 ft	Chromium*	3820	2/13/2004
WPL TP-6	5.5 – 6 ft	Chromium*	3380	11/26/1999
HD-ER-SD-02-03-0	3 ft	Chromium*	2230	8/18/2004
HD-WPL-SB-095-05-0	0.5 – 2.5 ft	Chromium*	1670	4/26/2007
TANK 3 NW 9	9 ft	Chromium*	1100	11/7/2000
WPLSS-15 6-7	6 – 7 ft	Chromium*	1100	6/19/1991
HD-SS-9-02-00	4 ft	Chromium*	781	7/30/2004

*As a conservative measures, 100 times the USEPA RSL for hexavalent chromium was used for the hot spot screening level. If the RSL for trivalent chromium was used, these sample locations would have passed the screening process and would not be considered hot spots.

COPCs were then screened against 10 times the PADEP MSCs as described above. There were no detected concentrations of COPCs that exceeded the MSC hot spot screening level.

According to the USEPA, hot spots should be evaluated separately in a risk assessment if the hot spot locations are in areas of the site that may be visited or used more frequently than other areas because of site or population characteristics (USEPA, 1989). The locations of the hot spots identified above are not in areas that may be accessed more frequently by the receptors identified in this report (Figure 4); therefore, it was determined that a separate risk analysis of hot spots was not necessary.

Additionally, while it was not appropriate to assess exposure to hot spots separately in this report, the identified hot spot locations were included in the data sets used for the evaluation of site hazards and risks as described in detail in the following sections. That is, the hot spot data were included in the statistical analysis of site data for each campus and, therefore, were incorporated into the estimate of exposure point concentrations (95% UCLs), subsequent intake calculations, and estimates of hazards and risks. Therefore, those hazards and risks calculated herein reflect exposures to hot spots as well as other areas of the site.

4 EXPOSURE ASSESSMENT

An exposure pathway is the course a chemical takes from its source to the exposed receptor. In order for an exposure pathway to be complete, it must contain a source, a transport medium (*e.g.*, soil, groundwater, *etc.*), a point-of-contact (receptor), and an exposure route (*e.g.*, ingestion, dermal, or inhalation). If any of these elements is not present, an exposure pathway is deemed incomplete and the chemical can be excluded from the quantitative evaluation of risk (USEPA, 1989). This evaluation identified three receptor populations that may result in complete exposure pathways for soil – maintenance workers, construction workers, and adolescent trespassers (see Section 2.0).

Chemical exposure/intake is expressed as the amount of the agent at the exchange boundaries of an organism (*e.g.*, skin, lungs, intestinal tract) that is available for systemic absorption. If the exposure occurs over time, the total exposure can be divided by the time-period of interest to obtain an average exposure rate (*e.g.*, mg/kg-day). This exposure rate (intake) was calculated for the dermal and oral exposure routes. For the inhalation exposure route, current USEPA guidance (USEPA, 2009a) recommends the calculation of an exposure concentration instead of an intake rate, and this approach was used herein.

4.1 Assessment of Mutagens

The USEPA has provided specific guidance on the assessment of childhood cancer risks associated with certain carcinogenic constituents that act through a mutagenic mode of action (mutagens). According to an analysis of available studies on mutagens, the USEPA has determined that higher cancer risks result from a given exposure occurring early in life (between the ages of 0 and 16) when compared with the same amount of exposure during adulthood (after the age of 16). As such, the methodology suggested in the USEPA guidance weighs childhood exposures to mutagens differently depending on the lifestage or age group. The USEPA recommends incorporating age-dependent adjustment factors [(ADAFs), depending on the age group] into the risk assessment exposure calculations to take into account the increased susceptibility of individuals to cancer when exposed to mutagens in early life (USEPA, 2005). These adjustment factors range from 10.0 for the ages between 0 and 2 years, 3.0 for the ages between 2 years and 16 years, and 1.0 for the ages older than 16 years. The PADEP has adopted this USEPA guidance in its most recent 2011 Chapter 250 regulations (§250.301, §250.306, and §250.307).

This risk assessment included two adolescent receptors to which the USEPA guidance on early-life exposures is applicable: adolescent trespasser on the East Campus and adolescent trespasser on the West Campus. These scenarios assessed exposures to adolescents aged 6 to 17 years. The only COPC selected through the screening process for adolescent trespassers on the East Campus was tetrachloroethene. Tetrachloroethene is not currently considered a mutagen by the USEPA or PADEP; therefore, the USEPA guidance on early life exposures was not implemented for that scenario. Exposures to COPCs classified as mutagens were assessed for the adolescent trespasser scenario on the West Campus. The following two mutagenic COPCs were assessed for that scenario: chromium, and trichloroethylene. PADEP's and USEPA's age-dependent adjustment factors were incorporated into the estimates of intake for these four COPCs for the scenario of adolescent trespasser at the West Campus. Consistent with USEPA and PADEP guidance and regulations, for the age range of 6 to 16 years, an adjustment factor of 3.0 was used, and for the age range of 16 to 17 years, an adjustment factor of 1.0 was used. The specific use of age-dependent adjustment factors for each exposure route (dermal, oral, and inhalation) is described in more detail in Section 4.3 below.

4.2 General Exposure Parameters

The exposure parameters described below and associated intake calculations are presented on Tables 6 through 24 for each receptor and exposure route for each exposure unit (East and West Campus). While some of the exposure parameters used to estimate intake are exposure route-specific, others are general parameters that remain constant for each exposure route (e.g., dermal and inhalation) and are present in each intake calculation. These general exposure parameters are discussed below and route-specific exposure parameters are discussed in the following section (Section 4.3).

Exposure point concentration, exposure frequency, exposure duration, averaging time, and body weight are general parameters that are specific to a receptor but do not vary between exposure routes for a given receptor.

The exposure point concentration for each substance in soil for each receptor was discussed above and is presented on Table 5.

The exposure frequency describes the number of times per year an event is likely to occur and is expressed in units of shifts/year or events/year for non-residential scenarios. Variables such as weather, vacations, and institutional controls are considered when determining reasonable and realistic exposure frequencies. For the maintenance worker scenario, an exposure frequency of 180 shifts/year was used consistent with PADEP regulations (Chapter 250 §250.306 and 250.307). A value of 60 shifts/year, based on best professional judgment, was used for the construction worker scenario. A value of 24 events/year was used for the adolescent trespasser conservatively assuming a visit to the site each weekend day during the three summer months of June, July, and August.

The exposure duration parameter in the intake equation represents the number of years over which an event is likely to occur. Factors affecting this parameter include variables such as age of receptor and population mobility. As recommended by the PADEP, an exposure duration of 25 years was used for the maintenance worker scenario (Chapter 250 §250.306 and 250.307). For construction activities that are typically less than one year, common risk assessment practice is to use an exposure duration of 1 year (USEPA, 2010). The adolescent trespasser was assumed to be between the ages of 6 and 17, therefore, the exposure duration for this receptor was 12 years.

The averaging time (AT) parameter is the period over which exposure is averaged. For noncarcinogenic effects, noncarcinogenic averaging time (AT_n) was used in calculating an average daily exposure, and is the product of the exposure duration and 365 days/year. Accordingly, for the maintenance worker, the noncarcinogenic averaging time was 9,125 days. For the construction worker, the AT_n value was 60 days, equivalent to the exposure frequency. The AT_n value for the adolescent trespasser was 4,380 days. The carcinogenic averaging time (AT_c) was the product of a 365-day year and a 70-year lifetime, or 25,550 days for each receptor in accordance with Chapter 250 regulations (Chapter 250 §250.306 and §250.307; 70 years is considered a typical lifetime and is used to assess exposures to carcinogens by both USEPA and PADEP). For inhalation exposures, these averaging times were converted to units of hours.

The body weight used for the adult receptors was 70 kg in accordance with PADEP regulations (Chapter 250 §250.306 and §250.307). For the adolescent trespasser, the body weight used for assessing exposures to non-mutagens was 45.36 kg, based on the average body weights of male and female children aged 6 to 17 years from Table 8-10 of USEPA's *Exposure Factors Handbook* (2011a). For adolescent trespasser exposures to mutagens, different body weights were used for the

two different age groups considered in the mutagen risk calculations. The average body weight for the adolescent trespasser aged 6 to 16 years was 43.35 kg while the body weight for the adolescent trespasser aged 17 years was 67.5 kg (USEPA, 2011a).

4.3 Route-Specific Exposure Parameters

Intakes due to contact with COPCs vary depending largely on the physicochemical properties of the COPC and the route by which the COPC enters the body. Dermal contact and incidental ingestion exposure-specific parameters take these differences into account and are addressed in this section.

Dermal Exposures to Soil (Non-Mutagens)

COPC intake as a result of dermal exposure to soil was estimated for non-mutagen COPCs using the following equation (USEPA, 2004):

$$Intake\ (mg/kg-day) = \frac{Cs \times SA \times AH \times ABS \times ED \times EF \times CF}{BW \times AT}$$

where:

Cs	=	COPC concentration in soil (mg/kg)
SA	=	Skin surface area available for exposure (cm^2/day, event, or shift)
AH	=	Soil adherence factor (mg/cm^2)
ABS	=	Dermal absorption fraction (unitless)
ED	=	Exposure duration (years)
EF	=	Exposure frequency (days/year)
CF	=	Conversion factor ($1x10^{-6}$ kg/mg)
BW	=	Body weight (kg)
AT	=	Averaging time (days)

The exposure-point concentration for soil was discussed in Section 3.0. The exposure duration, exposure frequency, body weight, and averaging time parameters were described in Section 4.1.

To calculate dermal intakes, the skin surface area available for exposure was estimated. For both the maintenance worker and construction worker scenarios, exposed body parts were assumed to include the head, hands, and forearms since these receptors were expected to wear short-sleeved shirts, long pants, and shoes. Accordingly, the exposed skin surface area for these adult receptors was 3,300 cm^2 as recommended by USEPA guidance (2004). The adolescent trespasser was

assumed to wear a short-sleeved shirt, shorts, and shoes thereby exposing the face, hands, forearms, legs, and lower legs comprising approximately 7,548 cm^2 as based on data for children aged 6 to 17 years from USEPA (2004).

The soil-to-skin adherence factor represents the amount of soil that adheres to the skin and is measured in units of mg of soil per cm^2 of skin surface area. This factor is influenced by soil types and varies considerably across different parts of the body (USEPA, 2004) and activity levels. Based on data for different types of activities provided in USEPA guidance, an adherence factor of 0.04 mg/cm^2 (representing landscaping-type activities) was selected for the maintenance worker. An adherence factor of 0.3 mg/cm^2 was selected for the construction worker scenario and is based on studies of actual construction workers (USEPA, 2004). For the adolescent trespasser scenario, an adherence factor of 0.04 mg/cm^2 was used representing teen soccer players (USEPA, 2004).

While COPCs may come into direct contact with the skin during the course of exposure (administered dose), only a fraction of the constituent may actually penetrate the skin barrier and enter the body (absorbed dose). To account for the effectiveness of the skin as a barrier to the absorption of COPCs, a dermal absorption fraction is applied to the intake equation. USEPA recommends several dermal absorption fractions for specific analytes and for classes of analytes (USEPA, 2004). These values were used in this assessment and included the following: arsenic – 0.03; cadmium – 0.001; benzo(a)pyrene and other polycyclic aromatic hydrocarbons (PAHs) – 0.13; Aroclors 1254 and 1242 and other Polychlorinated Biphenyls (PCBs) – 0.14; and semivolatile organic compounds (SVOCs) – 0.1. The USEPA does not provide dermal absorption fractions for volatile organic compounds (VOCs) stating that VOCs would tend to be volatilized from the soil on the skin (USEPA, 2004). Additionally, the USEPA does not provide dermal absorption fractions for many inorganic constituents because speciation is critical to dermal absorption and sufficient data do not exist for most inorganics on which to determine dermal absorption (USEPA, 2004). The dermal absorption fraction for VOCs and inorganics other than arsenic and cadmium was set to zero in keeping with USEPA guidance (2004).

Dermal Exposures to Soil (Mutagens)

For the scenario of trespasser at the West Campus, the following equations were used to estimate dermal intake of COPCs classified by the USEPA and PADEP as mutagens (based on equations in USEPA Regional Screening Level User's Guide, 2011b):

$$Average\ Lifetime\ Daily\ Intake\ (mg/kg-day) = \frac{Cs \times EF \times ADF_{adj} \times ABS \times CF}{AT_c}$$

where:

Cs	=	COPC exposure-point concentration in soil (mg/kg)
EF	=	Exposure frequency (days/year)
ADF_{adj}	=	Age-adjusted dermal factor (mg-year/kg-day)
ABS	=	Dermal absorption fraction (unitless)
CF	=	Conversion factor ($1x10^{-6}$ kg/mg)
AT_c	=	Averaging time for carcinogens (days)

The exposure-point concentration for soil was discussed in Section 3.0. The exposure frequency and averaging time parameters were discussed in Section 4.1. The dermal absorption fraction was discussed above. The age adjusted dermal factor was used to adjust dermal intake rates according to different life stages, as discussed in Section 4.0. For the trespasser scenario, the age adjusted dermal factor was calculated as follows:

$$ADF_{adj} = \frac{ADAF_{6-16} \times ED_{6-16} \times AH_c \times SA_c}{BW_{6-16}} + \frac{ADAF_{16-17} \times ED_{16-17} \times AH_a \times SA_a}{BW_{16-17}}$$

where:

$ADAF_{6-16}$	=	Age-dependent adjustment factor for adolescents aged 6 to 16 years (unitless)
ED_{6-16}	=	Exposure duration for adolescents aged 6 to 16 years (years)
AH_c	=	Adherence factor for adolescents aged 6 to 16 years (mg/cm^2)
SA_c	=	Skin surface area available for exposure for adolescents aged 6 to 16 years (cm^2/day)
BW_{6-16}	=	Body weight for adolescents aged 6 to 16 years (kg)
$ADAF_{16-17}$	=	Age-dependent adjustment factor for adolescents aged 16 to 17 years (unitless)
ED_{16-17}	=	Exposure duration for adolescents aged 16 to 17 years (years)
AH_a	=	Adherence factor for adolescents aged 16 to 17 years (mg/cm^2)
SA_a	=	Skin surface area available for exposure for adolescents aged 16 to 17 years (cm^2/day)

$BW_{16\text{-}17}$ = Body weight for adolescents aged 16 to 17 years (kg)

The body weight parameters were discussed in Section 4.1 and were based on the child body weight for adolescents aged 6 to 16 years and the adult body weight for adolescents aged 16 to 17 years. The ADAF value for adolescents aged 6 to 16 years was 3.0 and the ADAF value for adolescents aged 16 to 17 years as 1.0 as discussed in Section 4.0. The exposure duration for adolescents aged 6 to 16 years was 11 years while the exposure duration for adolescents aged 16 to 17 years was one year. The adherence factor for adolescents aged 6 to 16 years and the adherence factor for adolescents aged 16 to 17 years were both 0.04 mg/cm^2 as discussed above. This value was kept the same for the both of the adolescent life phases of the trespasser scenario because the soccer player activity level on which the adherence factor was based seemed appropriate for both age ranges. The skin surface area available for exposure for adolescents aged 6 to 16 years, 7,548 cm^2, was also discussed above. The skin surface area available for exposure for adolescents aged 16 to 17 years was estimated to be 5,200 cm^2, based on adult skin surface areas for the face, hands, forearms, and lower legs as taken from USEPA's *Exposure Factors Handbook* (2011a).

The resulting age-adjusted dermal factor was 223 mg-year/kg-event.

Incidental Ingestion of Soil (Non-Mutagens)

Soil ingestion intake levels were calculated for non-mutagen COPCs using the following equation (USEPA, 1989):

$$Intake\ (mg/kg-day) = \frac{Cs \times IngR \times EF \times ED \times CF}{BW \times AT}$$

where:

Cs = COPC exposure-point concentration in soil (mg/kg)
IngR = Soil ingestion rate (mg/day)
EF = Exposure frequency (days/year)
ED = Exposure duration (years)
CF = Conversion factor (1x10^{-6} kg/mg)
BW = Body weight (kg)
AT = Averaging time (days)

The exposure-point concentration in soil was discussed in Section 3.0. The exposure frequency, exposure duration, body weight, and averaging time parameters were discussed in Section 4.1.

For incidental ingestion exposures to soil, a soil ingestion rate was employed to determine COPC intake. The PADEP Chapter 250 regulations stipulate a soil ingestion rate of 50 mg/day for on-site workers (Chapter 250 §250.306); therefore, this value was adopted for the maintenance worker scenarios. This value, however, may not be appropriate for a construction worker who engages in more soil contact-intensive activities. A more appropriate value for a construction worker, as presented in USEPA guidance (USEPA, 2002b), is a soil ingestion rate of 330 mg/day and this value was adopted from the USEPA for this assessment for the construction worker scenarios. In the absence of guidance on appropriate soil ingestion rates for adolescent trespassers, PADEP's outdoor worker value of 50 mg/day (Chapter 250 §250.306) was adopted for the adolescent trespasser scenario.

Incidental Ingestion of Soil (Mutagens)

For the adolescent trespasser scenario at the West Campus, the following equations were used to estimate oral intake of COPCs classified by the USEPA and PADEP as mutagens (based on equations in PADEP Chapter 250 §250.306):

$$Average\ Lifetime\ Daily\ Intake\ (mg/kg-day) = \frac{Cs \times EF \times AIF_{adj} \times CF}{AT_c}$$

where:

Cs = COPC exposure-point concentration in soil (mg/kg)
EF = Exposure frequency (events/year)
AIF_{adj} = Age-adjusted ingestion factor (mg-year/kg-event)
CF = Conversion factor ($1x10^{-6}$ kg/mg)
AT_c = Averaging time for carcinogens (days)

The soil exposure-point concentration was discussed in Section 3.0 and the exposure frequency and averaging time parameters were discussed in Section 4.1. The age adjusted ingestion factor was used to adjust ingestion intake rates according to different life stages, as discussed in Section 4.0. For the adolescent trespasser scenario, the age adjusted ingestion factor was calculated as follows:

$$AIF_{adj}(mg-year/kg-event) = \frac{ADAF_{6-16} \times ED_{6-16} \times IngR_c}{BW_{6-16}} + \frac{ADAF_{16-17} \times ED_{16-17} \times IngR_a}{BW_{16-17}}$$

where:

$ADAF_{6\text{-}16}$	=	Age-dependent adjustment factor for adolescents aged 6 to 16 years (unitless)
$ED_{6\text{-}16}$	=	Exposure duration for adolescents aged 6 to 16 years (years)
$IngR_c$	=	Soil ingestion rate for adolescents aged 6 to 16 years (mg/event)
$BW_{6\text{-}16}$	=	Body weight for adolescents aged 6 to 16 years (kg)
$ADAF_{16\text{-}17}$	=	Age-dependent adjustment factor for adolescents aged 16 to 17 years (unitless)
$ED_{16\text{-}17}$	=	Exposure duration for adolescents aged 16 to 17 years (years)
$IngR_a$	=	Soil ingestion rate for adolescents aged 16 to 17 years (mg/event)
$BW_{16\text{-}17}$	=	Body weight for adolescents aged 16 to 17 years (kg)

The body weight parameters were discussed in Section 4.1 and were based on the child body weight for adolescents aged 6 to 16 years and 16 to 17 years. The ADAF value for adolescents aged 6 to 16 years was 3.0 and the ADAF value for adolescents aged 16 to 17 years as 1.0 as discussed in Section 4.0. The exposure duration for adolescents aged 6 to 16 years was 11 years while the exposure duration for adolescents aged 16 to 17 years was one year. The soil ingestion rate was set to 100 mg/day for both the 6 to 16 year age group and the 16 to 17 year age group as this soil ingestion level seemed appropriate for both age groups within the adolescent trespasser scenario.

The resulting age-adjusted ingestion factor was 74.2 mg-year/kg-event for the adolescent trespasser scenario.

Inhalation Exposures (Non-Mutagens)

Soil inhalation intake levels were calculated for non-mutagen COPCs using the following equation (USEPA, 2009):

$$Exposure\ concentration\ for\ non-carcinogens\ \left(\frac{mg}{m^3}\right) = \frac{Cs \times EF \times ED \times ET}{AT_n \times TF}$$

$$Exposure\ concentration\ for\ carcinogens\ \left(\frac{\mu g}{m^3}\right) = \frac{Cs \times ED \times EF \times ET \times 1000\frac{\mu g}{mg}}{AT_c \times TF}$$

where:

Cs	=	COPC exposure-point concentration in soil (mg/kg)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
ET	=	Exposure time (hours/day)
AT	=	Averaging time (hours)

TF = Transport factor ((mg/kg)/(mg/m^3))

The soil exposure-point concentration was discussed in Section 3.0. The exposure frequency, exposure duration, and averaging time parameters were discussed above in Section 4.1.

Under current USEPA guidance, inhalation exposures are a function of exposure time (USEPA, 2009a). As such, an exposure time of 8-hours per day was used to represent a typical work day for both the maintenance worker and construction worker scenarios. This value is also consistent with PADEP regulations (Chapter 250 §250.307). An exposure time of four hours per day was used for the adolescent trespasser scenario based on best professional judgment.

To estimate inhalation exposures, transport factors were used to convert soil exposure point concentrations to ambient air concentrations. Two types of transport factors were employed herein – a particulate emission factor (PEF) for non-VOCs and a volatilization factor (VF) for VOCs. Each of these factors is described in more detail below.

A VF was used to estimate the air concentration of VOCs for use in determining inhalation exposures to VOCs in soil. The soil exposure point concentration for a VOC was divided by the VF to estimate the air concentration that may be inhaled by a receptor. The compound-specific VFs were extracted from PADEP Chapter 250 regulations (Tables 5A and 5B). The PADEP provides VFs for both surface and subsurface soil. For the maintenance worker and adolescent trespasser scenarios, VFs for surface soil were employed since soil exposure to these receptors would likely be limited to surface soil. The construction worker may be exposed to both surface and subsurface soil; therefore, the more conservative VF for surface soil was also used for the construction worker scenarios.

A PEF was used to estimate the air concentration of non-VOCs. The air concentration of a non-VOC to be inhaled by each receptor was estimated by dividing the soil concentration by the PEF. The air concentration was then used to estimate compound intakes. Chapter 250 stipulates a PEF value of 1×10^{10} (mg/kg)/(mg/m^3) (Chapter 250 §250.307) and this value was used herein for non-volatile COPCs.

Inhalation Exposure (Mutagens)

For the West Campus adolescent trespasser scenario, the following equations were used to estimate inhalation intake of COPCs classified by the USEPA and PADEP as mutagens (based on equations in PADEP Chapter 250 §250.307):

$$Exposure\ Concentration\ (\mu g/m^3) = \frac{Cs \times AED \times EF \times ET \times 1000\,\mu g/mg}{AT_c \times TF}$$

where:

Cs = COPC exposure-point concentration in soil (mg/kg)
AED = Age-adjusted exposure duration (years)
EF = Exposure frequency (days/year)
ET = Exposure time (hours/day)
AT_c = Averaging time for carcinogens (hours)
TF = Transport factor ((mg/kg)/(mg/m^3))

The soil exposure-point concentration was discussed in Section 3.0. The exposure frequency, exposure duration, and averaging time parameters were discussed in Section 4.1. The transfer factor was discussed above. The AED parameter was calculated as follows:

$$Aged - adjusted\ exposure\ duration\ (years) = (ADAF_{6-16} \times ED_{6-16}) + (ADAF_{16-17} \times ED_{16-17})$$

where:

$ADAF_{6\text{-}16}$ = Age-dependent adjustment factor for adolescents aged 6 to 16 years (unitless)
$ED_{6\text{-}16}$ = Exposure duration for adolescents aged 6 to 16 years (years)
$ADAF_{16\text{-}17}$ = Age-dependent adjustment factor for adolescents aged 16 to 17 years (unitless)
$ED_{16\text{-}17}$ = Exposure duration for adolescents aged 16 to 17 years (years)

The ADAF factors were 3.0 for the ages between 6 and 16 and 1.0 for the ages between 16 and 17 as discussed in Section 4.0. The exposure duration for the ages between 6 and 16 years was 11 years and the exposure duration for the ages between 16 and 17 years was 1 year. The resulting age-adjusted exposure duration was 34 years.

4.4 Assessment of Lead Exposures

Lead was identified as a COPC in both East Campus soils (0-15 feet bgs) and West Campus soils (0-2 feet bgs and 0-15 feet bgs). The USEPA has not developed toxicity values for lead that can be used in traditional risk assessment intake equations. Instead, to evaluate lead exposures to adults under non-residential exposure scenarios, the USEPA has developed an approach relating exposures to lead in soils to blood lead concentrations (USEPA, 2003). USEPA's Adult Lead Methodology (ALM) uses a simplified representation of lead biokinetics to predict quasi-steady state blood lead concentrations among adults who have relatively steady patterns of site exposures (USEPA, 2003). The adult receptor of concern considered in the ALM is a woman of child-bearing age. The ALM was first used to calculate the blood lead concentration of an adult as a result of exposure to site soils, and that adult blood lead concentrations was then used to estimate the blood lead concentration of a developing fetus, the most sensitive receptor to be protected. The following algorithm was used to estimate central tendency blood lead levels in adult women (USEPA, 2003):

$$PbB_{adult,central} = PbB_{adult,0} + (PbS \times BKSF \times IRs \times AFs \times EFs)/AT$$

where:

$PbB_{adult,central}$	=	Central estimate of blood lead concentrations in a woman of child-bearing age that has nonresidential exposures to site soils (µg/dL)
$PbB_{adult,0}$	=	Typical blood lead concentration in woman of child-bearing age not exposed to site soils (µg/dL)
PbS	=	Soil lead concentration (µg/g)
BKSF	=	Biokinetic slope factor relating increase in typical adult blood lead concentration to average daily lead uptake (µg/dL blood lead increase per µg/day lead uptake)
IRs	=	Soil intake rate (g/day)
AFs	=	Gastrointestinal absorption fraction (unitless)
EFs	=	Exposure frequency (days/year)
AT	=	Averaging time (days)

The $PbB_{adult,0}$ value used in this assessment was 1.0 µg/dL. This value was extracted from recent USEPA guidance that presented the results of an evaluation of data from the Third National Health and Nutrition Examination Survey (NHANES) collected between 1999 and 2004 (USEPA, 2009b).

The PbS parameter represents the lead concentration in soil at the fYNOP site. USEPA's ALM recommends the use of an average soil lead concentration for the PbS parameter. The soil lead

exposure point concentrations used in this assessment were the soil mean lead concentrations as discussed in Section 3 and presented on Table 5.

USEPA's recommended BKSF value of 0.4 µg/dL per µg/day was used herein as the biokinetic slope factor (USEPA, 2003).

Soil intake rates (IRs) for lead exposures were receptor-specific and the same as the soil ingestion rates used to estimate exposures to other COPCs in soil as discussed in Section 4.2. For the maintenance worker scenario, the intake rate was 0.05 g/day; for the construction worker scenario, the intake rate was 0.33 g/day; and for the adolescent trespasser scenario, the intake rate was 0.1 g/day.

AFs represents the gastrointestinal absorption fraction of lead. USEPA's recommended value of 0.12, based on an absorption factor of soluble lead of 0.2 and a relative bioavailability of 0.6, was adopted in this assessment (USEPA, 2003).

Lastly, the AT for lead exposures is the total period during which soil contact may occur. For ongoing, long-term exposures such as those assessed in this report, the USEPA recommends a value of 365 days for the AT parameter (USEPA, 2003), and this value was adopted in this assessment.

Once the central tendency adult blood lead level was estimated using the equation above, the 95th percentile fetal blood lead concentration was calculated using the following equation (USEPA, 2003):

$$PbB_{fetal,0.95} = PbB_{adult,central} \times GSD_i^{1.645} \times R_{fetal/maternal}$$

where:

$PbB_{adult,central}$	=	Central estimate of blood lead concentrations in a woman of child-bearing age that has nonresidential exposures to site soils (µg/dL)
GSD_i	=	Geometric standard deviation (unitless). (The exponent 1.645 is the value of the standard normal deviate used to calculate the 95th percentile from a lognormal distribution of blood lead concentration.)
$R_{fetal/maternal}$	=	Constant of proportionality between fetal blood lead concentration at birth and maternal blood lead concentration (dimensionless)

The GSDi value of 1.8, as recommended in USEPA guidance (2009b) was used in this assessment.

The $R_{fetal/maternal}$ value relates the blood lead concentration of a mother to the blood lead concentration of a developing fetus. USEPA's recommended value of 0.9 was used in this assessment (USEPA, 2003).

The input parameters and equations used to determine lead exposures at the site are presented on Tables 24 through 27. These tables reflect the June 21, 2009 version of USEPA's worksheet for the calculation of blood lead concentrations. The results of the lead assessment are discussed in the Risk Characterization (Section 6.0).

5 TOXICITY ASSESSMENT

Toxicity assessment involves the evaluation of available toxicity information to be used in the risk assessment process. Toxicity values derived from dose-response relationships can be used to estimate the potential for the occurrence of adverse effects in individuals exposed to various constituent levels.

Adverse effects can be caused by acute exposure, which is a single or short-term exposure to a toxic substance, or by chronic exposure to lower levels on a continuous or repeated basis over an extended period of time. "Acceptable" acute or chronic levels of exposure to noncarcinogens are considered to be levels without any anticipated adverse effects. Such exposure levels are commonly expressed as reference doses (RfDs). RfDs were used to determine the potential for noncarcinogenic health effects resulting from dermal and oral exposures at the site. For inhalation exposures, reference concentrations (RfCs) were used to assess inhalation toxicity. RfCs are defined by the USEPA as an estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure to the human population (including sensitive subgroups) that is likely to be without appreciable risk of deleterious effects during a lifetime (USEPA, IRIS, 2012). An acceptable exposure level is calculated to provide an adequate margin of safety. RfDs and RfCs have been developed by the USEPA for exposure to constituents based on the most sensitive noncarcinogenic effects.

Carcinogenic risk refers to the probability of developing cancer as a result of exposure to known or suspected carcinogens. A cancer slope factor (CSF) is a plausible upper-bound estimate of the probability of an individual developing cancer as a result of a lifetime of exposure to a particular level of a potential carcinogen. CSFs were used to determine dermal and oral cancer risks at the site. For inhalation exposures, inhalation unit risk values (IURs) were used to assess risk. The USEPA defines an IUR as "the upper-bound excess lifetime cancer risk estimated to result from continuous exposure to an agent at a concentration of 1 $\mu g/m^3$ in air" (USEPA, IRIS, 2012). IURs were used to determine inhalation cancer risks at the site.

Currently, the USEPA has not developed RfDs or CSFs to be utilized for the dermal exposure route. In the absence of published USEPA dermal RfDs and CSFs, oral RfDs and CSFs were adjusted for dermal absorption in accordance with the most current USEPA guidance (USEPA, 2004). Oral

RfDs were multiplied by a gastrointestinal (GI) absorption factor to convert administered doses to absorbed RfDs. Oral CSFs were divided by a GI absorption factor to estimate absorbed CSFs. GI absorption factors were obtained from USEPA's most recent RSL tables (November, 2011; USEPA, 2011b).

USEPA and PADEP have not provided current, published toxicity values for thallium or dimethylphthalate. In the absence of toxicity values for these COPCs, hazards and/or risks could not be calculated. The effect of the absence of toxicity values for these COPCs is discussed more in the Uncertainty Analysis (Section 7.0).

Chromium soil data from the site were presented in the site database as either "chromium" or "hexavalent chromium." It is likely that the data termed "chromium" represent total chromium results, a combination of both the trivalent and hexavalent forms. Toxicity values are not available for total chromium; toxicity values are available for trivalent chromium and hexavalent chromium. Accordingly, for this assessment, data termed "chromium" were assumed to be 100% hexavalent chromium for purposes of toxicity. This is a very conservative approach given that hexavalent chromium is more toxic than trivalent chromium. In addition, in the East Campus data set for soils from zero to 15 feet bgs, both chromium and hexavalent chromium were identified as COPCs. By assuming the chromium data are of the hexavalent form, exposures to hexavalent chromium are duplicated (i.e., exposures to hexavalent chromium were assessed using data for both chromium and hexavalent chromium). This highly conservative approach was employed to ensure adequate protection of human health.

Oral and inhalation toxicity values used in this assessment followed the PADEP (PADEP, 2011) and USEPA (2003) hierarchy of toxicity values. The toxicity values and GI absorption factors used in this assessment are presented on Table 28.

6 RISK CHARACTERIZATION

The objective of the risk characterization is to determine potential risk to receptors by combining the results of the exposure and toxicity assessments.

The potential for noncancer health effects was evaluated by comparing the site-specific exposure level with the RfD or RfC. This ratio of exposure to toxicity (intake/RfD or exposure concentration/RfC) is called the hazard quotient (HQ). To assess the overall potential for noncancer effects posed by multiple COPCs, a hazard index (HI) was derived by summing the individual HQs. If the site-specific exposure level exceeded the effects-based threshold (*i.e.*, the HI exceeded a value greater than 1.0), there may be concern for potential noncancer effects. A HI of 1.0 corresponds to the statutory limit established by Act 2 for potential noncancer effects under the site specific standard.

For the East Campus, the hazard index summed across the dermal, oral, and inhalation pathways for soil was 0.008 for the maintenance workers, 0.08 for the construction worker, and 0.0007 for the adolescent trespasser. For the West Campus, the hazard index summed across the dermal, oral, and inhalation pathways for soil was 0.11 for the maintenance workers, 0.86 for the construction worker, and 0.04 for the adolescent trespasser. Each of these hazard indices is below the Act 2 acceptable level of 1.0. Hazard indices for each scenario are summarized on Table 29.

The product of the lifetime daily intake and the CSF (or IUR for inhalation exposures) was used to estimate the upper bound excess cancer risk for each scenario. Act 2 establishes an acceptable risk range of 1×10^{-4} to 1×10^{-6} for exposure to carcinogens; this range represents an incremental increase of 1 in 10,000 to 1 in 1,000,000 in the chance of developing cancer over a lifetime. To demonstrate attainment with Act 2's Site-Specific Standard, cancer risk cannot exceed a level of 1×10^{-4}.

For the East Campus, the total cancer risk estimated for the maintenance worker was 3×10^{-8}, the total cancer risk calculated for the construction worker was 5×10^{-7}, and the total cancer risk estimated for the adolescent trespasser was 1×10^{-9}. For the West Campus, the total cancer risk estimated for the maintenance worker was 2×10^{-5}, the total cancer risk calculated for the construction worker was 2×10^{-6}, and the total cancer risk estimated for the adolescent trespasser was

$9x10^{-6}$. Each of these cancer risk estimates were within or below Act 2's acceptable risk range of $1x10^{-4}$ to $1x10^{-6}$. Cancer risks for each scenario are summarized on Table 29.

Additionally, until the West Campus property is transferred, exposures of receptors to both East and West Campus soils may occur. As such, hazards and risks for each receptor were combined to assess potential exposures to the entire fYNOP property under current site conditions. Once again, hazards for each receptor evaluated herein were below Act 2's target benchmark of 1.0 for the combined exposures. Furthermore, the total cancer risk levels for each receptor were within Act 2's acceptable risk range for the combined exposures. The hazards and risks for the combined exposures are summarized on Table 29.

The results of the lead assessment yielded central tendency adult blood lead levels and 95th percentile fetal blood lead levels below USEPA's blood lead concentration of concern of 10 µg/dL. Tables 24 through 27 present the blood lead concentrations calculated for each scenario in which lead was screened in as a COPC.

Based on the human health risk assessment assumptions and methodologies used herein, COPCs detected in soil at the site at the concentrations identified in Section 3.0 meet the attainment requirements of the Chapter 250 Site-Specific Standard. Specifically, this risk assessment has demonstrated that "the risk level remaining at the site does not exceed a risk level of 1×10^{-4} and a hazard index of 1.0" as required in §250.702 (b)(3)(ii) of Chapter 250.

7 UNCERTAINTY ANALYSIS

Given the nature of risk assessment as a strongly model-based estimation of potential health hazards, a significant amount of uncertainty is inherent in the risk assessment process. Uncertainty in risk assessments commonly surrounds the likelihood, distribution, magnitude, and implications of risk. Sources of uncertainty include inherent randomness, imperfect or incomplete knowledge, and error. This section attempts to identify significant sources of uncertainty and how they may affect the outcome of the assessment. Uncertainty is present, to varying degrees, in each step of the risk assessment process, as described below.

7.1 Data Evaluation

Uncertainties in the data evaluation include analytical error and adequacy of sampling design, among others. Generally, the data evaluation contains far less uncertainty than other phases of the risk assessment.

Laboratory analysis of sampled media is typically very accurate relative to the other components of a risk assessment that are based on assumptions and professional judgment. Use of the appropriate analytical methods and data validation can reduce analytical uncertainty even more. The data used in this assessment were considered to accurately represent site environmental conditions. The sampling design focused on areas of known or suspected releases. As such, the associated data used in this evaluation likely represented potential worst-case conditions at the site and may have resulted in an overestimation of risks.

Surrogate reporting limits or detection limits were developed in the absence of reporting limits or detection limits for non-detect results for some analytes. Since the use of surrogate detection limits affected only some of the non-detect results, the overall effect on the risk assessment should be minimal. As a conservative measure, high-end detection limits were used thereby likely over-estimating exposure point concentrations and associated hazards and risks.

Concentrations of detected constituents were screened to determine the COPCs to be carried through the quantitative risk assessment. As a result, several detected constituents were eliminated from the risk assessment process. The screening process was developed to identify those constituents that may present a large majority of the hazard or risk that may be present at the site.

However, the elimination of constituents from the risk assessment may result in a very slight underestimation of hazards and risks.

Sine it would be very difficult and/or cost prohibitive to determine the actual soil concentrations that a receptor may come into contact with at the site, an exposure-point concentration is used as a reasonable estimate of the concentration to which a population may be exposed over time. Since it is unlikely that a receptor would be consistently exposed to a maximum concentration located at a single point on a property, an average of the concentrations from across the area of property available to receptors is more appropriate. However, due to the high level of uncertainty associated with this assumption, the USEPA recommends the use of a 95% UCL for the exposure point concentration. The 95% UCL is a concentration that will exceed, with 95% confidence, the true average concentration. Accordingly, while the exposure-point concentration introduces a great deal of uncertainty into a risk assessment, the use of the 95% UCL is a conservative approach that likely overestimates hazards and risks.

7.2 Exposure Assessment

Assumptions made in this evaluation regarding the current property setting and land use were based on a firm knowledge of the Site gained from a variety of sources closely associated with the property. As such, the uncertainty surrounding current land use assumptions was minimal. The East Campus will more likely than not remain an industrial motorcycle manufacturing facility into the foreseeable future and uncertainty associated with the future use of the East Campus is minimal since an environmental covenant will be placed on the property limiting it to commercial/industrial uses. The future use of the West Campus remains undetermined although it will remain commercial or industrial based on environmental covenants to be adopted for the property. A revised risk assessment may be necessary if the future use of the property is inconsistent with the land-use and exposure assumptions described herein.

Limitations are inherent in the use of models to predict real-life conditions. The greater the appropriateness and accuracy of a model, the less uncertainty will be associated with its use. The use of any model however, no matter how accurate, introduces some level of uncertainty into an analysis. The various exposure models used herein are commonly accepted models that have been

extensively peer reviewed and considered appropriate for the application in which they were used in this assessment.

This risk assessment employed single-point estimates of exposure parameter values based on assumptions regarding the physical setting of the Site, the current land use, and the potential future land use. Probabilistic measures, which incorporate ranges of exposure values, were not used. The greater the potential range of values is for an exposure parameter, the greater the uncertainty associated with the use of a single value to represent that range. This assessment used PADEP or USEPA default parameter values when applicable. Such parameter values are typically conservative and may result in an overestimation of hazards/risks. The uncertainty associated with each parameter value is compounded when combined in an exposure model with other parameter values that are also associated with uncertainty.

Dermal exposures were not quantified for VOC and some inorganic COPCs because of a lack of data on the dermal absorption of these constituents. The inability to assess dermal exposures for some constituents may have resulted in a slight underestimation of dermal hazards and risks. It is very likely, however, that oral exposures to these constituents represent a more significant exposure route and hazards and risks associated with oral exposures would more likely than not drive the overall hazard and risk estimates for these COPCs.

USEPA's ALM was used to assess lead exposures to the adolescent trespasser. The age range of the adolescent trespasser (6 to 17 years old) is generally younger than that typically considered as adulthood or representative of a child-bearing age. Nevertheless, the ALM was employed in the absence of a more appropriate model to determine blood lead levels for exposures to non-residential adolescents. USEPA has published another lead exposure model, the Integrated Exposure Uptake Biokinetic (IEUBK) Model for Lead in Children, that estimates blood lead concentrations; however, the IEUBK model applies to residential children under the age of seven years; therefore, the child lead model was considered even less appropriate to use for an adolescent trespasser scenario.

7.3 Toxicity Assessment

A significant amount of uncertainty surrounds the development of the published toxicity values used herein. Toxicity values for humans are often developed based on the results of animal studies.

The relationships between these animal studies and their applicability to humans remain a source of debate. Sources of uncertainty in the development of toxicity values include extrapolating from animal studies to predict effects on humans, the use of dose-response information observed at high doses to predict effects that may occur at low doses, the use of data from short-term studies to anticipate effects of long-term exposures, and the applicability of information gained from studies of homogenous, healthy populations to predict potential adverse health effects on sensitive or compromised sub-populations. The USEPA typically applies uncertainty factors (generally a value of 10) as a conservative measure to account for these disconnects and to be protective of human health. Although these uncertainty factors may help to prevent the underestimation of risk, the uncertainty associated with the toxicity values still remains. The USEPA has indicated that the uncertainty surrounding RfD values can span up to one order of magnitude (USEPA, 2012).

Current, published USEPA or PADEP toxicity values were not available for two COPCs: thallium and dimethylphalate for the dermal, oral, and inhalation exposure pathways. As a result, noncarcinogenic hazards and carcinogenic risks could not be estimated for these COPCs. The exclusion of these COPCs from the overall hazard and risk calculations likely has resulted in an underestimation of hazards and risks at the site.

Thallium was a COPC in West Campus soils from 0-15 feet bgs. The thallium data set for West Campus surface and subsurface soils contained 360 results. Of these results, all but two results were either nondetect or below the MSC screening level of 14 mg/kg. Since 99% of the thallium results were either nondetect or below the MSC, it is not likely that thallium is a widespread constituent of concern that would pose significant risks at the property.

Dimethylphthalate was identified as a COPC in both West Campus surface soil and West Campus surface and subsurface soil data sets. There were no MSCs or RSLs to use as screening criteria; therefore, dimethylphthalate was automatically retained as a COPC. The West Campus soils 0-15 feet bgs data set included 265 results for dimethylphthalate. This substance was detected in only five (<2%) of these results. Four of the five detected results from the West Campus soils 0-15 feet bgs data set were surface soil samples and, therefore, were also included in the West Campus soils 0-2 feet bgs data set. Given the relatively few detections of this analyte, dimethylphthalate is not likely a widespread constituent of concern that would pose significant risks at the site.

Data termed "chromium" (i.e., total chromium representing both trivalent and hexavalent forms) from the site soil database were assumed to be hexavalent chromium for purposes of toxicity in the absence of further information. Since hexavalent chromium is more toxic than the trivalent form, the assumption that the total chromium results are of the hexavalent form is highly conservative. In reality, only a fraction of the total chromium values likely represent hexavalent chromium concentrations. Accordingly, the assumption that total chromium concentrations are 100% hexavalent chromium for purposes of toxicity likely resulted in a significant overestimation of hazards and risks.

7.4 Risk Characterization

Noncarcinogenic hazards and carcinogenic risks for each constituent were summed to develop overall hazard or risk estimates. This assumption of dose additivity ignores synergisms or antagonisms that may occur among chemical mixtures; therefore, hazards and risks may be underestimated or overestimated. Additionally, the summation of hazards and risks assumes similarities in the mechanisms of action of the chemicals, weighs compounds with different weights of evidence for carcinogenicity equally, and combines hazard quotients for substances with critical effects of varying toxicological significance. The USEPA recognizes these limitations (USEPA, 1989) but still requires that hazard and risk estimates for individual chemicals be added in an effort to prevent underestimation of the potential for adverse health effects. The questionable applicability of assuming dose additivity increases the uncertainty associated with the risk assessment.

Additionally, hazards and risks from the East and West Campus were combined to represent exposures to the entire fYNOP property under current site conditions (prior to the sale of the East Campus to the YCIDA). By combining hazards and risks from the two exposure units, exposure was essentially doubled (e.g., a construction worker was assumed to be present on the East Campus 60 days a year and on the West Campus 60 days a year, but when the scenarios were combined, the construction worker is present on-site a total of 120 days/year). This very conservative approach has likely overestimated site hazards and risks.

8 CONCLUSIONS

This human health risk assessment of soil exposures was performed for the fYNOP property located in York, Pennsylvania on behalf of Harley-Davidson. Harley-Davidson is seeking relief from liability for the site under Act 2 and the corresponding Chapter 250 regulations. This risk assessment was developed in accordance with the Site-Specific Standard option under Act 2 and the PADEP Land Recycling Program Chapter 250 regulations.

The fYNOP property has been subdivided, and the West Campus was sold and is being transferred to the YCIDA. Accordingly, for purposes of assessing exposure, the fYNOP property was divided into two exposure units – East Campus and West Campus. Both the East and West Campus will be subject to environmental covenants restricting land use to commercial and/or industrial purposes. Noncarcinogenic hazards and carcinogenic risks were evaluated for the East and West Campus independently to represent future site conditions. Hazards and risks from the East and West Campus were also combined to represent current site conditions.

A data screening process was employed, using both MSCs and RSLs, to identify COPCs in surface soils and in a combination of surface and subsurface soils in both campuses. The resulting COPCs were carried through the quantitative risk assessment process.

Detected concentrations of COPCs in soil in both the East and West Campus were also screened to determine if "hot spots" of impacted soils were present at the site. The first portion of the hot spot screening process, which employed screening levels of 100 times the USEPA RSLs, identified several hot spots. However, when screening levels of ten times the PADEP Direct Contact Non-Residential MSCs were used, the screening process did not reveal any hot spots on the property. Since the hot spots identified using 100 times the RSLs were not located in areas of the site that may be accessed by receptors at a higher rate than other areas, a separate risk evaluation of the hot spot areas was not necessary. Data from hot spots were incorporated into the exposure-point concentration calculations, therefore, the hazards and risks estimated in this assessment reflect exposures to the hot spots as well as other areas of the site.

Maintenance workers, construction workers, and adolescent trespassers were identified as potential receptors for both the East Campus and West Campus. Dermal, oral, and inhalation exposures to the identified COPCs were evaluated for each receptor.

The risk assessment determined that noncarcinogenic hazards for each receptor were below Act 2's acceptable benchmark of 1.0. This risk assessment also yielded potential carcinogenic risks that were within or below Act 2's acceptable risk range. Additionally, exposures to lead in soils were determined to be below acceptable levels. These results indicate that potential exposures to soil under current and hypothetical future land use conditions, as described in this report, are within Act 2-acceptable limits, even given the use of several very conservative assumptions and approaches. Accordingly, the site-specific standard has been attained for those COPCs in soils identified in this report.

Should future land use change from the currently assumed commercial/industrial use, if additional impacts to soil are discovered, or if existing engineering controls (e.g., parking lots, buildings) are breached or removed, a revised risk assessment and/or remediation may be necessary for the protection of human health.

9 REFERENCES

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Table 1
Screening of Constituents in Surface Soil - East Campus
Former York Naval Ordnance Plant, York, PA

Analyte	MSC Screening Level mg/kg	Maximum Detected mg/kg	Maximum Detected Sample Location	Date Sampled	Is Maximum Concentration > MSC Screening Level?	US EPA Regional Screening Level mg/kg	Is Maximum Detected Concentration > RSL?
1,1,1,2-Tetrachloroethane	18	ND	NA	NA	No	NA	
1,1,1-Trichloroethane	20	50.9	NTT-SG25a	12/21/1999	Yes	3800	No
1,1,2,2-Tetrachloroethane	0.43	ND	NA	NA	No	NA	
1,1,2-Trichloroethane	0.5	ND	NA	NA	No	NA	
1,1-Dichloroethane	16	1.16	NETT-11	3/30/1987	No	NA	
1,1-Dichloroethene	0.7	0.05	NETT-10	3/30/1987	No	NA	
1,2,4-Trichlorobenzene	27	ND	NA	NA	No	NA	
1,2-Dibromo-3-Chloropropane	0.02	ND	NA	NA	No	NA	
1,2-Dibromoethane	0.005	ND	NA	NA	No	NA	
1,2-Dichlorobenzene	60	ND	NA	NA	No	NA	
1,2-Dichloroethane	0.5	ND	NA	NA	No	NA	
1,2-Dichloroethene	7	ND	NA	NA	No	NA	
1,2-Dichloropropane	0.5	ND	NA	NA	No	NA	
1,3-Dichlorobenzene	61	ND	NA	NA	No	NA	
1,3-Dichloropropene	2.6	ND	NA	NA	No	NA	
1,4-Dichlorobenzene	10	ND	NA	NA	No	NA	
1,4-Dioxane	3.2	ND	NA	NA	No	NA	
2,4,5-Trichlorophenol	6100	ND	NA	NA	No	NA	
2,4,6-Trichlorophenol	29	ND	NA	NA	No	NA	
2,4-Dichlorophenol	2	ND	NA	NA	No	NA	
2,4-Dimethylphenol	200	ND	NA	NA	No	NA	
2,4-Dinitrophenol	20	ND	NA	NA	No	NA	
2,4-Dinitrotoluene	0.84	ND	NA	NA	No	NA	
2,6-Dinitrotoluene	10	ND	NA	NA	No	NA	
2-Butanone	400	0.0365	HD Fire Pond A4 (0-1) Dup	6/16/2003	No	NA	
2-Chloroethyl Vinyl Ether	NA	ND	NA	NA	No	NA	
2-Chloronaphthalene	18000	ND	NA	NA	No	NA	
2-Chlorophenol	4.4	ND	NA	NA	No	NA	
2-Hexanone	4.4	ND	NA	NA	No	NA	
2-Methylnaphthalene	1600	0.058	HD-FCSA-SB-001-02-0	5/9/2007	No	NA	
2-Methylphenol	510	ND	NA	NA	No	NA	
2-Nitroaniline	31	ND	NA	NA	No	NA	
2-Nitrophenol	82	ND	NA	NA	No	NA	
3,3'-Dichlorobenzidine	32	ND	NA	NA	No	NA	
3/4-Methylphenol	51	88	PSWS-1	3/22/2000	Yes	310	No
3-Nitroaniline	3.1	ND	NA	NA	No	NA	
4,4'-DDD	120	ND	NA	NA	No	NA	
4,4'-DDE	170	ND	NA	NA	No	NA	
4,4'-DDT	230	ND	NA	NA	No	NA	
4,6-Dinitro-2-Methylphenol	1	ND	NA	NA	No	NA	
4-Bromophenyl phenyl ether	NA	ND	NA	NA	No	NA	
4-Chloro-3-Methyl-Phenol	110	ND	NA	NA	No	NA	
4-Chloroaniline	1.6	ND	NA	NA	No	NA	
4-Chlorodiphenyl Ether	NA	ND	NA	NA	No	NA	
4-Methyl-2-Pentanone	820	ND	NA	NA	No	NA	
4-Nitroaniline	13	ND	NA	NA	No	NA	
4-Nitrophenol	6	ND	NA	NA	No	NA	
Acenaphthene	4700	ND	NA	NA	No	NA	
Acenaphthylene	6900	ND	NA	NA	No	NA	
Acetone	9200	0.196	Fire Pond 1 (0-1)	6/13/2003	No	NA	
Acrolein	0.018	ND	NA	NA	No	NA	
Acrylonitrile	0.37	ND	NA	NA	No	NA	

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Aldrin	1.8	ND	NA	NA	No	NA	
Alpha-BHC	0.19	ND	NA	NA	No	NA	
Alpha-Endosulfan	260	ND	NA	NA	No	NA	
Aluminum	190000	21900	BG-12	6/3/1998	No	NA	
Anthracene	350	ND	NA	NA	No	NA	
Antimony	27	3	HD Fire Pond A4 (0-1)	6/16/2003	No	NA	
Aroclor-1016	200	ND	NA	NA	No	NA	
Aroclor-1221	0.63	ND	NA	NA	No	NA	
Aroclor-1232	0.5	ND	NA	NA	No	NA	
Aroclor-1242	16	ND	NA	NA	No	NA	
Aroclor-1248	40	ND	NA	NA	No	NA	
Aroclor-1254	40	5.5	SETT 10-1-01	10/1/2001	No	NA	
Aroclor-1260	40	0.0752	WP-SG7a	12/22/1999	No	NA	
Arsenic	29	18.1	PSWS-2	6/8/1998	No	NA	
Barium	8200	162	BG-11	6/3/1998	No	NA	
Benzene	0.5	0.018	SE Corner 11-15-01	11/15/2001	No	NA	
Benzo(a)anthracene	110	0.022	HD-B51-TP-2A-1.5/2-0	1/8/2009	No	NA	
Benzo(a)pyrene	11	ND	NA	NA	No	NA	
Benzo(b)fluoranthene	110	ND	NA	NA	No	NA	
Benzo(g,h,i)perylene	180	ND	NA	NA	No	NA	
Benzo(k)fluoranthene	610	ND	NA	NA	No	NA	
Beryllium	320	2.3	PSWS-2	6/8/1998	No	NA	
Beta-BHC	0.82	ND	NA	NA	No	NA	
Beta-Endosulfan	260	ND	NA	NA	No	NA	
Bis(2-Chloroethoxy) Methane	31	ND	NA	NA	No	NA	
Bis(2-Chloroethyl) Ether	0.076	ND	NA	NA	No	NA	
Bis(2-Chloroisopropyl) Ether	30	ND	NA	NA	No	NA	
Bis(2-ethylhexyl) phthalate	130	ND	NA	NA	No	NA	
Bromochloromethane	9	ND	NA	NA	No	NA	
Bromodichloromethane	8	ND	NA	NA	No	NA	
Bromoform	8	ND	NA	NA	No	NA	
Bromomethane	1	ND	NA	NA	No	NA	
Butylbenzylphthalate	10000	0.03	HD-B51-TP-2G-1.5/2-0	1/8/2009	No	NA	
Cadmium	38	5.3	PSWS-2	6/8/1998	No	NA	
Calcium*	NA	26400	PSWS-2	6/8/1998	No	NA	
Carbazole	83	ND	NA	NA	No	NA	
Carbon Disulfide	620	0.0156	HD Fire Pond A3 (0-1)	6/16/2003	No	NA	
Carbon Tetrachloride	0.5	ND	NA	NA	No	NA	
Chlordane	49	ND	NA	NA	No	NA	
Chlorobenzene	10	ND	NA	NA	No	NA	
Chlorodibromomethane	8	ND	NA	NA	No	NA	
Chloroethane	90	0.44	NETT-11	3/30/1987	No	NA	
Chloroform	8	0.0002	HD Fire Pond B4 (0-1)	6/16/2003	No	NA	
Chloromethane	3	ND	NA	NA	No	NA	
Chromium	190	139	HD-ELF-QC-DUP5-02-1	4/26/2007	No	NA	
Chrysene	230	ND	NA	NA	No	NA	
cis-1,2-Dichloroethene	7	0.53	HD-NETT-SB-042-02-0	4/4/2007	No	NA	
cis-1,3-Dichloropropene	2.6	ND	NA	NA	No	NA	
Cobalt	140	19.5	BG-12	6/3/1998	No	NA	
Copper	43000	173	HD-ELF-QC-DUP5-02-1	4/26/2007	No	NA	
Cyanide, Free	200	2.8	HD-NETT-SB-002-02-0	4/6/2007	No	NA	
Cyanide, Total	200	23	HD-NETT-SB-047-02-0	4/4/2007	No	NA	
Delta-BHC	NA	ND	NA	NA	No	NA	

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Dibenzo(a,h)anthracene	11	ND	NA	NA	No	NA	
Dibenzofuran	260	0.015	HD-FCSA-SB-001-02-0	5/9/2007	No	NA	
Dieldrin	0.44	ND	NA	NA	No	NA	
Diethylphthalate	8200	ND	NA	NA	No	NA	
Dimethylphthalate	NA	ND	NA	NA	No	NA	
Di-n-Butylphthalate	4100	ND	NA	NA	No	NA	
Di-n-octylphthalate	10000	0.498	NTT-SG25a	12/21/1999	No	NA	
Endosulfan Sulfate	70	ND	NA	NA	No	NA	
Endrin	5.5	ND	NA	NA	No	NA	
Endrin Aldehyde	NA	ND	NA	NA	No	NA	
Ethylbenzene	70	0.8	NETT-7	3/30/1987	No	NA	
Fluoranthene	3200	0.028	HD-B51-TP-2A-1.5/2-0	1/8/2009	No	NA	
Fluorene	3800	ND	NA	NA	No	NA	
Heptachlor	0.68	ND	NA	NA	No	NA	
Heptachlor Epoxide	1.1	ND	NA	NA	No	NA	
Hexachlorobenzene	0.96	ND	NA	NA	No	NA	
Hexachlorobutadiene	39	ND	NA	NA	No	NA	
Hexachlorocyclopentadiene	91	ND	NA	NA	No	NA	
Hexachloroethane	0.56	ND	NA	NA	No	NA	
Hexavalent Chromium	190	1.59	NTT-SG12a	12/16/1999	No	NA	
Indeno(1,2,3-cd)pyrene	110	ND	NA	NA	No	NA	
Iron	190000	90200	PSWS-2	6/8/1998	No	NA	
Isophorone	10	ND	NA	NA	No	NA	
Lead	450	218	BG-12	6/3/1998	No	NA	
Lindane (Gamma-BHC)	0.072	ND	NA	NA	No	NA	
m,p-Xylene	1000	0.0017	HD Fire Pond A3 (0-1)	6/16/2003	No	NA	
Magnesium*	NA	10100	PSWS-2	6/8/1998	No	NA	
Manganese	2000	1600	PSWS-2	6/8/1998	No	NA	
Mercury	10	1.7	OWCA-SP-1	4/27/1995	No	NA	
Methyl tert-butyl ether	2	ND	NA	NA	No	NA	
Methylene chloride	0.5	0.024	HD-NETT-SB-013-02-0	4/19/2007	No	NA	
Naphthalene	25	0.034	HD-FCSA-SB-001-02-0	5/9/2007	No	NA	
Nickel	650	112	WP-SG7a	12/22/1999	No	NA	
Nitrobenzene	20	ND	NA	NA	No	NA	
N-Nitrosodi-n-propylamine	0.037	ND	NA	NA	No	NA	
N-Nitrosodiphenylamine	83	ND	NA	NA	No	NA	
o-Xylene	1000	0.0054	HD Fire Pond B2 (0-1)	6/16/2003	No	NA	
Pentachlorophenol	5	ND	NA	NA	No	NA	
Phenanthrene	10000	0.036	HD-B51-TP-2A-1.5/2-0	1/8/2009	No	NA	
Phenol	200	ND	NA	NA	No	NA	
Potassium*	NA	3650	PSWS-2	6/8/1998	No	NA	
Pyrene	2200	0.032	HD-B51-TP-2A-1.5/2-0	1/8/2009	No	NA	
Selenium	26	19	SE Corner 11-15-01	11/15/2001	No	NA	
Silver	84	0.5	HD Fire Pond B4 and A2	6/16/2003	No	NA	
Sodium*	NA	310	PSWS-1-B	6/8/1998	No	NA	
Styrene	24	0.018	HD-NETT-SB-043-02-0	4/4/2007	No	NA	
Tetrachloroethene	0.5	403	NTT-SG25a	12/21/1999	Yes	2.6	**YES - COC**
Thallium	14	0.56	HD-ELF-SB-002-02-0	4/25/2007	No	NA	
Toluene	100	0.2	NETT-9	1/1/1987	No	NA	
Toxaphene	1.2	ND	NA	NA	No	NA	
trans-1,2-Dichloroethene	10	4.4	NETT-10	3/30/1987	No	NA	
trans-1,3-Dichloropropene	2.6	ND	NA	NA	No	NA	
Trichloroethene	0.5	0.8	NETT-8	3/30/1987	Yes	6.4	No
Trichlorofluoromethane	200	ND	NA	NA	No	NA	
Vanadium	20000	36.8	BG-12	6/3/1998	No	NA	
Vinyl Chloride	0.2	1.5	NETT-10	3/30/1987	Yes	1.7	No
Xylenes (Total)	1000	2.7	HD-NETT-SB-042-02-0	4/4/2007	No	NA	
Zinc	12000	606	PSWS-2	6/8/1998	No	NA	

NA - Not Applicable
ND - Not Detected
* Essential Nutrient

Table 2
Screening of Constituents in Surface and Subsurface Soil - East Campus
Former York Naval Ordnance Plant, York, PA

Analyte	MSC Screening Level mg/kg	Maximum Detected mg/kg	Maximum Detected Sample Location	Date Sampled	Is Maximum Concentration > MSC Screening Level?	US EPA Regional Screening Level mg/kg	Is Maximum Detected Concentration > RSL?
1,1,1,2-Tetrachloroethane	18	ND	NA	NA	No	NA	
1,1,1-Trichloroethane	20	50.9	NTT-SG25a	12/21/1999	Yes	3800	No
1,1,2,2-Tetrachloroethane	0.43	0.26	NPBA-OB-2 8-10	4/22/1988	No	NA	
1,1,2-Trichloroethane	0.5	ND	NA	NA	No	NA	
1,1-Dichloroethane	16	1.16	NETT-11	3/30/1987	No	NA	
1,1-Dichloroethene	0.7	0.05	NETT-10	3/30/1987	No	NA	
1,2,4-Trichlorobenzene	27	0.015	HD-B51-TP-1G-9/9.5-0	12/30/2008	No	NA	
1,2-Dibromo-3-Chloropropane	0.02	ND	NA	NA	No	NA	
1,2-Dibromoethane	0.005	ND	NA	NA	No	NA	
1,2-Dichlorobenzene	60	ND	NA	NA	No	NA	
1,2-Dichloroethane	0.5	4.1	LFTP-14	11/14/1986	Yes	2.2	**YES - COC**
1,2-Dichloroethene	7	ND	NA	NA	No	NA	
1,2-Dichloropropane	0.5	ND	NA	NA	No	NA	
1,3-Dichlorobenzene	61	ND	NA	NA	No	NA	
1,3-Dichloropropene	2.6	ND	NA	NA	No	NA	
1,4-Dichlorobenzene	10	0.021	HD-DSA-QC-DUP7-04-1	5/7/2007	No	NA	
1,4-Dioxane	3.2	ND	NA	NA	No	NA	
2,4,5-Trichlorophenol	6100	ND	NA	NA	No	NA	
2,4,6-Trichlorophenol	29	ND	NA	NA	No	NA	
2,4-Dichlorophenol	2	ND	NA	NA	No	NA	
2,4-Dimethylphenol	200	ND	NA	NA	No	NA	
2,4-Dinitrophenol	20	ND	NA	NA	No	NA	
2,4-Dinitrotoluene	0.84	ND	NA	NA	No	NA	
2,6-Dinitrotoluene	10	ND	NA	NA	No	NA	
2-Butanone	400	0.46	HD-ELF-SB-008-03-0	4/26/2007	No	NA	
2-Chloroethyl Vinyl Ether	NA	ND	NA	NA	No	NA	
2-Chloronaphthalene	18000	ND	NA	NA	No	NA	
2-Chlorophenol	4.4	ND	NA	NA	No	NA	
2-Hexanone	4.4	0.0772	NTT-SG15a Dup	12/17/1999	No	NA	
2-Methylnaphthalene	1600	0.2	HD-ELF-SB-008-03-0	4/26/2007	No	NA	
2-Methylphenol	510	ND	NA	NA	No	NA	
2-Nitroaniline	31	ND	NA	NA	No	NA	
2-Nitrophenol	82	ND	NA	NA	No	NA	
3,3'-Dichlorobenzidine	32	ND	NA	NA	No	NA	
3/4-Methylphenol	51	88	PSWS-1	3/22/2000	Yes	310	No
3-Nitroaniline	3.1	ND	NA	NA	No	NA	
4,4'-DDD	120	ND	NA	NA	No	NA	
4,4'-DDE	170	ND	NA	NA	No	NA	
4,4'-DDT	330	ND	NA	NA	No	NA	
4,6-Dinitro-2-Methylphenol	1	ND	NA	NA	No	NA	
4-Bromophenyl phenyl ether	NA	0.092	HD-DSA-SB-002-04-0	5/7/2007	No	NA	
4-Chloro-3-Methyl-Phenol	110	ND	NA	NA	No	NA	
4-Chloroaniline	1.6	ND	NA	NA	No	NA	
4-Chlorodiphenyl Ether	NA	ND	NA	NA	No	NA	
4-Methyl-2-Pentanone	820	0.4	HD-ELF-SB-009-09-0	6/22/2007	No	NA	
4-Nitroaniline	13	ND	NA	NA	No	NA	
4-Nitrophenol	6	ND	NA	NA	No	NA	
Acenaphthene	4700	0.37	HD-ELF-SB-008-03-0	4/26/2007	No	NA	
Acenaphthylene	6900	ND	NA	NA	No	NA	
Acetone	9200	0.49	HD-NETT-SB-038-04-0	4/3/2007	No	NA	
Acrolein	0.018	ND	NA	NA	No	NA	
Acrylonitrile	0.37	0.0022	SE Corner 11	11/21/2001	No	NA	
Aldrin	1.8	ND	NA	NA	No	NA	
Alpha-BHC	0.19	ND	NA	NA	No	NA	
Alpha-Endosulfan	260	ND	NA	NA	No	NA	
Aluminum	190000	21900	BG-12	6/3/1998	No	NA	
Anthracene	350	0.67	HD-ELF-SB-008-03-0	4/26/2007	No	NA	
Antimony	27	37	HD-3: 2-4	9/11/1989	Yes	410	No
Aroclor-1016	200	ND	NA	NA	No	NA	
Aroclor-1221	0.63	ND	NA	NA	No	NA	
Aroclor-1232	0.5	ND	NA	NA	No	NA	
Aroclor-1242	16	ND	NA	NA	No	NA	
Aroclor-1248	62	0.13	HD-ELF-SB-008-03-0	4/26/2007	No	NA	
Aroclor-1254	260	5.5	SETT 10-1-01	10/1/2001	No	NA	
Aroclor-1260	590	0.0752	WP-SG7a	12/22/1999	No	NA	
Arsenic	29	29.1	HD-ELF-SB-008-03-0	4/26/2007	Yes	1.6	**YES - COC**
Barium	8200	427	HD-ELF-SB-011-14-0	5/9/2007	No	NA	

Table 2
Screening of Constituents in Surface and Subsurface Soil - East Campus
Former York Naval Ordnance Plant, York, PA

Analyte	MSC Screening Level mg/kg	Maximum Detected mg/kg	Maximum Detected Sample Location	Date Sampled	Is Maximum Concentration > MSC Screening Level?	US EPA Regional Screening Level mg/kg	Is Maximum Detected Concentration > RSL?
Benzene	0.5	0.22	LFTP-14	11/14/1986	No	NA	
Benzo(a)anthracene	320	1.6	HD-ELF-SB-008-03-0	4/26/2007	No	NA	
Benzo(a)pyrene	46	2.6	HD-ELF-SB-006-14-0	4/26/2007	No	NA	
Benzo(b)fluoranthene	170	0.985	LF-SG13a	12/9/1999	No	NA	
Benzo(g,h,i)perylene	180	0.502	LF-SG13a	12/9/1999	No	NA	
Benzo(k)fluoranthene	610	0.49	LF-SG13a	12/9/1999	No	NA	
Beryllium	320	2.3	PSWS-2	6/8/1998	No	NA	
Beta-BHC	0.82	ND	NA	NA	No	NA	
Beta-Endosulfan	260	ND	NA	NA	No	NA	
Bis(2-Chloroethoxy) Methane	31	ND	NA	NA	No	NA	
Bis(2-Chloroethyl) Ether	0.076	ND	NA	NA	No	NA	
Bis(2-Chloroisopropyl) Ether	30	ND	NA	NA	No	NA	
Bis(2-ethylhexyl) phthalate	130	17	HD-ELF-SB-006-14-0	4/26/2007	No	NA	
Bromochloromethane	9	ND	NA	NA	No	NA	
Bromodichloromethane	8	ND	NA	NA	No	NA	
Bromoform	8	0.0011	SB-12-6	10/2/2002	No	NA	
Bromomethane	1	ND	NA	NA	No	NA	
Butylbenzylphthalate	10000	0.072	HD-B45-TP-1B-11/11.5-0	1/8/2009	No	NA	
Cadmium	38	21.2	HD-ELF-SB-007-03-0	6/22/2007	No	NA	
Calcium*	NA	26400	PSWS-2	6/8/1998	No	NA	
Carbazole	83	0.32	HD-ELF-SB-008-03-0	4/26/2007	No	NA	
Carbon Disulfide	620	0.0156	HD Fire Pond A3 (0-1)	6/16/2003	No	NA	
Carbon Tetrachloride	0.5	ND	NA	NA	No	NA	
Chlordane	49	ND	NA	NA	No	NA	
Chlorobenzene	10	0.34	LFTP-14	11/14/1986	No	NA	
Chlorodibromomethane	8	ND	NA	NA	No	NA	
Chloroethane	90	0.44	NETT-11	3/30/1987	No	NA	
Chloroform	8	0.015	LFTP-14	11/14/1986	No	NA	
Chloromethane	3	ND	NA	NA	No	NA	
Chromium	190	507	HD-SPBA-SB-024-03-0	1/23/2008	Yes	5.6	**YES - COC**
Chrysene	230	1.8	HD-ELF-SB-008-03-0	4/26/2007	No	NA	
cis-1,2-Dichloroethene	7	11	HD-NETT-SB-038-04-0	4/3/2007	Yes	200	No
cis-1,3-Dichloropropene	2.6	ND	NA	NA	No	NA	
Cobalt	140	19.5	BG-12	6/3/1998	No	NA	
Copper	43000	610	HD-ELF-SB-006-09-0	4/26/2007	No	NA	
Cyanide, Free	200	2.9	HD-NETT-SB-002-10-0	4/6/2007	No	NA	
Cyanide, Total	200	23	HD-NETT-SB-047-02-0	4/4/2007	No	NA	
Delta-BHC	NA	ND	NA	NA	No	NA	
Dibenzo(a,h)anthracene	160	0.058	HD-SPBA-SB-027-04-0	5/7/2007	No	NA	
Dibenzofuran	260	0.37	HD-ELF-SB-008-03-0	4/26/2007	No	NA	
Dieldrin	0.44	ND	NA	NA	No	NA	
Diethylphthalate	8200	0.06	HD-B51-TP-1C-9/9.5-0	12/30/2008	No	NA	
Dimethylphthalate	NA	ND	NA	NA	No	NA	
Di-n-Butylphthalate	4100	ND	NA	NA	No	NA	
Di-n-octylphthalate	10000	ND	NA	NA	No	NA	
Endosulfan Sulfate	70	ND	NA	NA	No	NA	
Endrin	5.5	ND	NA	NA	No	NA	
Endrin Aldehyde	NA	ND	NA	NA	No	NA	
Ethylbenzene	70	10	HD-NETT-SB-037-12-0	4/3/2007	No	NA	
Fluoranthene	3200	5.6	HD-ELF-SB-008-03-0	4/26/2007	No	NA	
Fluorene	3800	0.76	HD-ELF-SB-008-03-0	4/26/2007	No	NA	
Heptachlor	0.68	ND	NA	NA	No	NA	
Heptachlor Epoxide	1.1	ND	NA	NA	No	NA	
Hexachlorobenzene	0.96	ND	NA	NA	No	NA	
Hexachlorobutadiene	39	ND	NA	NA	No	NA	
Hexachlorocyclopentadiene	91	ND	NA	NA	No	NA	
Hexachloroethane	0.56	ND	NA	NA	No	NA	
Hexavalent Chromium	190	254	HD-SPBA-SB-024-03-0	1/23/2008	Yes	5.6	**YES - COC**
Indeno(1,2,3-cd)pyrene	28000	0.6	HD-ELF-SB-008-03-0	4/26/2007	No	NA	
Iron	190000	90200	PSWS-2	6/8/1998	No	NA	
Isophorone	10	ND	NA	NA	No	NA	
Lead	450	1580	HD-ELF-SB-006-14-0	4/26/2007	Yes	800	**YES - COC**
Lindane (Gamma-BHC)	0.072	ND	NA	NA	No	NA	
m,p-Xylene	1000	0.0017	HD Fire Pond A3 (0-1)	6/16/2003	No	NA	
Magnesium*	NA	10100	PSWS-2	6/8/1998	No	NA	
Manganese	2000	1600	PSWS-2	6/8/1998	No	NA	
Mercury	10	1.7	OWCA-SP-1	4/27/1995	No	NA	

Table 2
Screening of Constituents in Surface and Subsurface Soil - East Campus
Former York Naval Ordnance Plant, York, PA

Analyte	MSC Screening Level mg/kg	Maximum Detected mg/kg	Maximum Detected Sample Location	Date Sampled	Is Maximum Concentration > MSC Screening Level?	US EPA Regional Screening Level mg/kg	Is Maximum Detected Concentration > RSL?
Methyl tert-butyl ether	2	ND	NA	NA	No	NA	
Methylene chloride	0.5	0.7	LFTP-14	11/14/1986	Yes	53	No
Naphthalene	25	0.49	HD-ELF-SB-008-03-0	4/26/2007	No	NA	
Nickel	650	454	HD-ELF-SB-010-03-0	6/22/2007	No	NA	
Nitrobenzene	20	ND	NA	NA	No	NA	
N-Nitrosodi-n-propylamine	0.037	ND	NA	NA	No	NA	
N-Nitrosodiphenylamine	83	ND	NA	NA	No	NA	
o-Xylene	1000	0.0054	HD Fire Pond B2 (0-1)	6/16/2003	No	NA	
Pentachlorophenol	5	ND	NA	NA	No	NA	
Phenanthrene	10000	3.9	HD-ELF-SB-008-03-0	4/26/2007	No	NA	
Phenol	200	0.072	HD-B45-TP-1A-10/5/11-0	1/8/2009	No	NA	
Potassium*	NA	3650	PSWS-2	6/8/1998	No	NA	
Pyrene	2200	2.6	HD-ELF-SB-008-03-0	4/26/2007	No	NA	
Selenium	26	19	SE Corner 11-15-01	11/15/2001	No	NA	
Silver	84	15.3	HD-ELF-SB-006-14-0	4/26/2007	No	NA	
Sodium*	NA	310	PSWS-1-B	6/8/1998	No	NA	
Styrene	24	0.018	HD-NETT-SB-043-02-0	4/4/2007	No	NA	
Tetrachloroethene	0.5	660	SB-13-6	10/2/2002	Yes	2.6	**YES - COC**
Thallium	14	20	HD-3: 2-4	9/11/1989	Yes	10	**YES - COC**
Toluene	100	16	HD-NETT-SB-037-12-0	4/3/2007	No	NA	
Toxaphene	1.2	ND	NA	NA	No	NA	
trans-1,2-Dichloroethene	10	4.4	NETT-10	3/30/1987	No	NA	
trans-1,3-Dichloropropene	2.6	ND	NA	NA	No	NA	
Trichloroethene	0.5	0.8	NETT-8	3/30/1987	Yes	6.4	No
Trichlorofluoromethane	200	0.00036	SB-14-4	10/2/2002	No	NA	
Vanadium	72000	44.3	HD-SPBA-SB-025-03-0	1/23/2008	No	NA	
Vinyl Chloride	0.2	2.5	HD-NETT-SB-037-12-1	4/4/2007	Yes	1.7	**YES - COC**
Xylenes (Total)	1000	86	HD-ELF-SB-008-03-0	4/26/2007	No	NA	
Zinc	12000	2400	HD-ELF-SB-006-14-0	4/26/2007	No	NA	

NA - Not Applicable
ND - Not Detected
* Essential Nutrient

Table 3
Screening of Constituents in Surface Soil - West Campust
Former York Naval Ordnance Plant, York, PA

Analyte	MSC Screening Level mg/kg	Maximum Detected mg/kg	Maximum Detected Sample Location	Date Sampled	Is Maximum Concentration > MSC Screening Level?	US EPA Regional Screening Level mg/kg	Is Maximum Detected Concentration > RSL?
1,1,1,2-Tetrachloroethane	18	ND	NA	NA	No	NA	
1,1,1-Trichloroethane	20	0.26	OWCA-SP-7	4/26/1995	No	NA	
1,1,2,2-Tetrachloroethane	0.43	ND	NA	NA	No	NA	
1,1,2-Trichloroethane	0.5	ND	NA	NA	No	NA	
1,1-Dichloroethane	16	0.03	OWCA-SP-7	4/26/1995	No	NA	
1,1-Dichloroethene	0.7	ND	NA	NA	No	NA	
1,2,4-Trichlorobenzene	27	ND	NA	NA	No	NA	
1,2-Dibromoethane	0.005	ND	NA	NA	No	NA	
1,2-Dichlorobenzene	60	ND	NA	NA	No	NA	
1,2-Dichloroethane	0.5	ND	NA	NA	No	NA	
1,2-Dichloroethene	7	ND	NA	NA	No	NA	
1,2-Dichloropropane	0.5	ND	NA	NA	No	NA	
1,3-Dichlorobenzene	61	ND	NA	NA	No	NA	
1,3-Dichloropropene	2.6	ND	NA	NA	No	NA	
1,4-Dichlorobenzene	10	0.34	HD-BPA-SB-035-02-0	2/6/2004	No	NA	
1,4-Dioxane	3.2	ND	NA	NA	No	NA	
2,4,5-Trichlorophenol	6100	ND	NA	NA	No	NA	
2,4,6-Trichlorophenol	29	ND	NA	NA	No	NA	
2,4-Dichlorophenol	2	ND	NA	NA	No	NA	
2,4-Dimethylphenol	200	0.055	HD-B41S-SB-S7N-11	4/2/2008	No	NA	
2,4-Dinitrophenol	20	ND	NA	NA	No	NA	
2,4-Dinitrotoluene	0.84	ND	NA	NA	No	NA	
2,6-Dinitrotoluene	10	ND	NA	NA	No	NA	
2-Butanone	400	0.57	OWCA-SP-7	4/26/1995	No	NA	
2-Chloroethyl Vinyl Ether	NA	ND	NA	NA	No	NA	
2-Chloronaphthalene	18000	ND	NA	NA	No	NA	
2-Chlorophenol	4.4	ND	NA	NA	No	NA	
2-Hexanone	4.4	ND	NA	NA	No	NA	
2-Methylnaphthalene	1600	0.72	HD-WPL-SB-030-02-0	2/12/2004	No	NA	
2-Methylphenol	510	0.034	HD-B41S-SB-S7N-11	4/2/2008	No	NA	
2-Nitroaniline	31	ND	NA	NA	No	NA	
2-Nitrophenol	82	ND	NA	NA	No	NA	
3,3'-Dichlorobenzidine	32	ND	NA	NA	No	NA	
3/4-Methylphenol	51	0.39	HD-WPL-SB-120-02-0	4/19/2007	No	NA	
3-Nitroaniline	3.1	ND	NA	NA	No	NA	
4,6-Dinitro-2-Methylphenol	1	ND	NA	NA	No	NA	
4-Bromophenyl phenyl ether	NA	ND	NA	NA	No	NA	
4-Chloro-3-Methyl-Phenol	110	ND	NA	NA	No	NA	
4-Chloroaniline	1.6	0.097	HD-WPL-SB-106-01-0	4/23/2007	No	NA	
4-Chlorodiphenyl Ether	NA	ND	NA	NA	No	NA	
4-Methyl-2-Pentanone	820	ND	NA	NA	No	NA	
4-Methylphenol	51	0.23	HD-B-SS-2-02-00	7/30/2004	No	NA	
4-Nitroaniline	13	ND	NA	NA	No	NA	
4-Nitrophenol	6	ND	NA	NA	No	NA	
Acenaphthene	4700	2.5	HD-WPL-SB-023-02-0	2/12/2004	No	NA	
Acenaphthylene	6900	1	HD-WPL-SB-023-02-0	2/12/2004	No	NA	
Acetone	9200	0.26	HD-B-SS-2-02-00	7/30/2004	No	NA	
Acrolein	0.018	ND	NA	NA	No	NA	
Acrylonitrile	0.37	ND	NA	NA	No	NA	
Aluminum	190000	11300	BG-28	6/4/1998	No	NA	
Anthracene	350	3.8	HD-WPL-SB-023-02-0	2/12/2004	No	NA	
Antimony	27	7.6	HD-WPL-SB-115-01-0	4/12/2007	No	NA	
Aroclor-1016	200	ND	NA	NA	No	NA	
Aroclor-1221	0.63	ND	NA	NA	No	NA	
Aroclor-1232	0.5	ND	NA	NA	No	NA	
Aroclor-1242	16	ND	NA	NA	No	NA	
Aroclor-1248	40	0.078	HD-WPL-SB-118-02-0	4/30/2007	No	NA	
Aroclor-1254	40	14	WPLTP-11-4	7/23/1991	No	NA	
Aroclor-1260	40	6.3	HD-WPL-SB-017-02-0	2/13/2004	No	NA	
Aroclor-1268	0.5	ND	NA	NA	No	NA	
Arsenic	29	29	SB 522	5/1/2000	Yes	1.6	**YES - COC**
Barium	8200	347	HD-WPL-SB-120-02-0	4/19/2007	No	NA	
Benzene	0.5	0.002	HD-WPL-SB-024-02-0	2/13/2004	No	NA	
Benzo(a)anthracene	110	9.4	HD-WPL-SB-023-02-0	2/12/2004	No	NA	
Benzo(a)pyrene	11	9.3	HD-WPL-SB-023-02-0	2/12/2004	No	NA	
Benzo(b)fluoranthene	110	7.3	HD-WPL-SB-023-02-0	2/12/2004	No	NA	
Benzo(g,h,i)perylene	180	5.3	HD-WPL-SB-115-01-0	4/12/2007	No	NA	
Benzo(k)fluoranthene	610	9.3	HD-WPL-SB-023-02-0	2/12/2004	No	NA	
Beryllium	320	2.5	HD-B41S-SB-S7N-14	4/2/2008	No	NA	
Bis(2-Chloroethoxy) Methane	31	ND	NA	NA	No	NA	
Bis(2-Chloroethyl) Ether	0.076	ND	NA	NA	No	NA	

Table 3
Screening of Constituents in Surface Soil - West Campust
Former York Naval Ordnance Plant, York, PA

Analyte	MSC Screening Level mg/kg	Maximum Detected mg/kg	Maximum Detected Sample Location	Date Sampled	Is Maximum Concentration > MSC Screening Level?	US EPA Regional Screening Level mg/kg	Is Maximum Detected Concentration > RSL?
Bis(2-Chloroisopropyl) Ether	30	ND	NA	NA	No	NA	
Bis(2-ethylhexyl) phthalate	130	2.3	HD-B41S-SB-S7N-11	4/2/2008	No	NA	
Bromochloromethane	9	ND	NA	NA	No	NA	
Bromodichloromethane	8	ND	NA	NA	No	NA	
Bromoform	8	ND	NA	NA	No	NA	
Bromomethane	1	ND	NA	NA	No	NA	
Butylbenzylphthalate	10000	0.087	HD-B41S-SB-S7N-11	4/2/2008	No	NA	
Cadmium	38	112	UTSWS-3	6/9/1998	Yes	80	YES - COC
Calcium*	NA	3910	BG-27	6/4/1998	No	NA	
Carbazole	83	0.61	HD-WPL-SB-115-01-0	4/12/2007	No	NA	
Carbon Disulfide	620	0.0072	HD-B41S-SB-012-02-0	2/8/2008	No	NA	
Carbon Tetrachloride	0.5	ND	NA	NA	No	NA	
Chlorobenzene	10	ND	NA	NA	No	NA	
Chlorodibromomethane	8	ND	NA	NA	No	NA	
Chloroethane	90	ND	NA	NA	No	NA	
Chloroform	8	0.0039	HD-WPL-SB-120-02-0	4/19/2007	No	NA	
Chloromethane	3	ND	NA	NA	No	NA	
Chromium	190	3820	HD-WPL-SB-024-02-0	2/13/2004	Yes	5.6	YES - COC
Chrysene	230	8.6	HD-WPL-SB-023-02-0	2/12/2004	No	NA	
cis-1,2-Dichloroethene	7	5.1	HD-B41S-SB-S7N-16	4/2/2008	No	NA	
cis-1,3-Dichloropropene	2.6	ND	NA	NA	No	NA	
Cobalt	140	6.52	BG-28	6/4/1998	No	NA	
Copper	43000	2700	WPLTP-11-4	7/23/1991	No	NA	
Cyanide, Free	200	1	HD-B41S-SB-009-02-0	2/8/2008	No	NA	
Cyanide, Total	200	0.69	HD-WPL-SD-005-.5-0	7/5/2007	No	NA	
Dibenzo(a,h)anthracene	11	2.4	HD-WPL-SB-023-02-0	2/12/2004	No	NA	
Dibenzofuran	260	1.5	HD-WPL-SB-023-02-0	2/12/2004	No	NA	
Diethylphthalate	8200	0.041	HD-B41S-SB-012-02-0	2/8/2008	No	NA	
Dimethylphthalate	NA	0.066	HD-FCSA-SB-003-02-0	5/7/2007	No	NA	YES - COC
Di-n-Butylphthalate	4100	1.1	HD-WPL-SB-040-02-0	2/13/2004	No	NA	
Di-n-octylphthalate	10000	0.042	HD-B41S-SB-S7N-11	4/2/2008	No	NA	
Ethylbenzene	70	15	OWCA-SP-7	4/26/1995	No	NA	
Fluoranthene	3200	18	HD-WPL-SB-023-02-0	2/12/2004	No	NA	
Fluorene	3800	2.9	HD-WPL-SB-023-02-0	2/12/2004	No	NA	
Hexachlorobenzene	0.96	ND	NA	NA	No	NA	
Hexachlorobutadiene	39	ND	NA	NA	No	NA	
Hexachlorocyclopentadiene	91	ND	NA	NA	No	NA	
Hexachloroethane	0.56	ND	NA	NA	No	NA	
Hexavalent Chromium	190	122	HD-B41S-SB-010-02-0	2/8/2008	No	NA	
Indeno(1,2,3-cd)pyrene	110	5.6	HD-WPL-SB-023-02-0	2/12/2004	No	NA	
Iron	190000	15800	BG-27	6/4/1998	No	NA	
Isophorone	10	0.16	HD-WPL-SB-074-02-0	3/12/2004	No	NA	
Lead	450	1000	WPL-15-B-1	7/23/1991	Yes	800	YES - COC
Magnesium*	NA	1280	BG-28	6/4/1998	No	NA	
Manganese	2000	327	BG-28	6/4/1998	No	NA	
Mercury	10	6	HD-WPL-SB-030-02-0	2/12/2004	No	NA	
Methyl tert-butyl ether	2	ND	NA	NA	No	NA	
Methylene chloride	0.5	0.1	HD-B41S-SB-S7N-11	4/2/2008	No	NA	
Naphthalene	25	0.91	HD-WPL-SB-030-02-0	2/12/2004	No	NA	
Nickel	650	360	WPLTP-11-4	7/23/1991	No	2000	No
Nitrobenzene	20	0.88	HD-WPL-SB-106-01-0	4/23/2007	No	NA	
N-Nitrosodi-n-propylamine	0.037	ND	NA	NA	No	NA	
N-Nitrosodiphenylamine	83	ND	NA	NA	No	NA	
Pentachlorophenol	5	4.2	HD-WPL-SB-120-02-0	4/19/2007	No	NA	
Phenanthrene	10000	9.5	HD-WPL-SB-115-01-0	4/12/2007	No	NA	
Phenol	200	ND	NA	NA	No	NA	
Potassium*	NA	2810	BG-28	6/4/1998	No	NA	
Pyrene	2200	16	HD-WPL-SB-023-02-0	2/12/2004	No	NA	
Selenium	26	1.5	HD-WPL-SB-046-02-0	2/12/2004	No	NA	
Silver	84	42	WPLTP-11-4	7/23/1991	No	NA	
Sodium*	NA	ND	NA	NA	No	NA	
Styrene	24	ND	NA	NA	No	NA	
Tetrachloroethene	0.5	8.1	HD-B41S-SB-S7N-11	4/2/2008	Yes	2.6	YES - COC
Thallium	14	22	SB 522	5/1/2000	Yes	10	YES - COC
Toluene	100	23	OWCA-SP-7	4/26/1995	No	NA	
trans-1,2-Dichloroethene	10	0.0035	HD-B41S-SB-010-02-0	2/8/2008	No	NA	
trans-1,3-Dichloropropene	2.6	ND	NA	NA	No	NA	
Trichloroethene	0.5	7.8	HD-BPA-SB-054-01-0	3/13/2004	Yes	6.4	YES - COC
Trichlorofluoromethane	200	ND	NA	NA	No	NA	
Vanadium	20000	50.2	HD-WPL-SB-120-02-0	4/19/2007	No	NA	
Vinyl Chloride	0.2	0.088	HD-B41S-SB-S4N-06	4/2/2008	No	NA	
Xylenes (Total)	1000	100	OWCA-SP-7	4/26/1995	No	NA	
Zinc	12000	6900	HD-WPL-SB-024-02-0	2/13/2004	No	NA	

NA - Not Applicable

Table 3
Screening of Constituents in Surface Soil - West Campust
Former York Naval Ordnance Plant, York, PA

Analyte	MSC Screening Level mg/kg	Maximum Detected mg/kg	Maximum Detected Sample Location	Date Sampled	Is Maximum Concentration > MSC Screening Level?	US EPA Regional Screening Level mg/kg	Is Maximum Detected Concentration > RSL?

ND - Not Detected
* Essential Nutrient

Table 4
Screening of Constituents in Surface and Subsurface Soil - West Campus
Former York Naval Ordnance Plant, York, PA

Analyte	MSC Screening Level mg/kg	Maximum Detected mg/kg	Maximum Detected Sample Location	Date Sampled	Is Maximum Concentration > MSC Screening Level?	US EPA Regional Screening Level mg/kg	Is Maximum Detected Concentration > RSL?
1,1,1,2-Tetrachloroethane	18	ND	NA	NA	No	NA	
1,1,1-Trichloroethane	20	170	HD-B4ND-SB-014-15-0	7/23/2007	Yes	3800	No
1,1,2,2-Tetrachloroethane	0.43	ND	NA	NA	No	NA	
1,1,2-Trichloroethane	0.5	0.54	HD-WPL-SB-055-07-0	3/10/2004	Yes	5.3	No
1,1-Dichloroethane	16	1	HD-B4ND-SB-014-15-0	7/23/2007	No	NA	
1,1-Dichloroethene	0.7	0.11	OWCA-CB-9	4/27/1988	No	NA	
1,2,4-Trichlorobenzene	27	ND	NA	NA	No	NA	
1,2-Dibromo-3-Chloropropane	0.02	ND	NA	NA	No	NA	
1,2-Dibromoethane	0.005	ND	NA	NA	No	NA	
1,2-Dichlorobenzene	60	0.21	HD-WPL-SB-069-07-0	3/11/2004	No	NA	
1,2-Dichloroethane	0.5	ND	NA	NA	No	NA	
1,2-Dichloroethene	7	ND	NA	NA	No	NA	
1,2-Dichloropropane	0.5	ND	NA	NA	No	NA	
1,3-Dichlorobenzene	61	ND	NA	NA	No	NA	
1,3-Dichloropropene	2.6	ND	NA	NA	No	NA	
1,4-Dichlorobenzene	10	0.34	HD-BPA-SB-035-02-0	2/6/2004	No	NA	
1,4-Dioxane	3.2	ND	NA	NA	No	NA	
2,4,5-Trichlorophenol	6100	ND	NA	NA	No	NA	
2,4,6-Trichlorophenol	29	ND	NA	NA	No	NA	
2,4-Dichlorophenol	2	ND	NA	NA	No	NA	
2,4-Dimethylphenol	200	0.055	HD-B41S-SB-S7N-11	4/2/2008	No	NA	
2,4-Dinitrophenol	20	ND	NA	NA	No	NA	
2,4-Dinitrotoluene	0.84	ND	NA	NA	No	NA	
2,6-Dinitrotoluene	10	1.53	BPA TP-1a	12/7/1999	No	NA	
2-Butanone	400	5.2	OWCA-SP-3	4/28/1995	No	NA	
2-Chloroethyl Vinyl Ether	NA	ND	NA	NA	No	NA	
2-Chloronaphthalene	18000	ND	NA	NA	No	NA	
2-Chlorophenol	4.4	ND	NA	NA	No	NA	
2-Hexanone	4.4	ND	NA	NA	No	NA	
2-Methylnaphthalene	1600	6.6	HD-WPL-SB-095-05-0	4/26/2007	No	NA	
2-Methylphenol	510	0.085	HD-B41N-TP-1G-4/4.5-0	12/23/2008	No	NA	
2-Nitroaniline	31	ND	NA	NA	No	NA	
2-Nitrophenol	82	ND	NA	NA	No	NA	
3,3'-Dichlorobenzidine	32	ND	NA	NA	No	NA	
3/4-Methylphenol	51	0.39	HD-WPL-SB-120-02-0	4/19/2007	No	NA	
3-Nitroaniline	3.1	ND	NA	NA	No	NA	
4,4'-DDD	120	ND	NA	NA	No	NA	
4,4'-DDE	170	ND	NA	NA	No	NA	
4,4'-DDT	330	ND	NA	NA	No	NA	
4,6-Dinitro-2-Methylphenol	1	ND	NA	NA	No	NA	
4-Bromophenyl phenyl ether	NA	ND	NA	NA	No	NA	
4-Chloro-3-Methyl-Phenol	110	ND	NA	NA	No	NA	
4-Chloroaniline	1.6	ND	NA	NA	No	NA	
4-Chlorodiphenyl Ether	NA	ND	NA	NA	No	NA	
4-Methyl-2-Pentanone	820	0.43	OWCA-SP-7	4/26/1995	No	NA	
4-Methylphenol	51	0.23	HD-B-SS-2-02-00	7/30/2004	No	NA	
4-Nitroaniline	13	ND	NA	NA	No	NA	
4-Nitrophenol	6	ND	NA	NA	No	NA	
Acenaphthene	4700	8.2	WPL TP-5	11/26/1999	No	NA	
Acenaphthylene	6900	2.6	WPL TP-5	11/26/1999	No	NA	
Acetone	9200	3	OWCA-SP-7	4/26/1995	No	NA	
Acrolein	0.018	ND	NA	NA	No	NA	
Acrylonitrile	0.37	ND	NA	NA	No	NA	
Aldrin	1.8	ND	NA	NA	No	NA	
Alpha-BHC	0.19	ND	NA	NA	No	NA	
Alpha-Endosulfan	260	ND	NA	NA	No	NA	
Aluminum	190000	11300	BG-28	6/4/1998	No	NA	
Anthracene	350	13	WPL TP-5	11/26/1999	No	NA	

Table 4
Screening of Constituents in Surface and Subsurface Soil - West Campus
Former York Naval Ordnance Plant, York, PA

Analyte	MSC Screening Level mg/kg	Maximum Detected mg/kg	Maximum Detected Sample Location	Date Sampled	Is Maximum Concentration > MSC Screening Level?	US EPA Regional Screening Level mg/kg	Is Maximum Detected Concentration > RSL?
Antimony	27	122	WPL-SG-33a	12/29/1999	Yes	41	**YES - COC**
Aroclor-1016	200	ND	NA	NA	No	NA	
Aroclor-1221	0.63	ND	NA	NA	No	NA	
Aroclor-1232	0.5	ND	NA	NA	No	NA	
Aroclor-1242	16	0.04	HD-BPA-SB-024-04-0	2/5/2004	No	NA	
Aroclor-1248	62	0.078	HD-WPL-SB-118-02-0	4/30/2007	No	NA	
Aroclor-1254	260	270	HD-WPL-SB-095-05-0	4/26/2007	Yes	0.74	**YES - COC**
Aroclor-1260	590	6.3	HD-WPL-SB-017-02-0	2/13/2004	No	NA	
Aroclor-1268	0.5	ND	NA	NA	No	NA	
Arsenic	29	221	WPL-SG-33a	12/29/1999	Yes	1.6	**YES - COC**
Barium	8200	370	HD-WPL-SB-095-05-0	4/26/2007	No	NA	
Benzene	0.5	0.0728	WPL TP-5	11/26/1999	No	NA	
Benzo(a)anthracene	320	54	WPL TP-5	11/26/1999	No	NA	
Benzo(a)pyrene	46	74	WPL TP-5	11/26/1999	Yes	0.21	**YES - COC**
Benzo(b)fluoranthene	170	95	WPL TP-5	11/26/1999	No	NA	
Benzo(g,h,i)perylene	180	43	WPL TP-5	11/26/1999	No	NA	
Benzo(k)fluoranthene	610	27.2	BPA TP-1a	12/7/1999	No	NA	
Beryllium	320	225	WPL-SG-33a	12/29/1999	No	NA	
Beta-BHC	0.82	ND	NA	NA	No	NA	
Beta-Endosulfan	260	ND	NA	NA	No	NA	
Bis(2-Chloroethoxy) Methane	31	ND	NA	NA	No	NA	
Bis(2-Chloroethyl) Ether	0.076	ND	NA	NA	No	NA	
Bis(2-Chloroisopropyl) Ether	30	ND	NA	NA	No	NA	
Bis(2-ethylhexyl) phthalate	130	8.4	WPL TP-3	11/26/1999	No	NA	
			HD-WPL-SB-017-04-0	2/13/2004			
Bromochloromethane	9	0.0004	'HD-WPL-SB-036-04-0	2/17/2004	No	NA	
Bromodichloromethane	8	0.027	TANK 3 NW 7.5	11/7/2000	No	NA	
Bromoform	8	ND	NA	NA	No	NA	
Bromomethane	1	ND	NA	NA	No	NA	
Butylbenzylphthalate	10000	0.2	HD-B41S-SB-007-03-0	2/7/2008	No	NA	
Cadmium	38	224	WPL-SG-33a	12/29/1999	Yes	80	**YES - COC**
Calcium*	NA	3910	BG-27	6/4/1998	No	NA	
Carbazole	83	9.6	WPL TP-5	11/26/1999	No	NA	
Carbon Disulfide	620	0.0072	HD-B41S-SB-012-02-0	2/8/2008	No	NA	
Carbon Tetrachloride	0.5	ND	NA	NA	No	NA	
Chlordane	49	ND	NA	NA	No	NA	
Chlorobenzene	10	1.2	HD-WPL-SB-023-12-0	2/12/2004	No	NA	
Chlorodibromomethane	8	ND	NA	NA	No	NA	
Chloroethane	90	ND	NA	NA	No	NA	
Chloroform	8	0.0061	SB-14-14	10/19/2000	No	NA	
Chloromethane	3	ND	NA	NA	No	NA	
Chromium	190	8200	WPL-15-B-3	7/23/1991	Yes	5.6	**YES - COC**
Chrysene	230	54	WPL TP-5	11/26/1999	No	NA	
cis-1,2-Dichloroethene	7	40	HD-WPL-SB-055-07-0	3/10/2004	Yes	200	No
cis-1,3-Dichloropropene	2.6	0.0088	SB-14-14	10/19/2000	No	NA	
Cobalt	140	6.52	BG-28	6/4/1998	No	NA	
Copper	43000	3500	HD-WPL-TP-037-05-0	2/27/2004	No	NA	
Cyanide, Free	200	12.6	HD-B41N-TP-1D-2.5/3-0	12/23/2008	No	NA	
Cyanide, Total	200	174	HD-B41N-TP-1J-4/4.5-0	2/4/2009	No	NA	
Delta-BHC	NA	ND	NA	NA	No	NA	
Dibenzo(a,h)anthracene	160	15	WPL TP-5	11/26/1999	No	NA	
Dibenzofuran	260	4.4	WPL TP-5	11/26/1999	No	NA	
Dieldrin	0.44	ND	NA	NA	No	NA	
Diethylphthalate	8200	0.37	HD-B41N-TP-1G-4/4.5-1	12/23/2008	No	NA	
Dimethylphthalate	NA	0.066	HD-FCSA-SB-003-02-0	5/7/2007	No	NA	**YES - COC**
Di-n-Butylphthalate	4100	1.1	HD-WPL-SB-040-02-0	2/13/2004	No	NA	
Di-n-octylphthalate	10000	0.042	HD-B41S-SB-S7N-11	4/2/2008	No	NA	
Endosulfan Sulfate	70	ND	NA	NA	No	NA	
Endrin	5.5	ND	NA	NA	No	NA	
Endrin Aldehyde	NA	ND	NA	NA	No	NA	
Ethylbenzene	70	27	OWCA-SP-5	4/27/1995	No	NA	

Table 4
Screening of Constituents in Surface and Subsurface Soil - West Campus
Former York Naval Ordnance Plant, York, PA

Analyte	MSC Screening Level mg/kg	Maximum Detected mg/kg	Maximum Detected Sample Location	Date Sampled	Is Maximum Concentration > MSC Screening Level?	US EPA Regional Screening Level mg/kg	Is Maximum Detected Concentration > RSL?
Fluoranthene	3200	110	WPL TP-5	11/26/1999	No	NA	
Fluorene	3800	12	WPL TP-5	11/26/1999	No	NA	
Heptachlor	0.68	ND	NA	NA	No	NA	
Heptachlor Epoxide	1.1	ND	NA	NA	No	NA	
Hexachlorobenzene	0.96	4.36	BPA TP-1a	12/7/1999	Yes	1.1	**YES - COC**
Hexachlorobutadiene	39	ND	NA	NA	No	NA	
Hexachlorocyclopentadiene	91	ND	NA	NA	No	NA	
Hexachloroethane	0.56	ND	NA	NA	No	NA	
Hexavalent Chromium	190	122	HD-B41S-SB-010-02-0	2/8/2008	No	NA	
Indeno(1,2,3-cd)pyrene	28000	43	WPL TP-5	11/26/1999	No	NA	
Iron	190000	15800	BG-27	6/4/1998	No	NA	
Isophorone	10	0.16	HD-WPL-SB-074-02-0	3/12/2004	No	NA	
Lead	450	2760	HD-WPL-TP-037-05-0	2/27/2004	Yes	800	**YES - COC**
Lindane (Gamma-BHC)	0.072	ND	NA	NA	No	NA	
m,p-Xylene	1000	ND	NA	NA	No	NA	
Magnesium*	NA	1280	BG-28	6/4/1998	No	NA	
Manganese	2000	327	BG-28	6/4/1998	No	NA	
Mercury	10	6	HD-WPL-SB-030-02-0	2/12/2004	No	NA	
Methyl tert-butyl ether	2	ND	NA	NA	No	NA	
Methylene chloride	0.5	0.1	HD-B41S-SB-S7N-11	4/2/2008	No	NA	
Naphthalene	25	11	HD-WPL-TP-037-05-0	2/27/2004	No	NA	
Nickel	650	1500	BLD2-Tank 6 N	1/1/2000	Yes	2000	No
Nitrobenzene	20	0.88	HD-WPL-SB-106-01-0	4/23/2007	No	NA	
N-Nitrosodi-n-propylamine	0.037	0.075	HD-B41S-SB-007-03-0	2/7/2008	Yes	0.25	No
N-Nitrosodiphenylamine	83	ND	NA	NA	No	NA	
o-Xylene	1000	ND	NA	NA	No	NA	
Pentachlorophenol	5	4.2	HD-WPL-SB-120-02-0	4/19/2007	No	NA	
Phenanthrene	10000	61	WPL TP-5	11/26/1999	No	NA	
Phenol	200	0.41	HD-WPL-SB-061-06-0	3/11/2004	No	NA	
Potassium*	NA	2810	BG-28	6/4/1998	No	NA	
Pyrene	2200	120	WPL TP-5	11/26/1999	No	NA	
Selenium	26	194	WPL-SG-33a	12/29/1999	Yes	510	No
Silver	84	225	WPL-SG-33a	12/29/1999	Yes	510	No
Sodium*	NA	ND	NA	NA	No	NA	
Styrene	24	0.027	OWCA-SP-5	4/27/1995	No	NA	
Tetrachloroethene	0.5	1400	HD-B4ND-SB-014-15-0	7/23/2007	Yes	2.6	**YES - COC**
Thallium	14	212	WPL-SG-33a	12/29/1999	Yes	1	**YES - COC**
Toluene	100	131.25	WPL-15-B-3	7/23/1991	Yes	4500	No
Toxaphene	1.2	ND	NA	NA	No	NA	
trans-1,2-Dichloroethene	10	0.275	OWCA-CB-9	4/27/1988	No	NA	
trans-1,3-Dichloropropene	2.6	0.0096	SB-14-14	10/19/2000	No	NA	
Trichloroethene	0.5	460	HD-B4ND-SB-014-15-0	7/23/2007	Yes	6.4	**YES - COC**
Trichlorofluoromethane	200	ND	NA	NA	No	NA	
Vanadium	72000	53.9	HD-WPL-SB-111-11-0	4/19/2007	No	NA	
Vinyl Acetate	180	ND	NA	NA	No	NA	
Vinyl Chloride	0.2	0.63	HD-B41S-SB-004-03-0	2/8/2008	Yes	1.7	No
Xylenes (Total)	1000	100	OWCA-SP-7	4/26/1995	No	NA	
Zinc	12000	37000	WPL-15-B-3	7/23/1991	Yes	31000	**YES - COC**

NA - Not Applicable
ND - Not Detected
* Essential Nutrient

Table 5
Statistical Summaries and Identification of Exposure Point Concentrations
Former York Naval Ordnance Plant, York, PA

East Campus Soils 0-2 feet

Constituent of Concern	Maximum Detected mg/kg	Mean mg/kg	95%UCL mg/kg	% Nondetects	Distribution	Exposure Point Concentration mg/kg
Tetrachloroethene	403	2.947	21.73	85.40%	No Discernible Distribution	21.73

East Campus Soils 0-15 feet

Constituent of Concern	Maximum Detected mg/kg	Mean mg/kg	95%UCL mg/kg	% Nondetects	Distribution	Exposure Point Concentration mg/kg
Arsenic	29.1	5.467	5.933	0.46%	No Discernible Distribution	5.933
Chromium	507	30.12	48.82	0%	No Discernible Distribution	48.82
Hexavalent Chromium	254	4.407	14.56	75.37%	No Discernible Distribution	14.56
Thallium	20	0.375	0.542	83.98%	No Discernible Distribution	0.542
1,2-Dichloroethane	4.1	0.0182	0.135	99.35%	No Discernible Distribution	0.135
Tetrachloroethene	660	2.464	13.66	89.43%	No Discernible Distribution	13.66
Vinyl Chloride	2.5	0.0333	0.11	91.24%	No Discernible Distribution	0.11

West Campus Soils 0-2 feet

Constituent of Concern	Maximum Detected mg/kg	Mean mg/kg	95%UCL mg/kg	% Nondetects	Distribution	Exposure Point Concentration mg/kg
Arsenic	29	5.909	6.619	0.93%	No Discernible Distribution	6.619
Cadmium	112	2.6	7.384	28.04%	No Discernible Distribution	7.384
Chromium	3820	78.24	236.2	0%	No Discernible Distribution	236.2
Dimethylphthalate	0.066	NA	NA	98.70%	NA	0.066
Tetrachloroethene	8.1	0.21	0.831	77.36%	Lognormal	0.831
Thallium	22	0.664	1.69	95.10%	No Discernible Distribution	1.69
Trichloroethene	7.8	0.177	0.758	41.51%	No Discernible Distribution	0.758

West Campus Soils 0-15 feet

Constituent of Concern	Maximum Detected mg/kg	Mean mg/kg	95%UCL mg/kg	% Nondetects	Distribution	Exposure Point Concentration mg/kg
Antimony	122	1.505	2.407	70.03%	No Discernible Distribution	2.407
Arsenic	221	6.58	7.722	2.09%	No Discernible Distribution	7.722
Cadmium	224	2.18	6.468	47.64%	No Discernible Distribution	6.468
Chromium	8200	108.9	244.4	0%	No Discernible Distribution	244.4
Thallium	212	1.343	2.625	79.02%	No Discernible Distribution	2.625
Zinc	37000	268.2	707.5	0%	No Discernible Distribution	707.5
Aroclor 1254	270	1.91	9.264	68.78%	Lognormal	9.264
Benzo(a)pyrene	74	0.73	2.058	61.74%	No Discernible Distribution	2.058
Dimethylphthalate	0.066	NA	NA	99.61%	NA	0.066
Hexachlorobenzene	4.36	NA	NA	99.61%	NA	4.36
Tetrachloroethene	1400	4.098	27.56	70.05%	No Discernible Distribution	27.56
Trichloroethene	460	1.887	9.65	51.05%	No Discernible Distribution	9.65

NA - Statistics not available for data sets with very few detected results.

Exposure Point Concentrations for Lead in Soil

Media	Maximum Detected Lead Conc. mg/kg	% Nondetects	Exposure Point Conc. (Mean) mg/kg	Distribution
East Campus Soils 0-15'	1580	3.65%	33.42	No Discernible Distribution
West Campus Soils 0-2'	1000	1.87%	67.53	No Discernible Distribution
West Campus Soils 0-15'	2760	0.52%	59.78	No Discernable Distribution

Table 6
Dermal Contact with Surface Soil by a Maintenance Worker - East Campus
Former York Naval Ordnance Plant, York, PA

$$\text{Intake (mg/kg-day)} = \frac{Cs*SA*AH*ABS*EF*ED*CF}{BW*AT}$$

Cs - Concentration in soil =	mg/kg	chem. spec.	Site-specific
SA - Surface area available for exposure =	cm^2/shift	3300	USEPA, 2004
AH - Adherence factor =	mg/cm^2	0.04	USEPA, 2004
ABS - Dermal absortpion fraction =	unitless	Constituent-specific	USEPA, 2004
EF - Exposure frequency =	shifts/year	180	PADEP Chpt. 250
ED - Exposure duration =	years	25	PADEP Chpt. 250
CF - Conversion factor =	kg/mg	1.00E-06	
BW - Body weight =	kg	70	PADEP Chpt. 250
AT_n - Averaging time - noncarcinogenic =	days	9125	PADEP Chpt. 250
AT_c - Averaging time - carcinogenic =	days	25550	PADEP Chpt. 250

Constituent	Concentration in Soil mg/kg	Dermal Absorption Fraction	Average Daily Intake mg/kg-day	Dermal Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Dermal Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Volatiles								
Tetrachloroethene	2.17E+01	0.00E+00	0.00E+00	6.00E-03	0.00E+00	0.00E+00	2.10E-03	0.00E+00
			Total Hazard Quotient =		**0.0**		**Total Cancer Risk =**	**0E+00**

Table 7
Incidental Ingestion of Surface Soil by a Maintenance Worker - East Campus
Former York Naval Ordnance Plant, York, PA

$$\text{Intake (mg/kg-day)} = \frac{Cs*IngR*EF*ED*CF}{BW*AT}$$

Cs - Concentration in soil =	mg/kg	chem. spec.	Site-specific
IngR - Ingestion rate for soil =	mg/shift	50	PADEP Chpt. 250
EF - Exposure frequency =	shifts/year	180	PADEP Chpt. 250
ED - Exposure duration =	years	25	PADEP Chpt. 250
CF - Conversion factor =	kg/mg	1.00E-06	
BW - Body weight =	kg	70	PADEP Chpt. 250
AT_n - Averaging time - noncarcinogenic =	days	9125	PADEP Chpt. 250
AT_c - Averaging time - carcinogenic =	days	25550	PADEP Chpt. 250

Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Volatiles							
Tetrachloroethene	2.17E+01	7.65E-06	6.00E-03	1.28E-03	2.73E-06	2.10E-03	5.74E-09
			Total Hazard Quotient =	**0.0013**		**Total Cancer Risk =**	**5.74E-09**

Table 8
Inhalation Exposure to Surface Soil by a Maintenance Worker - East Campus
Former York Naval Ordnance Plant, York, PA

Noncarcinogen Exposure Concentration (mg/m^3) = $\frac{Cs*EF*ED*ET}{AT_{ni}*TF}$

Carcinogen Exposure Concentration (ug/m^3) = $\frac{Cs*ED*EF*ET*(1000\ ug/mg)}{AT_{ci}*TF}$

Cs - Concentration in soil =	mg/kg	see below	Site-specific
EF - Exposure frequency =	shifts/year	180	PADEP Chpt. 250
ED - Exposure duration =	years	25	PADEP Chpt. 250
ET - Exposure time =	hours/shift	8	PADEP Chpt. 250
AT_{ni} - Averaging time - noncarcinogenic =	hours	219,000	USEPA, 2009
TF - Transport factor =	(mg/kg)/(mg/m^3)	Constituent-specific	PADEP Chpt. 250
AT_{ci} - Averaging time - carcinogenic =	hours	613,200	USEPA, 2009

Constituent	Concentration in Soil mg/kg	Transport Factor	Noncarc. Exposure Concentration mg/m^3	Inhalation Reference Concentration mg/m^3	Hazard Index	Carc. Exposure Concentration ug/m^3	Inhalation Unit Risk $(ug/m^3)^{-1}$	Cancer Risk
Volatiles								
Tetrachloroethene	2.17E+01	1.31E+04	2.73E-04	4.00E-02	6.82E-03	9.74E-02	2.60E-07	2.53E-08
				Total Hazard Index:	**0.0068**		**Total Cancer Risk =**	**2.53E-08**

Table 9
Dermal Exposure to Surface and Subsurface Soil by a Construction Worker - East Campus
Former York Naval Ordnance Plant, York, PA

$$\text{Intake (mg/kg-day)} = \frac{Cs*SA*AH*ABS*EF*ED*CF}{BW*AT}$$

Cs - Concentration in soil =	mg/kg	See below	Site-specific
SA - Surface area available for exposure =	cm^2/shift	3300	USEPA, 2004
AH - Adherence factor =	mg/cm^2	0.3	USEPA, 2004
ABS - Dermal absortpion fraction =	unitless	Constituent-specific	USEPA, 2004
EF - Exposure frequency =	shifts/year	60	Reasonable assumption
ED - Exposure duration =	years	1	Reasonable assumption
CF - Conversion factor =	kg/mg	1.00E-06	
BW - Body weight =	kg	70	PADEP Chpt. 250
AT_n - Averaging time - noncarcinogenic =	days	365	Reasonable assumption
AT_c - Averaging time - carcinogenic =	days	25550	PADEP Chpt. 250

Constituent	Concentration in Soil mg/kg	Dermal Absorption Fraction	Average Daily Intake mg/kg-day	Dermal Chronic RfD mg/kg-day	Hazard Quotient	Average Lifetime Daily Intake mg/kg-day	Dermal Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Inorganics								
Arsenic	5.93E+00	0.03	4.14E-07	3.00E-04	1.38E-03	5.91E-09	1.50E+00	8.87E-09
Chromium	4.88E+01	0.00	0.00E+00	7.50E-05	0.00E+00	0.00E+00	2.00E+01	0.00E+00
Hexavalent Chromium	1.46E+01	0.00	0.00E+00	7.50E-05	0.00E+00	0.00E+00	2.00E+01	0.00E+00
Thallium	5.42E-01	0.00	0.00E+00	1.00E-05	0.00E+00	0.00E+00	NA	NA
Volatiles								
1,2-Dichloroethane	1.35E-01	0.00	0.00E+00	6.00E-03	0.00E+00	0.00E+00	9.10E-02	0.00E+00
Tetrachloroethene	1.37E+01	0.00	0.00E+00	6.00E-03	0.00E+00	0.00E+00	2.10E-03	0.00E+00
Vinyl Chloride	1.10E-01	0.00	0.00E+00	3.00E-03	0.00E+00	0.00E+00	7.20E-01	0.00E+00
NA - Not Available				**Total Hazard Index:**	**0.0014**		**Total Cancer Risk:**	**8.87E-09**

Table 10
Incidental Ingestion of Surface and Subsurface Soil by a Construction Worker - East Campus
Former York Naval Ordnance Plant, York, PA

$$\text{Intake (mg/kg-day)} = \frac{Cs * IngR * EF * ED * CF}{BW * AT}$$

Cs - Concentration in soil =	mg/kg	See below	Site-specific
IngR - Ingestion rate for soil =	mg/shift	330	USEPA, 2002
EF - Exposure frequency =	shifts/year	60	Reasonable assumption
ED - Exposure duration =	years	1	Reasonable assumption
CF - Conversion factor =	kg/mg	1.00E-06	
BW - Body weight =	kg	70	PADEP Chpt. 250
AT_n - Averaging time - noncarcinogenic =	days	365	Reasonable assumption
AT_c - Averaging time - carcinogenic =	days	25550	PADEP Chpt. 250

Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Quotient	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Inorganics							
Arsenic	5.93E+00	4.60E-06	3.00E-04	1.53E-02	6.57E-08	1.50E+00	9.85E-08
Chromium	4.88E+01	3.78E-05	3.00E-03	1.26E-02	5.40E-07	5.00E-01	2.70E-07
Hexavalent Chromium	1.46E+01	1.13E-05	3.00E-03	3.76E-03	1.61E-07	5.00E-01	8.06E-08
Thallium	5.42E-01	4.20E-07	1.00E-05	4.20E-02	6.00E-09	NA	NA
Volatiles							
1,2-Dichloroethane	1.35E-01	1.05E-07	6.00E-03	1.74E-05	1.49E-09	9.10E-02	1.36E-10
Tetrachloroethene	1.37E+01	1.06E-05	6.00E-03	1.76E-03	1.51E-07	2.10E-03	3.18E-10
Vinyl Chloride	1.10E-01	8.52E-08	3.00E-03	2.84E-05	1.22E-09	7.20E-01	8.77E-10
		Total Hazard Index =		**0.076**		**Total Cancer Risk =**	**4.51E-07**

NA - Not Available

Table 11
Inhalation Exposure To Surface and Subsurface Soil by a Construction Worker - East Campus
Former York Naval Ordnance Plant, York, PA

Noncarcinogen Exposure Concentration (mg/m^3) = $\frac{Cs*EF*ED*ET}{AT_n*TF}$

Carcinogen Exposure Concentration (ug/m^3) = $\frac{Cs*ED*EF*ET*(1000\ ug/mg)}{AT_c*TF}$

Cs - Concentration in soil =	mg/kg	Constituent-specific	Site-specific
EF - Exposure frequency =	shifts/year	60	Reasonable assumption
ED - Exposure duration =	years	1	Reasonable assumption
ET - Exposure time =	hours/shift	8	PADEP Chpt. 250
AT_n - Averaging time - noncarcinogenic =	hours	8,760	Reasonable assumption
TF - Transport factor =	$(mg/kg)/(mg/m^3)$	Constituent-specific	PADEP Chpt. 250
AT_c - Averaging time - carcinogenic =	hours	613,200	USEPA, 2009

Constituent	Concentration in Soil mg/kg	Transport Factor	Noncarc. Exposure Concentration mg/m^3	Inhalation Reference Concentration mg/m^3	Hazard Index	Carc. Exposure Concentration ug/m^3	Inhalation Unit Risk $(ug/m^3)^{-1}$	Cancer Risk
Inorganics								
Arsenic	5.93E+00	1.00E+10	3.25E-11	1.50E-05	2.17E-06	4.64E-10	4.30E-03	2.00E-12
Chromium	4.88E+01	1.00E+10	2.68E-10	1.00E-04	2.68E-06	3.82E-09	8.40E-02	3.21E-10
Hexavalent Chromium	1.46E+01	1.00E+10	7.98E-11	1.00E-04	7.98E-07	1.14E-09	8.40E-02	9.57E-11
Thallium	5.42E-01	1.00E+10	2.97E-12	NA	NA	4.24E-11	NA	NA
Volatiles								
1,2-Dichloroethane	1.35E-01	1.31E+04	5.65E-07	7.00E-03	8.07E-05	8.07E-06	2.60E-05	2.10E-10
Tetrachloroethene	1.37E+01	1.31E+04	5.71E-05	6.00E-02	9.52E-04	8.16E-04	2.60E-07	2.12E-10
Vinyl Chloride	1.10E-01	1.32E+04	4.57E-07	1.00E-01	4.57E-06	6.52E-06	4.40E-06	2.87E-11
				Total Hazard Index:	**0.001**		**Total Cancer Risk =**	**8.69E-10**

Table 12
Dermal Contact with Surface Soil by an Adolescent Trespasser - East Campus
Former York Naval Ordnance Plant, York, PA

$$\text{Intake (mg/kg-day)} = \frac{Cs*SA*AH*ABS*EF*ED*CF}{BW*AT}$$

Cs - Concentration in soil =	mg/kg	chem. spec.	
SA - Surface area available for exposure =	cm^2/event	7548	USEPA, 2004
AH - Adherence factor =	mg/cm^2	0.04	USEPA, 2004
ABS - Dermal absortpion fraction =	unitless	Constituent-specific	USEPA, 2004
EF - Exposure frequency =	events/year	24	Reasonable assumption
ED - Exposure duration =	years	12	Reasonable assumption
CF - Conversion factor =	kg/mg	1.00E-06	
BW - Body weight =	kg	45.36	USEPA 2011, EFH
AT_n - Averaging time - noncarcinogenic =	days	4380	PADEP Chpt. 250
AT_c - Averaging time - carcinogenic =	days	25550	PADEP Chpt. 250

Constituent	Concentration in Soil mg/kg	Dermal Absorption Fraction	Average Daily Intake mg/kg-day	Dermal Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Dermal Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Volatiles								
Tetrachloroethene	2.17E+01	0.00E+00	0.00E+00	6.00E-03	0.00E+00	0.00E+00	2.10E-03	0.00E+00
			Total Hazard Quotient =		**0.0**		**Total Cancer Risk =**	**0E+00**

Table 13
Incidental Ingestion of Surface Soil by an Adolescent Trespasser - East Campus
Former York Naval Ordnance Plant, York, PA

$$\text{Intake (mg/kg-day)} = \frac{Cs*IngR*EF*ED*CF}{BW*AT}$$

Cs - Concentration in soil =	mg/kg	chem. spec.	
IngR - Ingestion rate for soil =	mg/event	50	PADEP Chpt. 250
EF - Exposure frequency =	events/year	24	Reasonable assumption
ED - Exposure duration =	years	12	Reasonable assumption
CF - Conversion factor =	kg/mg	1.00E-06	
BW - Body weight =	kg	45.36	USEPA 2011, EFH
AT_n - Averaging time - noncarcinogenic =	days	4380	PADEP Chpt. 250
AT_c - Averaging time - carcinogenic =	days	25550	PADEP Chpt. 250

Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Volatiles							
Tetrachloroethene	2.17E+01	1.57E-06	6.00E-03	2.62E-04	2.70E-07	2.10E-03	5.67E-10
			Total Hazard Quotient =	**0.00026**		**Total Cancer Risk =**	**5.67E-10**

Table 14
Inhalation Exposure to Surface Soil by an Adolescent Trespasser - East Campus
Former York Naval Ordnance Plant, York, PA

Noncarcinogen Exposure Concentration (mg/m^3) = $\frac{Cs*EF*ED*ET}{AT_n*TF}$

Carcinogen Exposure Concentration (ug/m^3) = $\frac{Cs*ED*EF*ET*(1000\ ug/mg)}{AT_c*TF}$

Cs - Concentration in soil =	mg/kg	see below	
EF - Exposure frequency =	days/year	24	PADEP Chpt. 250
ED - Exposure duration =	years	12	PADEP Chpt. 250
ET - Exposure time =	hours/day	4	Reasonable assumption
AT_n - Averaging time - noncarcinogenic =	hours	105,120	USEPA, 2009
TF - Transport factor =	$(mg/kg)/(mg/m^3)$	Constituent-specific	PADEP Chpt. 250
AT_c - Averaging time - carcinogenic =	hours	613,200	USEPA, 2009

Constituent	Concentration in Soil mg/kg	Transport Factor	Noncarc. Exposure Concentration mg/m^3	Inhalation Reference Concentration mg/m^3	Hazard Index	Carc. Exposure Concentration ug/m^3	Inhalation Unit Risk $(ug/m^3)^{-1}$	Cancer Risk
Volatiles								
Tetrachloroethene	2.17E+01	1.31E+04	1.82E-05	4.00E-02	4.54E-04	3.12E-03	2.60E-07	8.10E-10
				Total Hazard Index:	**0.00045**		**Total Cancer Risk =**	**8.10E-10**

Table 15
Dermal Contact with Surface Soil by a Maintenance Worker - West Campus
Former York Naval Ordnance Plant, York, PA

$$\text{Intake (mg/kg-day)} = \frac{Cs*SA*AH*ABS*EF*ED*CF}{BW*AT}$$

Cs - Concentration in soil =	mg/kg	See below	Site-specific
SA - Surface area available for exposure =	cm^2/shift	3300	USEPA, 2004
AH - Adherence factor =	mg/cm^2	0.04	USEPA, 2004
ABS - Dermal absortpion fraction =	unitless	Constituent-specific	USEPA, 2004
EF - Exposure frequency =	shifts/year	180	PADEP Chpt. 250
ED - Exposure duration =	years	25	PADEP Chpt. 250
CF - Conversion factor =	kg/mg	1.00E-06	
BW - Body weight =	kg	70	PADEP Chpt. 250
AT_n - Averaging time - noncarcinogenic =	days	9125	PADEP Chpt. 250
AT_c - Averaging time - carcinogenic =	days	25550	PADEP Chpt. 250

Constituent	Concentration in Soil mg/kg	Dermal Absorption Fraction	Average Daily Intake mg/kg-day	Dermal Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Dermal Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Inorganics								
Arsenic	6.62E+00	0.03	1.85E-07	3.00E-04	6.16E-04	6.59E-08	1.50E+00	9.89E-08
Cadmium	7.38E+00	0.001	6.87E-09	2.50E-05	2.75E-04	2.45E-09	NA	NA
Chromium	2.36E+02	0.0	0.00E+00	7.50E-05	0.00E+00	0.00E+00	2.00E+01	0.00E+00
Thallium	1.69E+00	0.0	0.00E+00	1.00E-05	0.00E+00	0.00E+00	NA	NA
Semivolatiles								
Dimethylphthalate	6.60E-02	0.1	6.14E-09	NA	NA	2.19E-09	NA	NA
Volatiles								
Tetrachloroethene	8.31E-01	0.0	0.00E+00	6.00E-03	0.00E+00	0.00E+00	2.10E-03	0.00E+00
Trichloroethene	7.58E-01	0.0	0.00E+00	5.00E-04	0.00E+00	0.00E+00	4.60E-02	0.00E+00
				Total Hazard Quotient =	**0.001**		**Total Cancer Risk =**	**9.89E-08**

Table 16
Incidental Ingestion of Surface Soil by a Maintenance Worker - West Campus
Former York Naval Ordnance Plant, York, PA

$$\text{Intake (mg/kg-day)} = \frac{Cs*IngR*EF*ED*CF}{BW*AT}$$

Cs - Concentration in soil =	mg/kg	See below	Site-specific
IngR - Ingestion rate for soil =	mg/shift	50	PADEP Chpt. 250
EF - Exposure frequency =	shifts/year	180	PADEP Chpt. 250
ED - Exposure duration =	years	25	PADEP Chpt. 250
CF - Conversion factor =	kg/mg	1.00E-06	
BW - Body weight =	kg	70	PADEP Chpt. 250
AT_n - Averaging time - noncarcinogenic =	days	9125	PADEP Chpt. 250
AT_c - Averaging time - carcinogenic =	days	25550	PADEP Chpt. 250

Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Inorganics							
Arsenic	6.62E+00	2.33E-06	3.00E-04	7.77E-03	8.33E-07	1.5	1.25E-06
Cadmium	7.38E+00	2.60E-06	5.00E-04	5.20E-03	9.29E-07	NA	NA
Chromium	2.36E+02	8.32E-05	3.00E-03	2.77E-02	2.97E-05	5.00E-01	1.49E-05
Thallium	1.69E+00	5.95E-07	1.00E-05	5.95E-02	2.13E-07	NA	NA
Semivolatiles							
Dimethylphthalate	6.60E-02	2.32E-08	NA	NA	8.30E-09	NA	NA
Volatiles							
Tetrachloroethene	8.31E-01	2.93E-07	6.00E-03	4.88E-05	1.05E-07	2.10E-03	2.20E-10
Trichloroethene	7.58E-01	2.67E-07	5.00E-04	5.34E-04	9.54E-08	4.60E-02	4.39E-09
		Total Hazard Quotient =		**0.10**	**Total Cancer Risk =**		**1.61E-05**

Table 17
Inhalation Exposure to Surface Soil by a Maintenance Worker - West Campus
Former York Naval Ordnance Plant, York, PA

Noncarcinogen Exposure Concentration (mg/m^3) = $\frac{Cs*EF*ED*ET}{AT_{ni}*TF}$

Carcinogen Exposure Concentration (ug/m^3) = $\frac{Cs*ED*EF*ET*(1000\ ug/mg)}{AT_{ci}*TF}$

Cs - Concentration in soil =	mg/kg	See below	Site-specific
EF - Exposure frequency =	shifts/year	180	PADEP Chpt. 250
ED - Exposure duration =	years	25	PADEP Chpt. 250
ET - Exposure time =	hours/shift	8	PADEP Chpt. 250
AT_{ni} - Averaging time - noncarcinogenic =	hours	219,000	USEPA, 2009
TF - Transport factor =	$(mg/kg)/(mg/m^3)$	Constituent-specific	PADEP Chpt. 250
AT_{ci} - Averaging time - carcinogenic =	hours	613,200	USEPA, 2009

Constituent	Concentration in Soil mg/kg	Transport Factor	Noncarc. Exposure Concentration mg/m^3	Inhalation Reference Concentration mg/m^3	Hazard Index	Carc. Exposure Concentration ug/m^3	Inhalation Unit Risk $(ug/m^3)^{-1}$	Cancer Risk
Inorganics								
Arsenic	6.62E+00	1.00E+10	1.09E-10	1.50E-05	7.25E-06	3.89E-08	4.30E-03	1.67E-10
Cadmium	7.38E+00	1.00E+10	1.21E-10	2.00E-05	6.07E-06	4.34E-08	1.80E-03	7.80E-11
Chromium	2.36E+02	1.00E+10	3.88E-09	1.00E-04	3.88E-05	1.39E-06	8.40E-02	1.16E-07
Thallium	1.69E+00	1.00E+10	2.78E-11	NA	NA	9.92E-09	NA	NA
Semivolatiles								
Dimethylphthalate	6.60E-02	1.00E+10	1.08E-12	NA	NA	3.87E-10	NA	NA
Volatiles								
Tetrachloroethene	8.31E-01	1.31E+04	1.04E-05	4.00E-02	2.61E-04	3.72E-03	2.60E-07	9.68E-10
Trichloroethene	7.58E-01	1.31E+04	9.51E-06	2.30E-03	4.14E-03	3.40E-03	4.10E-06	1.39E-08
				Total Hazard Index:	**0.004**		**Total Cancer Risk =**	**1.32E-07**

Table 18
Dermal Exposure to Surface and Subsurface Soil by a Construction Worker - West Campus
Former York Naval Ordnance Plant, York, PA

$$\text{Intake (mg/kg-day)} = \frac{Cs*SA*AH*ABS*EF*ED*CF}{BW*AT}$$

Cs - Concentration in soil =	mg/kg	See below	Site-specific
SA - Surface area available for exposure =	cm^2/shift	3300	USEPA, 2004
AH - Adherence factor =	mg/cm^2	0.3	USEPA, 2004
ABS - Dermal absortpion fraction =	unitless	Constituent-specific	USEPA, 2004
EF - Exposure frequency =	shifts/year	60	Reasonable assumption
ED - Exposure duration =	years	1	Reasonable assumption
CF - Conversion factor =	kg/mg	1.00E-06	
BW - Body weight =	kg	70	PADEP Chpt. 250
AT_n - Averaging time - noncarcinogenic =	days	365	Reasonable assumption
AT_c - Averaging time - carcinogenic =	days	25550	PADEP Chpt. 250

Constituent	Concentration in Soil mg/kg	Dermal Absorption Fraction	Average Daily Intake mg/kg-day	Dermal Chronic RfD mg/kg-day	Hazard Quotient	Average Lifetime Daily Intake mg/kg-day	Dermal Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Inorganics								
Antimony	2.41E+00	0.0	0.00E+00	6.00E-05	0.00E+00	0.00E+00	NA	NA
Arsenic	7.72E+00	0.03	5.39E-07	3.00E-04	1.80E-03	7.69E-09	1.50E+00	1.15E-08
Cadmium	6.47E+00	0.001	1.50E-08	2.50E-05	6.01E-04	2.15E-10	NA	NA
Chromium	2.44E+02	0.0	0.00E+00	7.50E-05	0.00E+00	0.00E+00	2.00E+01	0.00E+00
Thallium	2.63E+00	0.0	0.00E+00	1.00E-05	0.00E+00	0.00E+00	NA	NA
Zinc	7.08E+02	0.0	0.00E+00	3.00E-01	0.00E+00	0.00E+00	NA	NA
Semivolatiles								
Benzo(a)pyrene	2.06E+00	0.13	6.22E-07	NA	NA	8.89E-09	7.30E+00	6.49E-08
Dimethylphthalate	6.60E-02	0.1	1.53E-08	NA	NA	2.19E-10	NA	NA
Hexachlorobenzene	4.36E+00	0.1	1.01E-06	8.00E-04	1.27E-03	1.45E-08	1.60E+00	2.32E-08
PCBs								
Aroclor 1254	9.26E+00	0.14	3.02E-06	2.00E-05	1.51E-01	4.31E-08	2.00E+00	8.61E-08
Volatiles								
Tetrachloroethene	2.76E+01	0.0	0.00E+00	6.00E-03	0.00E+00	0.00E+00	2.10E-03	0.00E+00
Trichloroethene	9.65E+00	0.0	0.00E+00	5.00E-04	0.00E+00	0.00E+00	4.60E-02	0.00E+00
NA - Not Available			**Total Hazard Index:**		**0.15**		**Total Cancer Risk:**	**1.86E-07**

Table 19
Incidental Ingestion of Surface and Subsurface Soil by a Construction Worker - West Campus
Former York Naval Ordnance Plant, York, PA

$$\text{Intake (mg/kg-day)} = \frac{Cs*IngR*EF*ED*CF}{BW*AT}$$

Cs - Concentration in soil =	mg/kg	See below	Site-specific
IngR - Ingestion rate for soil =	mg/shift	330	USEPA, 2002
EF - Exposure frequency =	shifts/year	60	Reasonable assumption
ED - Exposure duration =	years	1	Reasonable assumption
CF - Conversion factor =	kg/mg	1.00E-06	
BW - Body weight =	kg	70	PADEP Chpt. 250
AT_n - Averaging time - noncarcinogenic =	days	365	Reasonable assumption
AT_c - Averaging time - carcinogenic =	days	25550	PADEP Chpt. 250

Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Quotient	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Inorganics							
Antimony	2.41E+00	1.87E-06	4.00E-04	4.66E-03	2.66E-08	NA	NA
Arsenic	7.72E+00	5.98E-06	3.00E-04	1.99E-02	8.55E-08	1.50E+00	1.28E-07
Cadmium	6.47E+00	5.01E-06	5.00E-04	1.00E-02	7.16E-08	NA	NA
Chromium	2.44E+02	1.89E-04	3.00E-03	6.31E-02	2.71E-06	5.00E-01	1.35E-06
Thallium	2.63E+00	2.03E-06	1.00E-05	2.03E-01	2.91E-08	NA	NA
Zinc	7.08E+02	5.48E-04	3.00E-01	1.83E-03	7.83E-06	NA	NA
Semivolatiles							
Benzo(a)pyrene	2.06E+00	1.59E-06	NA	NA	2.28E-08	7.30E+00	1.66E-07
Dimethylphthalate	6.60E-02	5.11E-08	NA	NA	7.31E-10	NA	NA
Hexachlorobenzene	4.36E+00	3.38E-06	8.00E-04	4.22E-03	4.83E-08	1.60E+00	7.72E-08
PCBs							
Aroclor 1254	9.26E+00	7.18E-06	2.00E-05	3.59E-01	1.03E-07	2.00E+00	2.05E-07
Volatiles							
Tetrachloroethene	2.76E+01	2.14E-05	6.00E-03	3.56E-03	3.05E-07	2.10E-03	6.41E-10
Trichloroethene	9.65E+00	7.48E-06	5.00E-04	1.50E-02	1.07E-07	4.60E-02	4.91E-09

NA - Not Available

Total Hazard Index = 0.68 **Total Cancer Risk = 1.94E-06**

Table 20
Inhalation Exposure to Surface and Subsurface Soil by a Construction Worker - West Campus
Former York Naval Ordnance Plant, York, PA

Noncarcinogen Exposure Concentration (mg/m^3) = $\frac{Cs*EF*ED*ET}{AT_n*TF}$

Carcinogen Exposure Concentration (ug/m^3) = $\frac{Cs*ED*EF*ET*(1000\ ug/mg)}{AT_c*TF}$

Cs - Concentration in soil =	mg/kg	See below	Site-specific
EF - Exposure frequency =	shifts/year	60	Reasonable assumption
ED - Exposure duration =	years	1	Reasonable assumption
ET - Exposure time =	hours/shift	8	PADEP Chpt. 250
AT_n - Averaging time - noncarcinogenic =	hours	8,760	Reasonable assumption
TF - Transport factor =	$(mg/kg)/(mg/m^3)$	Constituent-specific	PADEP Chpt. 250
AT_c - Averaging time - carcinogenic =	hours	613,200	USEPA, 2009

Constituent	Concentration in Soil mg/kg	Transport Factor	Noncarc. Exposure Concentration mg/m^3	Inhalation Reference Concentration mg/m^3	Hazard Index	Carc. Exposure Concentration ug/m^3	Inhalation Unit Risk $(ug/m^3)^{-1}$	Cancer Risk
Inorganics								
Antimony	2.41E+00	1.00E+10	1.32E-11	NA	NA	1.88E-10	NA	NA
Arsenic	7.72E+00	1.00E+10	4.23E-11	1.50E-05	2.82E-06	6.04E-10	4.30E-03	2.60E-12
Cadmium	6.47E+00	1.00E+10	3.54E-11	2.00E-05	1.77E-06	5.06E-10	1.80E-03	9.11E-13
Chromium	2.44E+02	1.00E+10	1.34E-09	1.00E-04	1.34E-05	1.91E-08	8.40E-02	1.61E-09
Thallium	2.63E+00	1.00E+10	1.44E-11	NA	NA	2.05E-10	NA	NA
Zinc	7.08E+02	1.00E+10	3.88E-09	NA	NA	5.54E-08	NA	NA
Semivolatiles								
Benzo(a)pyrene	2.06E+00	1.00E+10	1.13E-11	NA	NA	1.61E-10	1.10E-03	1.77E-13
Dimethylphthalate	6.60E-02	1.00E+10	3.62E-13	NA	NA	5.17E-12	NA	NA
Hexachlorobenzene	4.36E+00	1.00E+10	2.39E-11	NA	NA	3.41E-10	4.60E-04	1.57E-13
PCBs								
Aroclor 1254	9.26E+00	1.00E+10	5.08E-11	NA	NA	7.25E-10	5.70E-04	4.13E-13
Volatiles								
Tetrachloroethene	2.76E+01	1.31E+04	1.15E-04	4.00E-02	2.88E-03	1.65E-03	2.60E-07	4.28E-10
Trichloroethene	9.65E+00	1.31E+04	4.04E-05	2.30E-03	1.75E-02	5.77E-04	4.10E-06	2.36E-09
NA - Not Available				**Total Hazard Index:**	**0.020**		**Total Cancer Risk =**	**4.40E-09**

Table 21
Dermal Contact with Surface Soil by an Adolescent Trespasser - West Campus
Former York Naval Ordnance Plant, York, PA

$$\text{Intake (mg/kg-day)} = \frac{Cs*SA*AH*ABS*EF*ED*CF}{BW*AT}$$

Cs - Concentration in soil =	mg/kg	See below	Site-specific
SA_c - Skin surface area available for exposure =	cm^2/event	7548	USEPA, 2004
AH_c - Adherence factor =	mg/cm^2	0.04	USEPA, 2004
ABS - Dermal absortpion fraction =	unitless	Constituent-specific	USEPA, 2004
EF - Exposure frequency =	events/year	24	Reasonable assumption
ED - Exposure duration =	years	12	Reasonable assumption
CF - Conversion factor =	kg/mg	1.00E-06	
BW_c - Body weight =	kg	45.36	USEPA, 2011, EFH
AT_n - Averaging time - noncarcinogenic =	days	4380	PADEP Chpt. 250
AT_c - Averaging time - carcinogenic =	days	25550	PADEP Chpt. 250

Average Lifetime Daily Intake For Mutagens (mg/kg-day) = $(Cs*EF*ADF_{adj}*ABS*CF)/AT_c$

ADF_{adj} - Age-dependent dermal factor = mg-yr/kg-event 2.23E+02 Calculated

$$ADF_{adj} = [(ADAF_{6\text{-}16}*ED_{6\text{-}16}*AH_c*SA_c)/(BW_c)]+[(ADAF_{16\text{-}17}*ED_{16\text{-}17}*AH_a*SA_a)/(BW_{16\text{-}17})]$$

$ADAF_{6\text{-}16}$ - Age factor for 6 -16 years =	unitless	3	PADEP Chpt. 250
$ADAF_{16\text{-}17}$ - Age factor for 16 - 17 years =	unitless	1	PADEP Chpt. 250
ED_c - Exposure duration for 6 - 16 years =	years	11	Reasonable assumption
ED_a - Exposure duration for 16 - 17 years =	year	1	Reasonable assumption
$BW_{16\text{-}17}$ - Body weight for 16 to 17 years =	kg	67.5	USEPA, 2011, EFH
SA_a - Adult skin surface area available for exposure =	cm^2/event	5200	USEPA, 2011, EFH
AH_a - Adult adherence factor =	mg/cm^2	0.04	USEPA, 2004

Constituent	Concentration in Soil mg/kg	Dermal Absorption Fraction	Average Daily Intake mg/kg-day	Dermal Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Dermal Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Inorganics								
Arsenic	6.62E+00	0.03	8.69E-08	3.00E-04	2.90E-04	1.49E-08	1.50E+00	2.23E-08
Cadmium	7.38E+00	0.001	3.23E-09	2.50E-05	1.29E-04	5.54E-10	NA	NA
Thallium	1.69E+00	0.0	0.00E+00	1.00E-05	0.00E+00	0.00E+00	NA	NA
Semivolatiles								
Dimethylphthalate	6.60E-02	0.1	2.89E-09	NA	NA	4.95E-10	NA	NA
Volatiles								
Tetrachloroethene	8.31E-01	0.0	0.00E+00	6.00E-03	0.00E+00	0.00E+00	2.10E-03	0.00E+00
Mutagens								
Chromium	2.36E+02	0.0	0.00E+00	7.50E-05	0.00E+00	0.00E+00	2.00E+01	0.00E+00
Trichloroethene	7.58E-01	0.0	0.00E+00	5.00E-04	0.00E+00	0.00E+00	4.60E-02	0.00E+00
			Total Hazard Quotient =		**0.00042**	**Total Cancer Risk =**		**2.23E-08**

NA - Not available

Table 22
Incidental Ingestion of Surface Soil by an Adolescent Trespasser - West Campus
Former York Naval Ordnance Plant, York, PA

$$\text{Intake (mg/kg-day)} = \frac{Cs * IngR_a * EF * ED * CF}{BW_c * AT}$$

Cs - Concentration in soil =	mg/kg	See below	Site-specific
$IngR_a$ - Ingestion rate for soil =	mg/event	100	PADEP Chpt. 250
EF - Exposure frequency =	events/year	24	Reasonable assumption
ED - Exposure duration =	years	12	Reasonable assumption
CF - Conversion factor =	kg/mg	1.00E-06	
BW_c - Body weight =	kg	45.36	USEPA, 2011, EFH
AT_n - Averaging time - noncarcinogenic =	days	4380	PADEP Chpt. 250
AT_c - Averaging time - carcinogenic =	days	25550	PADEP Chpt. 250

Average Lifetime Daily Intake For Mutagens (mg/kg-day) = $(Cs*EF*AIF_{adj}*CF)/AT_c$

AIF_{adj} - Age-dependent ingestion factor =	mg-yr/kg-event	7.42E+01	Calculated

$$AIF_{adj} = [(ADAF_{6\text{-}16} * ED_{6\text{-}16} * IngR_c)/BW_c] + [(ADAF_{16\text{-}17} * ED_{16\text{-}17} * IngR_a)/BW_{16\text{-}17}]$$

$ADAF_{6\text{-}16}$ - Age factor for 6 - 16 years =	unitless	3	PADEP Chpt. 250
$ADAF_{16\text{-}17}$ - Age factor for 16 - 17 years =	unitless	1	PADEP Chpt. 250
ED_c - Exposure duration for 6 - 16 years =	years	11	Reasonable assumption
ED_a - Exposure duration for 16 - 17 years =	year	1	Reasonable assumption
$IngR_c$ - Child soil ingestion rate =	mg/event	100	PADEP Chpt. 250
$BW_{16\text{-}17}$ - Body weight for 16 to 17 years =	kg	67.5	USEPA, 2011, EFH

Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Inorganics							
Arsenic	6.62E+00	9.59E-07	3.00E-04	3.20E-03	1.64E-07	1.5	2.47E-07
Cadmium	7.38E+00	1.07E-06	5.00E-04	2.14E-03	1.83E-07	NA	NA
Thallium	1.69E+00	2.45E-07	1.00E-05	2.45E-02	4.20E-08	NA	NA
Semivolatiles							
Dimethylphthalate	6.60E-02	9.57E-09	NA	NA	1.64E-09	NA	NA
Volatiles							
Tetrachloroethene	8.31E-01	1.20E-07	6.00E-03	2.01E-05	2.07E-08	2.10E-03	4.34E-11
Mutagens							
Chromium	2.36E+02	3.42E-05	3.00E-03	1.14E-02	1.65E-05	5.00E-01	8.24E-06
Trichloroethene	7.58E-01	1.10E-07	5.00E-04	2.20E-04	5.29E-08	4.60E-02	2.43E-09
NA - Not available		**Total Hazard Quotient =**		**0.041**		**Total Cancer Risk =**	**8.48E-06**

Table 23
Inhalation Exposure to Surface Soil by an Adolescent Trespasser - West Campus
Former York Naval Ordnance Plant, York, PA

Noncarcinogen Exposure Concentration (mg/m^3) = $\frac{Cs*EF*ED*ET}{AT_n*TF}$

Carcinogen Exposure Concentration (ug/m^3) = $\frac{Cs*ED*EF*ET*(1000\ ug/mg)}{AT_c*TF}$

Cs - Concentration in soil =	mg/kg	See below	Site-specific
EF - Exposure frequency =	events/year	24	Reasonable assumption
ED - Exposure duration =	years	12	Reasonable assumption
ET - Exposure time =	hours/event	4	Reasonable assumption
AT_n - Averaging time - noncarcinogenic =	hours	105,120	USEPA, 2009
TF - Transport factor =	$(mg/kg)/(mg/m^3)$	Constituent-speci	PADEP Chpt. 250
AT_c - Averaging time - carcinogenic =	hours	613,200	USEPA, 2009

Mutagen Carcinogenic Exposure Concentration (ug/m^3) = $\frac{Cs*AED*EF*ET*(1000\ ug/mg)}{AT_c*TF}$

AED (years) = (ADAFc*EDc)+(ADAFa*EDa)

AED - Age-adjusted exposure duration =	years	34	Reasonable assumption
$ADAF_{6\text{-}16}$ - Age factor for 6 -16 years =	unitless	3	PADEP Chpt. 250
$ADAF_{16\text{-}17}$ - Age factor for 16 - 17 years =	unitless	1	PADEP Chpt. 250
ED_c - Exposure duration for 6 - 16 years =	years	11	Reasonable assumption
ED_a - Exposure duration for 16 - 17 years =	year	1	Reasonable assumption

Constituent	Concentration in Soil mg/kg	Transport Factor	Noncarc. Exposure Concentration mg/m^3	Inhalation Reference Concentration mg/m^3	Hazard Index	Carc. Exposure Concentration ug/m^3	Inhalation Unit Risk $(ug/m^3)^{-1}$	Cancer Risk
Inorganics								
Arsenic	6.62E+00	1.00E+10	7.25E-12	1.50E-05	4.84E-07	1.24E-09	4.30E-03	5.35E-12
Cadmium	7.38E+00	1.00E+10	8.09E-12	2.00E-05	4.05E-07	1.39E-09	1.80E-03	2.50E-12
Thallium	1.69E+00	1.00E+10	1.85E-12	NA	NA	3.17E-10	NA	NA
Semivolatiles								
Dimethylphthalate	6.60E-02	1.00E+10	7.23E-14	NA	NA	1.24E-11	NA	NA
Volatiles								
Tetrachloroethene	8.31E-01	1.31E+04	6.95E-07	4.00E-02	1.74E-05	1.19E-04	2.60E-07	3.10E-11
Mutagens								
Chromium	2.36E+02	1.00E+10	2.59E-10	1.00E-04	2.59E-06	1.26E-07	8.40E-02	1.06E-08
Trichloroethene	7.58E-01	1.31E+04	6.34E-07	2.30E-03	2.76E-04	3.08E-04	4.10E-06	1.26E-09
				Total Hazard Index:	**0.0003**		**Total Cancer Risk =**	**1.19E-08**

NA - Not available

Table 24
Calculations of Blood Lead Concentrations (PbBs) for Construction Workers on the East Campus
Former York Naval Ordnance Plant, York, PA

Variable	Description of Variable	Units	Construction Worker - East Campus
PbS	Soil lead concentration	ug/g or ppm	33.42
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9
BKSF	Biokinetic Slope Factor	ug/dL per ug/day	0.4
GSD_i	Geometric standard deviation PbB	--	1.8
PbB_0	Baseline PbB	ug/dL	1.0
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.330
IR_{S+D}	Total ingestion rate of outdoor soil and indoor dust	g/day	--
W_S	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--
K_{SD}	Mass fraction of soil in dust	--	--
$AF_{S, D}$	Absorption fraction (same for soil and dust)	--	0.12
$EF_{S, D}$	Exposure frequency (same for soil and dust)	days/yr	60
$AT_{S, D}$	Averaging time (same for soil and dust)	days/yr	365
PbB_{adult}	**PbB of adult worker, geometric mean**	**ug/dL**	**1.09**
$PbB_{fetal, 0.95}$	**95th percentile PbB among fetuses of adult workers**	**ug/dL**	**2.57**
PbB_t	Target PbB level of concern (e.g., 10 ug/dL)	ug/dL	10.0
$P(PbB_{fetal} > PbB_t)$	**Probability that fetal PbB > PbB_t, assuming lognormal distribution**	**%**	**0.004%**

Table Source: U.S. EPA (1996). Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil
Table version date 6/21/2009

Table 25
Calculations of Blood Lead Concentrations (PbBs) for Maintenance Workers on the West Campus
Former York Naval Ordnance Plant, York, PA

Variable	Description of Variable	Units	Maintenance Worker - West Campus
PbS	Soil lead concentration	ug/g or ppm	67.53
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9
BKSF	Biokinetic Slope Factor	ug/dL per ug/day	0.4
GSD_i	Geometric standard deviation PbB	--	1.8
PbB_0	Baseline PbB	ug/dL	1.0
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.050
IR_{S+D}	Total ingestion rate of outdoor soil and indoor dust	g/day	--
W_S	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--
K_{SD}	Mass fraction of soil in dust	--	--
$AF_{S, D}$	Absorption fraction (same for soil and dust)	--	0.12
$EF_{S, D}$	Exposure frequency (same for soil and dust)	days/yr	180
$AT_{S, D}$	Averaging time (same for soil and dust)	days/yr	365
PbB_{adult}	**PbB of adult worker, geometric mean**	**ug/dL**	**1.08**
$PbB_{fetal, 0.95}$	**95th percentile PbB among fetuses of adult workers**	**ug/dL**	**2.56**
PbB_t	Target PbB level of concern (e.g., 10 ug/dL)	ug/dL	10.0
$P(PbB_{fetal} > PbB_t)$	**Probability that fetal PbB > PbB_t, assuming lognormal distribution**	**%**	**0.004%**

Table Source: U.S. EPA (1996). Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil
Table version date 6/21/2009

Table 26
Calculations of Blood Lead Concentrations (PbBs) for Adolescent Trespassers on the West Campus
Former York Naval Ordnance Plant, York, PA

Variable	Description of Variable	Units	Adolescent Trespasser - West Campus
PbS	Soil lead concentration	ug/g or ppm	67.53
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9
BKSF	Biokinetic Slope Factor	ug/dL per ug/day	0.4
GSD_i	Geometric standard deviation PbB	--	1.8
PbB_0	Baseline PbB	ug/dL	1.0
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.100
IR_{S+D}	Total ingestion rate of outdoor soil and indoor dust	g/day	--
W_S	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--
K_{SD}	Mass fraction of soil in dust	--	--
$AF_{S, D}$	Absorption fraction (same for soil and dust)	--	0.12
$EF_{S, D}$	Exposure frequency (same for soil and dust)	days/yr	24
$AT_{S, D}$	Averaging time (same for soil and dust)	days/yr	365
PbB_{adult}	**PbB of adult worker, geometric mean**	**ug/dL**	**1.02**
$PbB_{fetal, 0.95}$	**95th percentile PbB among fetuses of adult workers**	**ug/dL**	**2.42**
PbB_t	Target PbB level of concern (e.g., 10 ug/dL)	ug/dL	10.0
$P(PbB_{fetal} > PbB_t)$	**Probability that fetal PbB > PbB_t, assuming lognormal distribution**	**%**	**0.002%**

Table Source: U.S. EPA (1996). Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil
Table version date 6/21/2009

Table 27
Calculations of Blood Lead Concentrations (PbBs) for Construction Workers on the West Campus
Former York Naval Ordnance Plant, York, PA

Variable	Description of Variable	Units	Construction Worker - West Campus
PbS	Soil lead concentration	ug/g or ppm	59.78
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9
BKSF	Biokinetic Slope Factor	ug/dL per ug/day	0.4
GSD_i	Geometric standard deviation PbB	--	1.8
PbB_0	Baseline PbB	ug/dL	1.0
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.330
IR_{S+D}	Total ingestion rate of outdoor soil and indoor dust	g/day	--
W_S	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--
K_{SD}	Mass fraction of soil in dust	--	--
$AF_{S, D}$	Absorption fraction (same for soil and dust)	--	0.12
$EF_{S, D}$	Exposure frequency (same for soil and dust)	days/yr	60
$AT_{S, D}$	Averaging time (same for soil and dust)	days/yr	365
PbB_{adult}	**PbB of adult worker, geometric mean**	**ug/dL**	**1.16**
$PbB_{fetal, 0.95}$	**95th percentile PbB among fetuses of adult workers**	**ug/dL**	**2.74**
PbB_t	Target PbB level of concern (e.g., 10 ug/dL)	ug/dL	10.0
$P(PbB_{fetal} > PbB_t)$	**Probability that fetal PbB > PbB_t, assuming lognormal distribution**	**%**	**0.01%**

Table Source: U.S. EPA (1996). Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil
Table version date 6/21/2009

Table 28
Summary of Toxicity Factors
Former York Naval Ordnance Plant, York, PA

Constituent	Mutagen	Oral Chronic Reference Dose mg/kg-day	Source[1]	GI Absorption Factor	Source[1]	Dermal Chronic Reference Dose mg/kg-day	Source[1]	Inhalation Reference Concentration mg/m^3	Source[1]	Oral Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$	Source[1]	Dermal Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$	Source[1]	Inhalation Unit Risk $(ug/m^3)^{-1}$	Source[1]
Inorganics															
Antimony		4.00E-04	IRIS	0.15	RSL	6.00E-05	R to R	NA		NA		NA		NA	
Arsenic		3.00E-04	IRIS	1	RSL	3.00E-04	R to R	1.50E-05	CalEPA	1.50E+00	IRIS	1.50E+00	R to R	4.30E-03	IRIS
Cadmium		5.00E-04	IRIS	0.05	RSL	2.50E-05	R to R	2.00E-05	CalEPA	NA		NA		1.80E-03	IRIS
Chromium*	X	3.00E-03	IRIS	0.025	RSL	7.50E-05	R to R	1.00E-04	IRIS	5.00E-01	NJDEP	2.00E+01	R to R	8.40E-02	IRISx7
Chromium - Hexavalent	X	3.00E-03	IRIS	0.025	RSL	7.50E-05	R to R	1.00E-04	IRIS	5.00E-01	NJDEP	2.00E+01	R to R	8.40E-02	IRISx7
Thallium		1.00E-05	PPRTVa	1	RSL	1.00E-05	R to R	NA		NA		NA		NA	
Zinc		3.00E-01	IRIS	1	RSL	3.00E-01	R to R	NA		NA		NA		NA	
Semivolatiles															
Benzo(a)pyrene	X	NA		1	RSL	NA		NA		7.30E+00	IRIS	7.30E+00	R to R	1.10E-03	CalEPA
Benzo(b)fluoranthene	X	NA		1	RSL	NA		NA		7.30E-01	CalEPA	7.30E-01	R to R	1.10E-04	CalEPA
Carbazole		NA		1	RSL	NA		NA		2.00E-02	PADEP	2.00E-02	R to R	NA	
Dimethylphthalate		NA		1	RSL	NA		NA		NA		NA		NA	
Hexachlorobenzene		8.00E-04	IRIS	1	RSL	8.00E-04	R to R	NA		1.60E+00	IRIS	1.60E+00	R to R	4.60E-04	IRIS
Pentachlorophenol		5.00E-03	IRIS	1	RSL	5.00E-03	R to R	NA		4.00E-01	IRIS	4.00E-01	R to R	5.10E-06	CalEPA
PCBs															
Aroclor 1254		2.00E-05	IRIS	1	RSL	2.00E-05	R to R	NA		2.00E+00	IRIS PCB Up	2.00E+00	R to R	5.70E-04	IRIS high
Volatiles															
1,2-Dichloroethane		6.00E-03	PPRTVa	1	RSL	6.00E-03	R to R	7.00E-03	PPRTV	9.10E-02	IRIS	9.10E-02	R to R	2.60E-05	IRIS
Tetrachloroethene		6.00E-03	IRIS	1	RSL	6.00E-03	R to R	4.00E-02	IRIS	2.10E-03	IRIS	2.10E-03	R to R	2.60E-07	IRIS
Trichloroethene	X	5.00E-04	IRIS	1	RSL	5.00E-04	R to R	2.30E-03	IRIS	4.60E-02	IRIS	4.60E-02	R to R	4.10E-06	IRIS
Vinyl Chloride		3.00E-03	IRIS	1	RSL	3.00E-03	R to R	1.00E-01	IRIS	7.20E-01	IRIS	7.20E-01	R to R	4.40E-06	IRIS

[1] Toxicity values as presented were obtained from the November 2011 USEPA RSL tables (with the exception of carbazole). Sources presented are as listed on the November 2011 RSL tables.
IRIS - USEPA Integrated Risk Information System
RSL - USEPA Regional Screening Level Tables, November, 2011
R to R - Route to route extrapolation using methodology from USEPA, 2004.
NA - Not Available
CalEPA - California Environmental Protection Agency published value
* For purposes of toxicity, chromium was assumed to be hexavalent chromium.
NJDEP - New Jersey Department of Environmental Protection published value
PPRTVa - USEPA Provisional Peer Review Toxicity Appendix Value
IRISx7 - USEPA's IRIS published value for hexavalent chromium multiplied by a factor of 7 as published in USEPA's RSL tables, June 2011.
PADEP - PADEP Toxicity Value Database located at http://www.depreportingsvcs.state.pa.us/ReportServer/Pages/ReportViewer.aspx?/CPP/Toxicity
IRIS PCB Up - Upper bound value for high risk mixtures of PCBs as published in USEPA's IRIS
IRIS high - IUR converted from the high risk oral slope factor for PCB mixtures as published in USEPA's IRIS
PPRTV - USEPA Provisional Peer Review Toxicity Value
ATSDR - Agency for Toxic Substances and Disease Registry

Table 29
Summary of Hazard and Risk Calculations
Former York Naval Ordnance Plant, York, PA

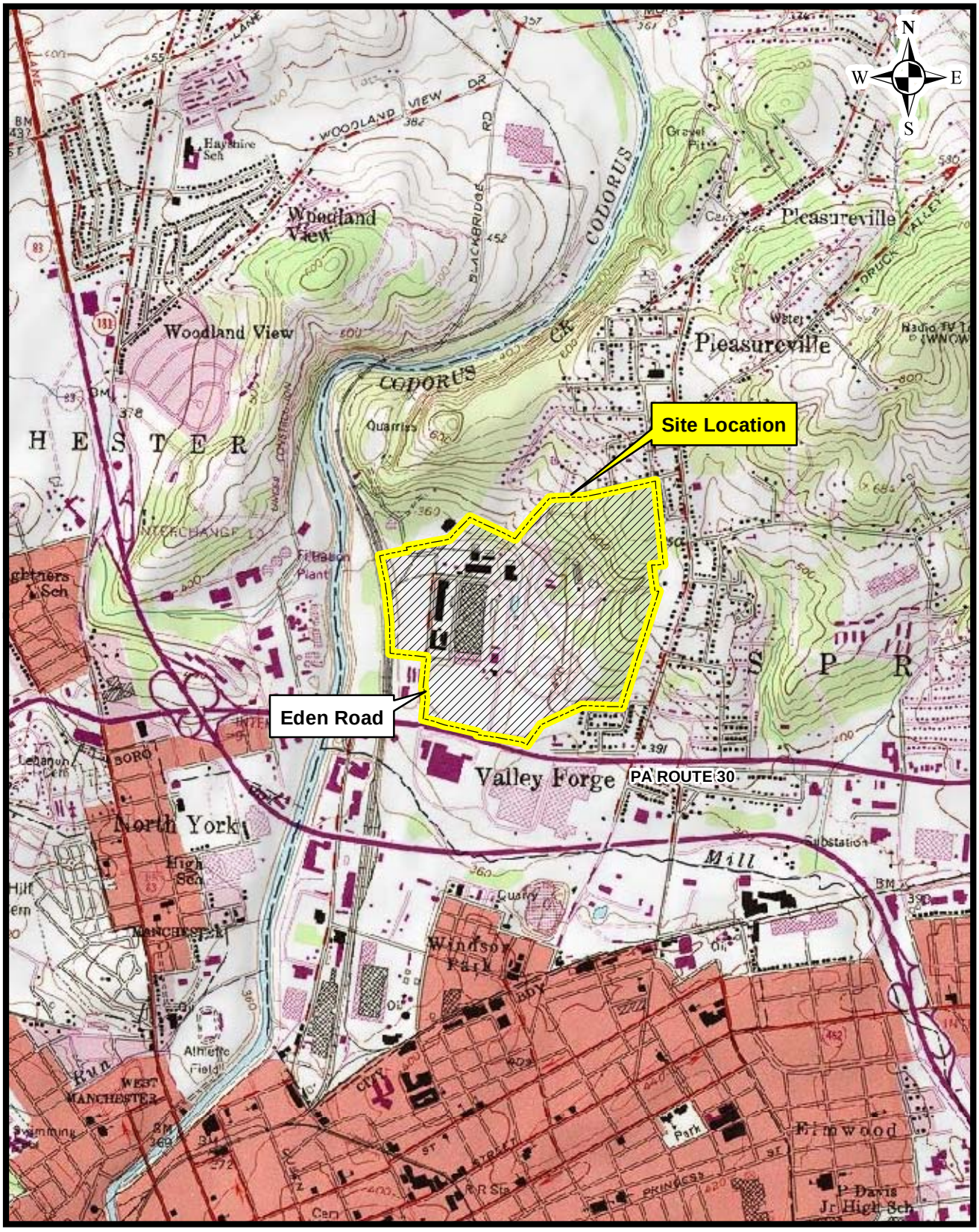
East Campus

Receptor/Pathway	Hazard Index	Cancer Risk	Table #
Maintenance Worker			
Dermal exposure to surface soil	0.00	0.00	6
Oral exposure to surface soil	0.0013	5.74E-09	7
Inhalation exposure to surface soil	0.0068	2.53E-08	8
Total Maintenance Worker:	**0.0081**	**3.11E-08**	
Construction Worker			
Dermal exposure to surface and subsurface soil	0.0014	8.87E-09	9
Oral exposure to surface and subsurface soil	0.076	4.51E-07	10
Inhalation exposure to surface and subsurface soil	0.0010	8.69E-10	11
Total Construction Worker:	**0.078**	**4.60E-07**	
Adolescent Trespasser			
Dermal exposure to surface soil	0.000	0.00E+00	12
Oral exposure to surface soil	0.00026	5.67E-10	13
Inhalation exposure to surface soil	0.00045	8.10E-10	14
Total Adolescent Trespasser:	**0.0007**	**1.38E-09**	

West Campus

Receptor/Pathway	Hazard Index	Cancer Risk	Table #
Maintenance Worker			
Dermal exposure to surface soil	0.001	9.89E-08	15
Oral exposure to surface soil	0.10	1.61E-05	16
Inhalation exposure to surface soil	0.004	1.32E-07	17
Total Maintenance Worker:	**0.11**	**1.63E-05**	
Construction Worker			
Dermal exposure to surface and subsurface soil	0.15	1.86E-07	18
Oral exposure to surface and subsurface soil	0.68	1.94E-06	19
Inhalation exposure to surface and subsurface soil	0.020	4.40E-09	20
Total Construction Worker:	**0.86**	**2.13E-06**	
Adolescent Trespasser			
Dermal exposure to surface soil	0.00042	2.23E-08	21
Oral exposure to surface soil	0.041	8.48E-06	22
Inhalation exposure to surface soil	0.0003	1.19E-08	23
Total Adolescent Trespasser:	**0.04**	**8.52E-06**	

Combined Exposures: East and West Campus	Hazard Index	Cancer Risk
Maintenance Worker	0.11	1.64E-05
Construction Worker	0.94	2.59E-06
Adolescent Site Visitor	0.04	8.52E-06



Portion of the York, PA
7.5-minute USGS Quadrangle
(2001)

Figure 1

Former York Naval Ordnance Plant

1425 Eden Road, York, PA 17402

Site Location Map

GROUNDWATER SCIENCES CORPORATION

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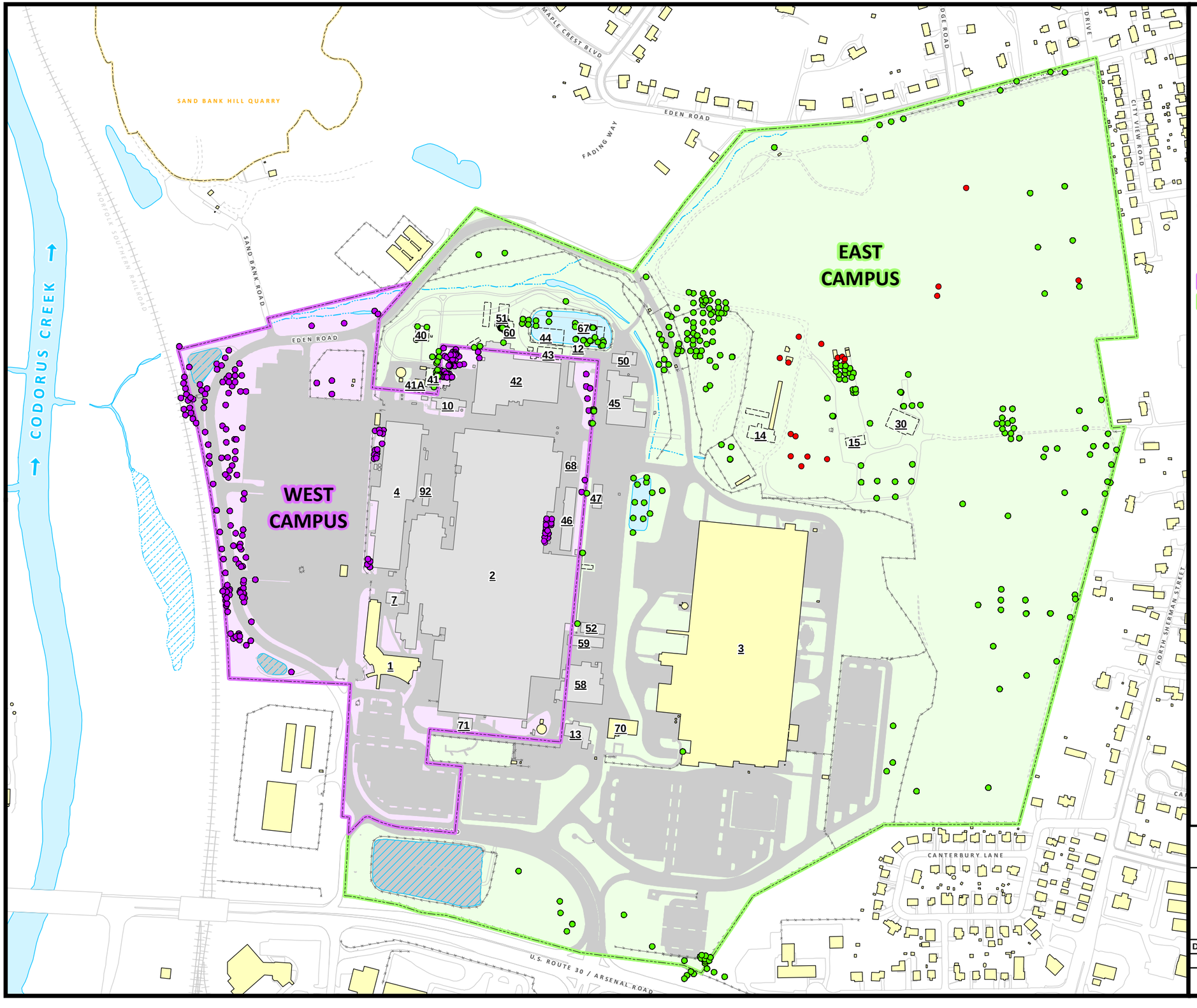

LEGEND

- Soil Sample (East Campus, Non-Impervious, 0-15' BOS)
- Soil Sample (West Campus, Non-Impervious, 0-15' BOS)
- MMRP Sample Location Points *
- Proposed West Tract (2012)
- Proposed East Tract (2012)
- Impervious Surface Area (as of 1/24/2012) **
- Impervious Liner (as of 1/24/2012) **
- Active Building
- Former Building (Slab-in-Place)
- Former Building (Slab Removed)
- Road or Walkway
- Road (Unpaved)
- Fenceline
- Railroad
- Existing Water Feature
- Existing Stream
- Wetland Boundary (2006)

** MMRP sample location points were taken from Table 3-1 of the Final Site Inspection Report, York Naval Ordnance Plant (ALION, 2008); locations as plotted are suspect.*

*** Impervious areas were revised using the following sources:*
***FR09-ES-5 Plans.dwg** (NuTec Design Associates, Inc., May 2010)*
***Master Utility.dwg** (Harley-Davidson, October 2011)*
Figure 1, "West Parking Lot and Eden Road Relocation Areas Stormwater Facilities" (SAIC, December 2005)
Figure 3.5-2 of the Supplemental Remediation Investigation Soils Report, York Naval Ordnance Plant (SAIC, December 2009).
Input from Sharon R. Fisher (H-D) and Rodney G. Myers (SAIC) on Jan. 24, 2012.

Scale (feet)
0 100 200 400

Figure 2

Former York Naval Ordnance Plant
1425 Eden Road, York, PA 17402

East and West Campus Divisions
Location of Soil Samples

DRAWN BY: JPB	CHECKED AND APPROVED BY: SMS	DATE: 3/9/2012

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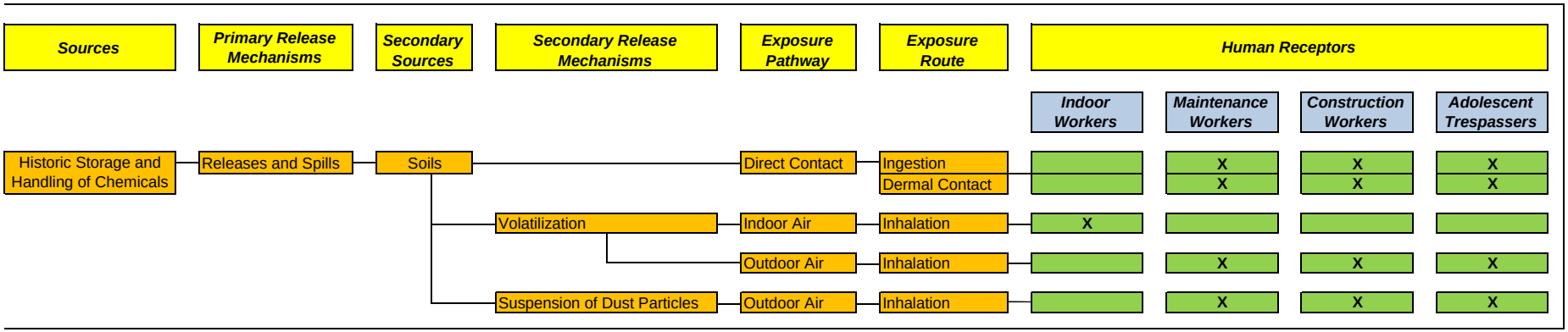
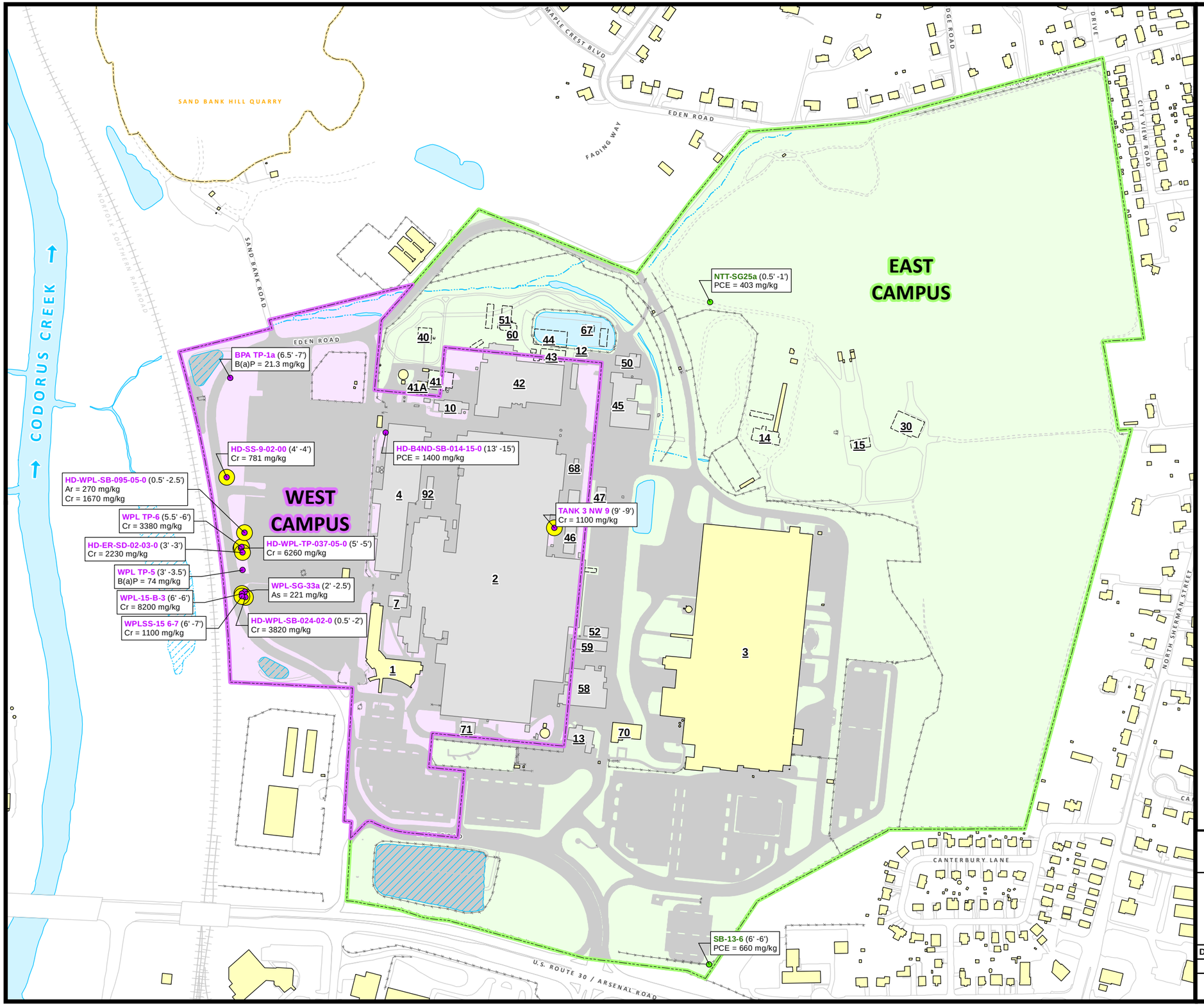
Figure 3: Conceptual Site Model - Soil Exposure Pathway Analysis
Former York Naval Ordnance Plant, York, PA



Complete Pathway to be evaluated in the Human Health Risk Assessment



N

W E

S

LEGEND

- Hot Spot Soil Sample (East Campus, Non-Impervious, 0-15' BOS)
- Hot Spot Soil Sample (West Campus, Non-Impervious, 0-15' BOS)
- Chromium Hot Spot (Using Chromium VI Screening Level)*
- Proposed West Tract (2012)
- Proposed East Tract (2012)
- Impervious Surface Area (as of 1/24/2012) **
- Impervious Liner (as of 1/24/2012) **
- Active Building
- Former Building (Slab-in-Place)
- Former Building (Slab Removed)
- Road or Walkway
- Road (Unpaved)
- Fenceline
- Railroad
- Existing Water Feature
- Existing Stream
- Wetland Boundary (2006)

Soil Sample ID (Top of Sample - Bottom of Sample)
PCE = Tetrachloroethene
Ar = Aroclor-1254
As = Arsenic
B(a)P = Benzo (a) Pyrene
Cr = Chromium

** The hot spot evaluation used Chromium VI screening levels for these locations. If screening levels based on Chromium III are used, these locations are not considered hot spots.*

*** Impervious areas were revised using the following sources:*
***FR09-ES-5 Plans.dwg** (NuTec Design Associates, Inc., May 2010)*
***Master Utility.dwg** (Harley-Davidson, October 2011)*
Figure 1, "West Parking Lot and Eden Road Relocation Areas Stormwater Facilities" (SAIC, December 2005)
Figure 3.5-2 of the Supplemental Remediation Investigation Soils Report, York Naval Ordnance Plant (SAIC, December 2009).
Input from Sharon R. Fisher (H-D) and Rodney G. Myers (SAIC) on Jan. 24, 2012.

Scale (feet)
0 100 200 400

Figure 4

Former York Naval Ordnance Plant
1425 Eden Road, York, PA 17402

Sample Locations Exceeding USEPA RSL Hot Spot Screening Levels

DRAWN BY: JPB	CHECKED AND APPROVED BY: KZ/SS	DATE: 3/9/2012

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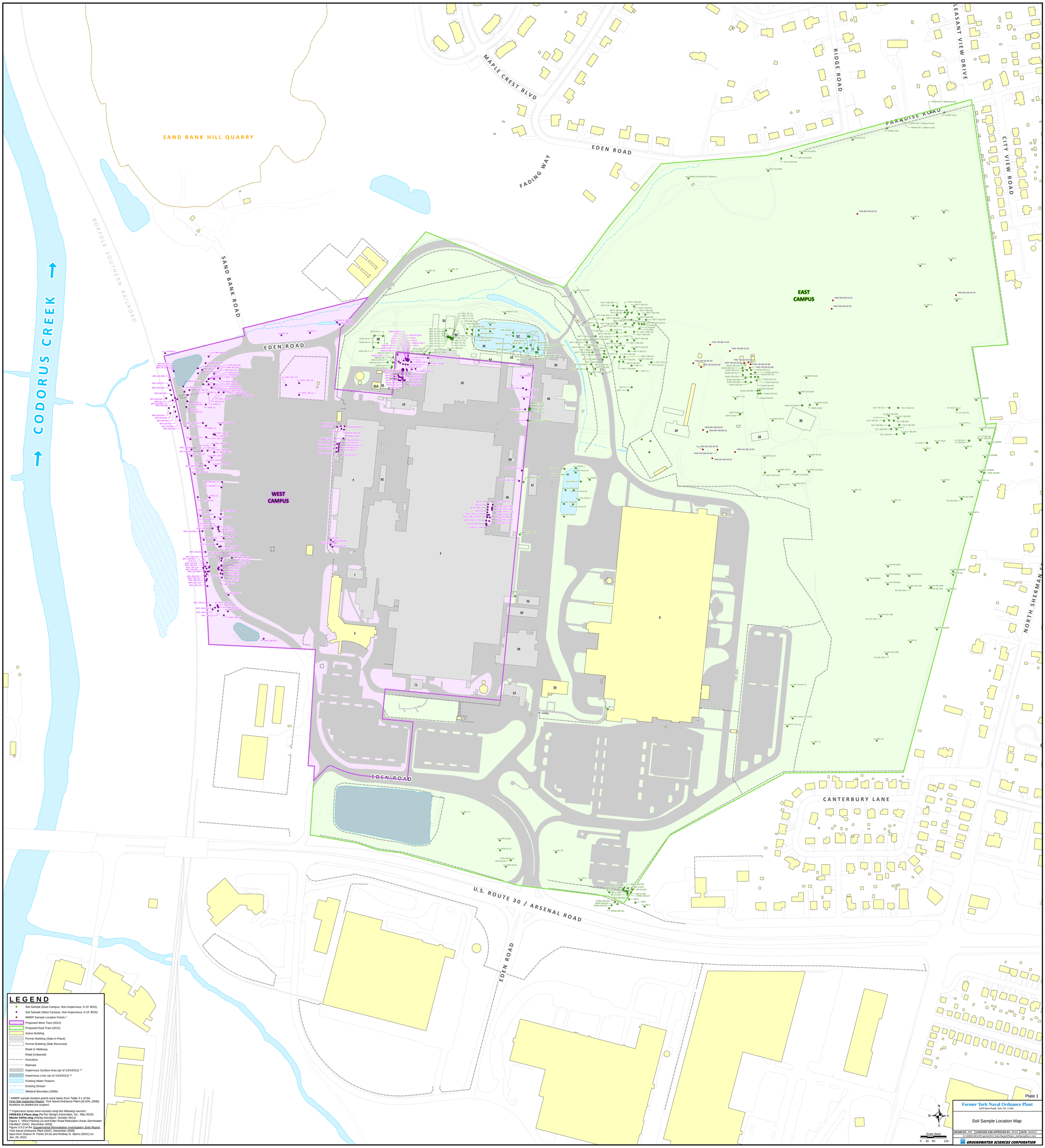
GROUNDWATER SCIENCES CORPORATION


SAND BANK HILL QUARRY
MAPLE CREST BLVD
EDEN ROAD
FADING WAY
RIDGE ROAD
LEASANT VIEW DRIVE
PARADISE ROAD
CITY VIEW ROAD
NORFOLK SOUTHERN RAILROAD
SAND BANK ROAD
CODORUS CREEK
WEST CAMPUS
EAST CAMPUS
NORTH SHERMAN S
CANTERBURY LANE
U.S. ROUTE 30 / ARSENAL ROAD
NPBA DIVERSION TRENCH
LEGEND
Soil Sample (East Campus, Non-Impervious, 0-15' BOS)
Soil Sample (West Campus, Non-Impervious, 0-15' BOS)
MMRP Sample Location Points *
Proposed West Tract (2012)
Proposed East Tract (2012)
Active Building
Former Building (Slab-in-Place)
Former Building (Slab Removed)
Road or Walkway
Road (Unpaved)
Fenceline
Railroad
Impervious Surface Area (as of 1/24/2012) **
Impervious Liner (as of 1/24/2012) **
Existing Water Feature
Existing Stream
Wetland Boundary (2006)
* MMRP sample location points were taken from Table 3-1 of the Final Site Inspection Report, York Naval Ordnance Plant (ALION, 2008); locations as plotted are suspect.
** Impervious areas were revised using the following sources:
FR09-ES-5 Plans.dwg (NuTec Design Associates, Inc., May 2010)
Master Utility.dwg (Harley-Davidson, October 2011)
Figure 1, "West Parking Lot and Eden Road Relocation Areas Stormwater Facilities" (SAIC, December 2005)
Figure 3.5-2 of the Supplemental Remediation Investigation Soils Report, York Naval Ordnance Plant (SAIC, December 2009).
Input from Sharon R. Fisher (H-D) and Rodney G. Myers (SAIC) on Jan. 24, 2012.
Plate 1
Former York Naval Ordnance Plant
1425 Eden Road, York, PA 17402
Soil Sample Location Map
DRAWN BY: JPB
CHECKED AND APPROVED BY: JR/SS
DATE: 3/9/2012
K:\10000\10012\Projects\2012 Soils Report\Plate1_SoilSampRev1.mxd
GROUNDWATER SCIENCES CORPORATION
Scale (feet)
0 30 60 120
N
W
E
S

Appendix A
Surrogate Reporting Limits for Select COPCs in Soils
Former York Naval Ordnance Plant, York, PA

East Campus Soils 0-2 feet bgs

COPC	**Surrogate Reporting Limit (mg/kg)**
Tetrachloroethene	0.004

East Campus Soils 0-15 feet bgs

COPC	**Surrogate Reporting Limit (mg/kg)**
1,2-Dichloroethane	0.53
Arsenic	1.2
Hexavalent Chromium	11.9
Thallium	11.1
Tetrachloroethene	0.53
Vinyl Chloride	0.35

West Campus 0-2 feet bgs

COPC	**Surrogate Reporting Limit (mg/kg)**
Arsenic	2
Cadmium	0.69
Dimethylphthalate	2
Tetrachloroethene	0.57
Thallium	6.3
Trichloroethene	0.57

West Campus 0-15 feet bgs

COPC	**Surrogate Reporting Limit (mg/kg)**
Antimony	7.2
Arsenic	2
Cadmium	3.2
Thallium	6.5
Aroclor-1254	0.89
Benzo(a)pyrene	1.3
Dimethylphthalate	2
Hexachlorobenzene	2.4
Tetrachloroethene	0.2
Trichloroethene	0.2

Appendix B-1
ProUCL Outputs for East Campus Soils 0-2 Feet
Former York Naval Ordnance Plant, York, PA

Tetrachloroethene

General Statistics

Number of Valid Data	137	Number of Detected Data	20
Number of Distinct Detected Data	16	Number of Non-Detect Data	117
		Percent Non-Detects	85.40%

Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.0012	Minimum Detected	-6.725
Maximum Detected	403	Maximum Detected	5.999
Mean of Detected	20.18	Mean of Detected	-3.838
SD of Detected	90.11	SD of Detected	2.617
Minimum Non-Detect	0.0022	Minimum Non-Detect	-6.119
Maximum Non-Detect	2.6	Maximum Non-Detect	0.956

Note: Data have multiple DLs - Use of KM Method is recommended
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

		Number treated as Non-Detect	136
		Number treated as Detected	1
		Single DL Non-Detect Percentage	99.27%

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.236	Shapiro Wilk Test Statistic	0.679
5% Shapiro Wilk Critical Value	0.905	5% Shapiro Wilk Critical Value	0.905
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	

Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	2.959	Mean	-5.593
SD	34.43	SD	1.466
95% DL/2 (t) UCL	7.831	95% H-Stat (DL/2) UCL	0.0152
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	-7.094
		SD in Log Scale	2.138
		Mean in Original Scale	2.946
		SD in Original Scale	34.43
		95% t UCL	7.818
		95% Percentile Bootstrap UCL	8.829
		95% BCA Bootstrap UCL	11.77
		95% H-UCL	0.0153

Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**
k star (bias corrected)	0.132	**Data do not follow a Discernable Distribution (0.05)**
Theta Star	152.6	
nu star	5.29	
A-D Test Statistic	5.82	**Nonparametric Statistics**
5% A-D Critical Value	0.922	Kaplan-Meier (KM) Method
K-S Test Statistic	0.922	Mean 2.947
5% K-S Critical Value	0.218	SD 34.3
Data not Gamma Distributed at 5% Significance Level		SE of Mean 3.007
		95% KM (t) UCL 7.927
Assuming Gamma Distribution		95% KM (z) UCL 7.893
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL 7.818
Minimum	0.000001	95% KM (bootstrap t) UCL 9894
Maximum	403	95% KM (BCA) UCL 8.83
Mean	2.945	95% KM (Percentile Bootstrap) UCL 8.83
Median	0.000001	95% KM (Chebyshev) UCL 16.05
SD	34.43	97.5% KM (Chebyshev) UCL 21.73
k star	0.0671	99% KM (Chebyshev) UCL 32.87
Theta star	43.89	
Nu star	18.39	**Potential UCLs to Use**
AppChi2	9.67	97.5% KM (Chebyshev) UCL 21.73
95% Gamma Approximate UCL	5.6	
95% Adjusted Gamma UCL	5.639	

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Appendix B-2
ProUCL Outputs for East Campus Soils 0-15 Feet
Former York Naval Ordnance Plant, York, PA

1,2-Dichloroethane

General Statistics

Number of Valid Data	310	Number of Detected Data	2
Number of Distinct Detected Data	2	Number of Non-Detect Data	308
		Percent Non-Detects	99.35%

Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.005	Minimum Detected	-5.298
Maximum Detected	4.1	Maximum Detected	1.411
Mean of Detected	2.053	Mean of Detected	-1.944
SD of Detected	2.896	SD of Detected	4.744
Minimum Non-Detect	0.0019	Minimum Non-Detect	-6.266
Maximum Non-Detect	2.6	Maximum Non-Detect	0.956

Note: Data have multiple DLs - Use of KM Method is recommended
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

Number treated as Non-Detect	309
Number treated as Detected	1
Single DL Non-Detect Percentage	99.68%

Warning: Data set has only 2 Distinct Detected Values.
This may not be adequate enough to compute meaningful and reliable test statistics and estimates.
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

Unless Data Quality Objectives (DQOs) have been met, it is suggested to collect additional observations.

The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.
Those methods will return a 'N/A' value on your output display!

It is necessary to have 4 or more Distinct Values for bootstrap methods.
However, results obtained using 4 to 9 distinct values may not be reliable.
It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	N/A	Shapiro Wilk Test Statistic	N/A
5% Shapiro Wilk Critical Value	N/A	5% Shapiro Wilk Critical Value	N/A
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.0379	Mean	-5.548
SD	0.25	SD	1.372
95% DL/2 (t) UCL	0.0614	95% H-Stat (DL/2) UCL	0.0121
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	N/A
		SD in Log Scale	N/A
		Mean in Original Scale	N/A
		SD in Original Scale	N/A
		95% t UCL	N/A
		95% Percentile Bootstrap UCL	N/A
		95% BCA Bootstrap UCL	N/A
		95% H-UCL	N/A

Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	N/A	**Data do not follow a Discernable Distribution (0.05)**	
Theta Star	N/A		
nu star	N/A		
A-D Test Statistic	N/A	**Nonparametric Statistics**	
5% A-D Critical Value	N/A	Kaplan-Meier (KM) Method	
K-S Test Statistic	N/A	Mean	0.0182
5% K-S Critical Value	N/A	SD	0.232
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.0187
		95% KM (t) UCL	0.049
Assuming Gamma Distribution		95% KM (z) UCL	0.0489
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	2.662
Minimum	N/A	95% KM (bootstrap t) UCL	N/A
Maximum	N/A	95% KM (BCA) UCL	4.1
Mean	N/A	95% KM (Percentile Bootstrap) UCL	N/A
Median	N/A	95% KM (Chebyshev) UCL	0.0995
SD	N/A	97.5% KM (Chebyshev) UCL	0.135
k star	N/A	99% KM (Chebyshev) UCL	0.204
Theta star	N/A		
Nu star	N/A	**Potential UCLs to Use**	
AppChi2	N/A	97.5% KM (Chebyshev) UCL	0.135
95% Gamma Approximate UCL	N/A		
95% Adjusted Gamma UCL	N/A		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Chromium

General Statistics

Number of Valid Observations	219	Number of Distinct Observations	147

Raw Statistics		**Log-transformed Statistics**	
Minimum	2.4	Minimum of Log Data	0.875
Maximum	507	Maximum of Log Data	6.229
Mean	30.12	Mean of log Data	2.736
Median	12.7	SD of log Data	0.899
SD	63.48		
Std. Error of Mean	4.29		
Coefficient of Variation	2.108		
Skewness	4.701		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Lilliefors Test Statistic	0.372	Lilliefors Test Statistic	0.19
Lilliefors Critical Value	0.0599	Lilliefors Critical Value	0.0599
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	

Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	37.2	95% H-UCL	26.22
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	30.24
95% Adjusted-CLT UCL (Chen-1995)	38.63	97.5% Chebyshev (MVUE) UCL	33.35
95% Modified-t UCL (Johnson-1978)	37.43	99% Chebyshev (MVUE) UCL	39.45

Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	0.868	**Data do not follow a Discernable Distribution (0.05)**	
Theta Star	34.71		
MLE of Mean	30.12		
MLE of Standard Deviation	32.33		
nu star	380		
Approximate Chi Square Value (.05)	335.9	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0489	95% CLT UCL	37.17
Adjusted Chi Square Value	335.6	95% Jackknife UCL	37.2
		95% Standard Bootstrap UCL	37.37
Anderson-Darling Test Statistic	27.9	95% Bootstrap-t UCL	39.86
Anderson-Darling 5% Critical Value	0.79	95% Hall's Bootstrap UCL	38.81
Kolmogorov-Smirnov Test Statistic	0.288	95% Percentile Bootstrap UCL	37.49
Kolmogorov-Smirnov 5% Critical Value	0.0636	95% BCA Bootstrap UCL	39.06
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	48.82
		97.5% Chebyshev(Mean, Sd) UCL	56.91
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	72.8
95% Approximate Gamma UCL	34.08		
95% Adjusted Gamma UCL	34.11		

Potential UCL to Use	Use 95% Chebyshev (Mean, Sd) UCL 48.82

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Appendix B-2
ProUCL Outputs for East Campus Soils 0-15 Feet
Former York Naval Ordnance Plant, York, PA

Hexavalent Chromium

General Statistics

Number of Valid Data	134	Number of Detected Data	33
Number of Distinct Detected Data	29	Number of Non-Detect Data	101
		Percent Non-Detects	75.37%

Raw Statistics

Minimum Detected	0.16
Maximum Detected	254
Mean of Detected	16.74
SD of Detected	52.39
Minimum Non-Detect	0.43
Maximum Non-Detect	11.9

Log-transformed Statistics

Minimum Detected	-1.833
Maximum Detected	5.537
Mean of Detected	0.00871
SD of Detected	1.894
Minimum Non-Detect	-0.844
Maximum Non-Detect	2.477

Note: Data have multiple DLs - Use of KM Method is recommended
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

Number treated as Non-Detect	130
Number treated as Detected	4
Single DL Non-Detect Percentage	97.01%

UCL Statistics

Normal Distribution Test with Detected Values Only

Shapiro Wilk Test Statistic	0.369
5% Shapiro Wilk Critical Value	0.931

Data not Normal at 5% Significance Level

Assuming Normal Distribution

DL/2 Substitution Method	
Mean	6.716
SD	26.44
95% DL/2 (t) UCL	10.5
Maximum Likelihood Estimate(MLE) Method	N/A

MLE yields a negative mean

Lognormal Distribution Test with Detected Values Only

Shapiro Wilk Test Statistic	0.729
5% Shapiro Wilk Critical Value	0.931

Data not Lognormal at 5% Significance Level

Assuming Lognormal Distribution

DL/2 Substitution Method	
Mean	0.354
SD	1.632
95% H-Stat (DL/2) UCL	8.069
Log ROS Method	
Mean in Log Scale	-1.006
SD in Log Scale	1.45
Mean in Original Scale	4.485
SD in Original Scale	26.65
95% t UCL	8.298
95% Percentile Bootstrap UCL	8.559
95% BCA Bootstrap UCL	11.17
95% H-UCL	1.459

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	0.25
Theta Star	67.02
nu star	16.48
A-D Test Statistic	6.865
5% A-D Critical Value	0.876
K-S Test Statistic	0.876
5% K-S Critical Value	0.168

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data	
Minimum	0.000001
Maximum	254
Mean	6.579
Median	0.000001
SD	27.71
k star	0.083
Theta star	79.25
Nu star	22.25
AppChi2	12.52
95% Gamma Approximate UCL	11.69
95% Adjusted Gamma UCL	11.76

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only

Data do not follow a Discernable Distribution (0.05)

Nonparametric Statistics

Kaplan-Meier (KM) Method	
Mean	4.407
SD	26.55
SE of Mean	2.33
95% KM (t) UCL	8.266
95% KM (z) UCL	8.239
95% KM (jackknife) UCL	8.221
95% KM (bootstrap t) UCL	16.21
95% KM (BCA) UCL	8.882
95% KM (Percentile Bootstrap) UCL	8.853
95% KM (Chebyshev) UCL	14.56
97.5% KM (Chebyshev) UCL	18.96
99% KM (Chebyshev) UCL	27.59

Potential UCLs to Use

95% KM (Chebyshev) UCL	14.56

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Appendix B-2
ProUCL Outputs for East Campus Soils 0-15 Feet
Former York Naval Ordnance Plant, York, PA

Tetrachloroethene

General Statistics

Number of Valid Data	435	Number of Detected Data	46
Number of Distinct Detected Data	39	Number of Non-Detect Data	389
		Percent Non-Detects	89.43%

Raw Statistics

Minimum Detected	0.00024
Maximum Detected	660
Mean of Detected	23.28
SD of Detected	112.9
Minimum Non-Detect	0.0019
Maximum Non-Detect	2.6

Log-transformed Statistics

Minimum Detected	-8.335
Maximum Detected	6.492
Mean of Detected	-4.29
SD of Detected	2.974
Minimum Non-Detect	-6.266
Maximum Non-Detect	0.956

Note: Data have multiple DLs - Use of KM Method is recommended
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

Number treated as Non-Detect	432
Number treated as Detected	3
Single DL Non-Detect Percentage	99.31%

UCL Statistics

Normal Distribution Test with Detected Values Only

Shapiro Wilk Test Statistic	0.227
5% Shapiro Wilk Critical Value	0.945

Data not Normal at 5% Significance Level

Assuming Normal Distribution

DL/2 Substitution Method	
Mean	2.545
SD	37.03
95% DL/2 (t) UCL	5.472
Maximum Likelihood Estimate(MLE) Method	N/A

MLE yields a negative mean

Lognormal Distribution Test with Detected Values Only

Shapiro Wilk Test Statistic	0.804
5% Shapiro Wilk Critical Value	0.945

Data not Lognormal at 5% Significance Level

Assuming Lognormal Distribution

DL/2 Substitution Method	
Mean	-4.356
SD	2.28
95% H-Stat (DL/2) UCL	0.25
Log ROS Method	
Mean in Log Scale	-7.197
SD in Log Scale	2.233
Mean in Original Scale	2.464
SD in Original Scale	37.04
95% t UCL	5.392
95% Percentile Bootstrap UCL	5.499
95% BCA Bootstrap UCL	7.017
95% H-UCL	0.013

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	0.116
Theta Star	201.5
nu star	10.63
A-D Test Statistic	11.67
5% A-D Critical Value	0.965
K-S Test Statistic	0.965
5% K-S Critical Value	0.148

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data	
Minimum	0.000001
Maximum	660
Mean	3.575
Median	0.000001
SD	37.62
k star	0.0648
Theta star	55.21
Nu star	56.34
AppChi2	40.08
95% Gamma Approximate UCL	5.025
95% Adjusted Gamma UCL	5.03

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only

Data do not follow a Discernable Distribution (0.05)

Nonparametric Statistics

Kaplan-Meier (KM) Method	
Mean	2.464
SD	37
SE of Mean	1.793
95% KM (t) UCL	5.42
95% KM (z) UCL	5.414
95% KM (jackknife) UCL	5.391
95% KM (bootstrap t) UCL	2710
95% KM (BCA) UCL	5.498
95% KM (Percentile Bootstrap) UCL	5.515
95% KM (Chebyshev) UCL	10.28
97.5% KM (Chebyshev) UCL	13.66
99% KM (Chebyshev) UCL	20.31

Potential UCLs to Use

97.5% KM (Chebyshev) UCL	13.66

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Appendix B-2
ProUCL Outputs for East Campus Soils 0-15 Feet
Former York Naval Ordnance Plant, York, PA

Thallium

General Statistics

Number of Valid Data	206	Number of Detected Data	33
Number of Distinct Detected Data	21	Number of Non-Detect Data	173
		Percent Non-Detects	83.98%

Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.13	Minimum Detected	-2.04
Maximum Detected	20	Maximum Detected	2.996
Mean of Detected	0.934	Mean of Detected	-1.141
SD of Detected	3.431	SD of Detected	0.94
Minimum Non-Detect	0.341	Minimum Non-Detect	-1.076
Maximum Non-Detect	28.7	Maximum Non-Detect	3.357

Note: Data have multiple DLs - Use of KM Method is recommended
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

Number treated as Non-Detect	206
Number treated as Detected	0
Single DL Non-Detect Percentage	100.00%

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.224	Shapiro Wilk Test Statistic	0.73
5% Shapiro Wilk Critical Value	0.931	5% Shapiro Wilk Critical Value	0.931
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	2.68	Mean	0.164
SD	3.232	SD	1.368
95% DL/2 (t) UCL	3.052	95% H-Stat (DL/2) UCL	3.808
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	-1.351
		SD in Log Scale	0.629
		Mean in Original Scale	0.392
		SD in Original Scale	1.385
		95% t UCL	0.551
		95% Percentile Bootstrap UCL	0.584
		95% BCA Bootstrap UCL	0.765
		95% H-UCL	0.343

Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.547	**Data do not follow a Discernable Distribution (0.05)**	
Theta Star	1.708		
nu star	36.08		
A-D Test Statistic	6.244	**Nonparametric Statistics**	
5% A-D Critical Value	0.804	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.804	Mean	0.375
5% K-S Critical Value	0.161	SD	1.389
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.101
		95% KM (t) UCL	0.542
Assuming Gamma Distribution		95% KM (z) UCL	0.541
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.54
Minimum	0.000001	95% KM (bootstrap t) UCL	0.984
Maximum	20	95% KM (BCA) UCL	0.601
Mean	0.67	95% KM (Percentile Bootstrap) UCL	0.565
Median	0.285	95% KM (Chebyshev) UCL	0.814
SD	1.527	97.5% KM (Chebyshev) UCL	1.005
k star	0.186	99% KM (Chebyshev) UCL	1.378
Theta star	3.597		
Nu star	76.75	**Potential UCLs to Use**	
AppChi2	57.57	95% KM (t) UCL	0.542
95% Gamma Approximate UCL	0.893	95% KM (% Bootstrap) UCL	0.565
95% Adjusted Gamma UCL	0.895		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Appendix B-2
ProUCL Outputs for East Campus Soils 0-15 Feet
Former York Naval Ordnance Plant, York, PA

Vinyl Chloride

General Statistics

Number of Valid Data	331	Number of Detected Data	29
Number of Distinct Detected Data	21	Number of Non-Detect Data	302
		Percent Non-Detects	91.24%

Raw Statistics

Minimum Detected	0.0015
Maximum Detected	2.5
Mean of Detected	0.351
SD of Detected	0.671
Minimum Non-Detect	0.0019
Maximum Non-Detect	2.6

Log-transformed Statistics

Minimum Detected	-6.502
Maximum Detected	0.916
Mean of Detected	-3.329
SD of Detected	2.37
Minimum Non-Detect	-6.266
Maximum Non-Detect	0.956

Note: Data have multiple DLs - Use of KM Method is recommended
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

Number treated as Non-Detect	331
Number treated as Detected	0
Single DL Non-Detect Percentage	100.00%

UCL Statistics

Normal Distribution Test with Detected Values Only

Shapiro Wilk Test Statistic	0.592
5% Shapiro Wilk Critical Value	0.926

Data not Normal at 5% Significance Level

Assuming Normal Distribution

DL/2 Substitution Method	
Mean	0.0552
SD	0.233
95% DL/2 (t) UCL	0.0763
Maximum Likelihood Estimate(MLE) Method	N/A

MLE method failed to converge properly

Lognormal Distribution Test with Detected Values Only

Shapiro Wilk Test Statistic	0.906
5% Shapiro Wilk Critical Value	0.926

Data not Lognormal at 5% Significance Level

Assuming Lognormal Distribution

DL/2 Substitution Method	
Mean	-5.199
SD	1.615
95% H-Stat (DL/2) UCL	0.0259
Log ROS Method	
Mean in Log Scale	-6.265
SD in Log Scale	1.796
Mean in Original Scale	0.034
SD in Original Scale	0.219
95% t UCL	0.0538
95% Percentile Bootstrap UCL	0.0546
95% BCA Bootstrap UCL	0.0624
95% H-UCL	0.0127

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	0.294
Theta Star	1.193
nu star	17.04
A-D Test Statistic	1.988
5% A-D Critical Value	0.856
K-S Test Statistic	0.856
5% K-S Critical Value	0.177

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data	
Minimum	0.000001
Maximum	2.5
Mean	0.0554
Median	0.000001
SD	0.227
k star	0.101
Theta star	0.546
Nu star	67.15
AppChi2	49.29
95% Gamma Approximate UCL	0.0755
95% Adjusted Gamma UCL	0.0756

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only

Data do not follow a Discernable Distribution (0.05)

Nonparametric Statistics

Kaplan-Meier (KM) Method	
Mean	0.0333
SD	0.219
SE of Mean	0.0123
95% KM (t) UCL	0.0536
95% KM (z) UCL	0.0535
95% KM (jackknife) UCL	0.0533
95% KM (bootstrap t) UCL	0.0672
95% KM (BCA) UCL	0.054
95% KM (Percentile Bootstrap) UCL	0.054
95% KM (Chebyshev) UCL	0.0868
97.5% KM (Chebyshev) UCL	0.11
99% KM (Chebyshev) UCL	0.155

Potential UCLs to Use

97.5% KM (Chebyshev) UCL	0.11

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Appendix B-2
ProUCL Outputs for East Campus Soils 0-15 Feet
Former York Naval Ordnance Plant, York, PA

Arsenic

General Statistics

Number of Valid Data	218	Number of Detected Data	217
Number of Distinct Detected Data	148	Number of Non-Detect Data	1
		Percent Non-Detects	0.46%

Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.37	Minimum Detected	-0.994
Maximum Detected	29.1	Maximum Detected	3.371
Mean of Detected	5.488	Mean of Detected	1.471
SD of Detected	4.302	SD of Detected	0.688
Minimum Non-Detect	1.2	Minimum Non-Detect	0.182
Maximum Non-Detect	1.2	Maximum Non-Detect	0.182

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Lilliefors Test Statistic	0.2	Lilliefors Test Statistic	0.0744
5% Lilliefors Critical Value	0.0601	5% Lilliefors Critical Value	0.0601
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	5.466	Mean	1.462
SD	4.305	SD	0.699
95% DL/2 (t) UCL	5.948	95% H-Stat (DL/2) UCL	6.034
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	5.373	Mean in Log Scale	1.464
SD	4.435	SD in Log Scale	0.693
95% MLE (t) UCL	5.869	Mean in Original Scale	5.468
95% MLE (Tiku) UCL	5.846	SD in Original Scale	4.303
		95% t UCL	5.95
		95% Percentile Bootstrap UCL	5.952
		95% BCA Bootstrap UCL	6.009
		95% H UCL	6.017

Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	2.281	**Data do not follow a Discernable Distribution (0.05)**	
Theta Star	2.406		
nu star	989.9		
A-D Test Statistic	2.759	**Nonparametric Statistics**	
5% A-D Critical Value	0.764	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.764	Mean	5.467
5% K-S Critical Value	0.0624	SD	4.294
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.292
		95% KM (t) UCL	5.949
Assuming Gamma Distribution		95% KM (z) UCL	5.947
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	5.949
Minimum	0.000001	95% KM (bootstrap t) UCL	5.991
Maximum	29.1	95% KM (BCA) UCL	5.933
Mean	5.463	95% KM (Percentile Bootstrap) UCL	5.957
Median	4.48	95% KM (Chebyshev) UCL	6.738
SD	4.309	97.5% KM (Chebyshev) UCL	7.288
k star	1.808	99% KM (Chebyshev) UCL	8.368
Theta star	3.021		
Nu star	788.5	**Potential UCLs to Use**	
AppChi2	724.3	95% KM (BCA) UCL	5.933
95% Gamma Approximate UCL	5.947		
95% Adjusted Gamma UCL	5.951		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Appendix B-2
ProUCL Outputs for East Campus Soils 0-15 Feet
Former York Naval Ordnance Plant, York, PA

Lead

General Statistics

Number of Valid Data	219	Number of Detected Data	211
Number of Distinct Detected Data	169	Number of Non-Detect Data	8
		Percent Non-Detects	3.65%

Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	1	Minimum Detected	0
Maximum Detected	1580	Maximum Detected	7.365
Mean of Detected	34.53	Mean of Detected	2.646
SD of Detected	118	SD of Detected	1.063
Minimum Non-Detect	3.3	Minimum Non-Detect	1.194
Maximum Non-Detect	15	Maximum Non-Detect	2.708

Note: Data have multiple DLs - Use of KM Method is recommended
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

		Number treated as Non-Detect	141
		Number treated as Detected	78
		Single DL Non-Detect Percentage	64.38%

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Lilliefors Test Statistic	0.388	Lilliefors Test Statistic	0.127
5% Lilliefors Critical Value	0.061	5% Lilliefors Critical Value	0.061
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	33.39	Mean	2.585
SD	116	SD	1.096
95% DL/2 (t) UCL	46.33	95% H-Stat (DL/2) UCL	28.55
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	2.589
		SD in Log Scale	1.092
		Mean in Original Scale	33.41
		SD in Original Scale	116
		95% t UCL	46.35
		95% Percentile Bootstrap UCL	48.17
		95% BCA Bootstrap UCL	57.13
		95% H-UCL	28.51

Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.671	**Data do not follow a Discernable Distribution (0.05)**	
Theta Star	51.44		
nu star	283.3		
A-D Test Statistic	19.4	**Nonparametric Statistics**	
5% A-D Critical Value	0.803	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.803	Mean	33.42
5% K-S Critical Value	0.0652	SD	115.7
Data not Gamma Distributed at 5% Significance Level		SE of Mean	7.836
		95% KM (t) UCL	46.37
Assuming Gamma Distribution		95% KM (z) UCL	46.31
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	46.37
Minimum	0.000001	95% KM (bootstrap t) UCL	63.99
Maximum	1580	95% KM (BCA) UCL	49.74
Mean	33.27	95% KM (Percentile Bootstrap) UCL	47.77
Median	10.5	95% KM (Chebyshev) UCL	67.58
SD	116	97.5% KM (Chebyshev) UCL	82.36
k star	0.44	99% KM (Chebyshev) UCL	111.4
Theta star	75.55		
Nu star	192.9	**Potential UCLs to Use**	
AppChi2	161.8	95% KM (Chebyshev) UCL	67.58
95% Gamma Approximate UCL	39.67		
95% Adjusted Gamma UCL	39.72		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Appendix B-3
ProUCL Outputs for East Campus Soils 0-2 Feet
Former York Naval Ordnance Plant, York, PA

Arsenic

General Statistics

Number of Valid Data	107	Number of Detected Data	106
Number of Distinct Detected Data	58	Number of Non-Detect Data	1
		Percent Non-Detects	0.93%

Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	1.3	Minimum Detected	0.262
Maximum Detected	29	Maximum Detected	3.367
Mean of Detected	5.95	Mean of Detected	1.632
SD of Detected	4.264	SD of Detected	0.522
Minimum Non-Detect	2	Minimum Non-Detect	0.693
Maximum Non-Detect	2	Maximum Non-Detect	0.693

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Lilliefors Test Statistic	0.271	Lilliefors Test Statistic	0.143
5% Lilliefors Critical Value	0.0861	5% Lilliefors Critical Value	0.0861
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	5.904	Mean	1.617
SD	4.271	SD	0.543
95% DL/2 (t) UCL	6.589	95% H-Stat (DL/2) UCL	6.436
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	5.775	Mean in Log Scale	1.623
SD	4.44	SD in Log Scale	0.528
95% MLE (t) UCL	6.487	Mean in Original Scale	5.912
95% MLE (Tiku) UCL	6.455	SD in Original Scale	4.262
		95% t UCL	6.596
		95% Percentile Bootstrap UCL	6.603
		95% BCA Bootstrap UCL	6.767
		95% H UCL	6.404

Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	3.369	Data do not follow a Discernable Distribution (0.05)	
Theta Star	1.766		
nu star	714.1		
A-D Test Statistic	4.767	**Nonparametric Statistics**	
5% A-D Critical Value	0.758	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.758	Mean	5.909
5% K-S Critical Value	0.0884	SD	4.245
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.412
		95% KM (t) UCL	6.593
Assuming Gamma Distribution		95% KM (z) UCL	6.587
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	6.593
Minimum	0.000001	95% KM (bootstrap t) UCL	6.842
Maximum	29	95% KM (BCA) UCL	6.619
Mean	5.894	95% KM (Percentile Bootstrap) UCL	6.648
Median	5.1	95% KM (Chebyshev) UCL	7.706
SD	4.283	97.5% KM (Chebyshev) UCL	8.484
k star	1.849	99% KM (Chebyshev) UCL	10.01
Theta star	3.188		
Nu star	395.6	**Potential UCLs to Use**	
AppChi2	350.5	95% KM (BCA) UCL	6.619
95% Gamma Approximate UCL	6.653		
95% Adjusted Gamma UCL	6.664		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Appendix B-3
ProUCL Outputs for East Campus Soils 0-2 Feet
Former York Naval Ordnance Plant, York, PA

Cadmium

General Statistics

Number of Valid Data	107	Number of Detected Data	77
Number of Distinct Detected Data	63	Number of Non-Detect Data	30
		Percent Non-Detects	28.04%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.05	Minimum Detected	-2.996
Maximum Detected	112	Maximum Detected	4.718
Mean of Detected	3.54	Mean of Detected	-0.224
SD of Detected	13.26	SD of Detected	1.485
Minimum Non-Detect	0.047	Minimum Non-Detect	-3.058
Maximum Non-Detect	1	Maximum Non-Detect	0

Note: Data have multiple DLs - Use of KM Method is recommended
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

Number treated as Non-Detect	78
Number treated as Detected	29
Single DL Non-Detect Percentage	72.90%

UCL Statistics

Normal Distribution Test with Detected Values Only

Lilliefors Test Statistic	0.396
5% Lilliefors Critical Value	0.101

Data not Normal at 5% Significance Level

Assuming Normal Distribution

DL/2 Substitution Method	
Mean	2.617
SD	11.33
95% DL/2 (t) UCL	4.434
Maximum Likelihood Estimate(MLE) Method	N/A

MLE yields a negative mean

Lognormal Distribution Test with Detected Values Only

Lilliefors Test Statistic	0.102
5% Lilliefors Critical Value	0.101

Data not Lognormal at 5% Significance Level

Assuming Lognormal Distribution

DL/2 Substitution Method	
Mean	-0.659
SD	1.55
95% H-Stat (DL/2) UCL	2.612
Log ROS Method	
Mean in Log Scale	-0.819
SD in Log Scale	1.665
Mean in Original Scale	2.588
SD in Original Scale	11.33
95% t UCL	4.406
95% Percentile Bootstrap UCL	4.549
95% BCA Bootstrap UCL	5.943
95% H-UCL	2.82

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	0.428
Theta Star	8.275
nu star	65.88
A-D Test Statistic	6.173
5% A-D Critical Value	0.833
K-S Test Statistic	0.833
5% K-S Critical Value	0.109

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data	
Minimum	0.000001
Maximum	112
Mean	2.55
Median	0.39
SD	11.34
k star	0.159
Theta star	16.03
Nu star	34.03
AppChi2	21.69
95% Gamma Approximate UCL	4.001
95% Adjusted Gamma UCL	4.026

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only

Data do not follow a Discernable Distribution (0.05)

Nonparametric Statistics

Kaplan-Meier (KM) Method	
Mean	2.6
SD	11.28
SE of Mean	1.098
95% KM (t) UCL	4.421
95% KM (z) UCL	4.405
95% KM (jackknife) UCL	4.417
95% KM (bootstrap t) UCL	8.75
95% KM (BCA) UCL	4.621
95% KM (Percentile Bootstrap) UCL	4.645
95% KM (Chebyshev) UCL	7.384
97.5% KM (Chebyshev) UCL	9.454
99% KM (Chebyshev) UCL	13.52

Potential UCLs to Use

95% KM (Chebyshev) UCL	7.384

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Appendix B-3
ProUCL Outputs for East Campus Soils 0-2 Feet
Former York Naval Ordnance Plant, York, PA

Chromium

General Statistics

Number of Valid Observations	107	Number of Distinct Observations	96

Raw Statistics

Minimum	4.86
Maximum	3820
Mean	78.24
Median	21.1
SD	374.9
Std. Error of Mean	36.25
Coefficient of Variation	4.792
Skewness	9.599

Log-transformed Statistics

Minimum of Log Data	1.581
Maximum of Log Data	8.248
Mean of log Data	3.247
SD of log Data	0.974

Relevant UCL Statistics

Normal Distribution Test

Lilliefors Test Statistic	0.422
Lilliefors Critical Value	0.0857

Data not Normal at 5% Significance Level

Lognormal Distribution Test

Lilliefors Test Statistic	0.18
Lilliefors Critical Value	0.0857

Data not Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	138.4

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	173.8
95% Modified-t UCL (Johnson-1978)	144

Assuming Lognormal Distribution

95% H-UCL	50.8
95% Chebyshev (MVUE) UCL	61.11
97.5% Chebyshev (MVUE) UCL	69.8
99% Chebyshev (MVUE) UCL	86.85

Gamma Distribution Test

k star (bias corrected)	0.551
Theta Star	141.9
MLE of Mean	78.24
MLE of Standard Deviation	105.4
nu star	118
Approximate Chi Square Value (.05)	93.94
Adjusted Level of Significance	0.0478
Adjusted Chi Square Value	93.64
Anderson-Darling Test Statistic	17.05
Anderson-Darling 5% Critical Value	0.813
Kolmogorov-Smirnov Test Statistic	0.315
Kolmogorov-Smirnov 5% Critical Value	0.0923

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL	98.3
95% Adjusted Gamma UCL	98.61

Data Distribution

Data do not follow a Discernable Distribution (0.05)

Nonparametric Statistics

95% CLT UCL	137.9
95% Jackknife UCL	138.4
95% Standard Bootstrap UCL	138.3
95% Bootstrap-t UCL	372.7
95% Hall's Bootstrap UCL	329.7
95% Percentile Bootstrap UCL	147.2
95% BCA Bootstrap UCL	214.5
95% Chebyshev(Mean, Sd) UCL	236.2
97.5% Chebyshev(Mean, Sd) UCL	304.6
99% Chebyshev(Mean, Sd) UCL	438.9

Potential UCL to Use	Use 95% Chebyshev (Mean, Sd) UCL 236.2

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Dimethylphthalate

General Statistics

Number of Valid Data	82	Number of Detected Data	1
Number of Distinct Detected Data	1	Number of Non-Detect Data	81
		Percent Non-Detects	98.78%

Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!
It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Dimethylphthalate was not processed!

Appendix B-3
ProUCL Outputs for East Campus Soils 0-2 Feet
Former York Naval Ordnance Plant, York, PA

Lead

General Statistics

Number of Valid Data	107	Number of Detected Data	105
Number of Distinct Detected Data	96	Number of Non-Detect Data	2
		Percent Non-Detects	1.87%

Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	7.1	Minimum Detected	1.96
Maximum Detected	1000	Maximum Detected	6.908
Mean of Detected	68.62	Mean of Detected	3.466
SD of Detected	133.7	SD of Detected	1.08
Minimum Non-Detect	15	Minimum Non-Detect	2.708
Maximum Non-Detect	15	Maximum Non-Detect	2.708

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Lilliefors Test Statistic	0.339	Lilliefors Test Statistic	0.0914
5% Lilliefors Critical Value	0.0865	5% Lilliefors Critical Value	0.0865
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	67.47	Mean	3.439
SD	132.7	SD	1.088
95% DL/2 (t) UCL	88.75	95% H-Stat (DL/2) UCL	71.77
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	30.95	Mean in Log Scale	3.444
SD	166	SD in Log Scale	1.082
95% MLE (t) UCL	57.59	Mean in Original Scale	67.53
95% MLE (Tiku) UCL	58.62	SD in Original Scale	132.6
		95% t UCL	88.8
		95% Percentile Bootstrap UCL	90.6
		95% BCA Bootstrap UCL	98.23
		95% H UCL	71.55

Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.765	Data do not follow a Discernable Distribution (0.05)	
Theta Star	89.68		
nu star	160.7		
A-D Test Statistic	6.948	**Nonparametric Statistics**	
5% A-D Critical Value	0.794	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.794	Mean	67.53
5% K-S Critical Value	0.0915	SD	132
Data not Gamma Distributed at 5% Significance Level		SE of Mean	12.82
		95% KM (t) UCL	88.81
Assuming Gamma Distribution		95% KM (z) UCL	88.62
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	88.81
Minimum	0.000001	95% KM (bootstrap t) UCL	100.5
Maximum	1000	95% KM (BCA) UCL	88.93
Mean	67.33	95% KM (Percentile Bootstrap) UCL	89.39
Median	30.2	95% KM (Chebyshev) UCL	123.4
SD	132.7	97.5% KM (Chebyshev) UCL	147.6
k star	0.572	99% KM (Chebyshev) UCL	195.1
Theta star	117.7		
Nu star	122.4	**Potential UCLs to Use**	
AppChi2	97.84	95% KM (Chebyshev) UCL	123.4
95% Gamma Approximate UCL	84.23		
95% Adjusted Gamma UCL	84.49		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Appendix B-3
ProUCL Outputs for East Campus Soils 0-2 Feet
Former York Naval Ordnance Plant, York, PA

Tetrachloroethene

General Statistics

Number of Valid Data	106	Number of Detected Data	24
Number of Distinct Detected Data	23	Number of Non-Detect Data	82
		Percent Non-Detects	77.36%

Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.0003	Minimum Detected	-8.112
Maximum Detected	8.1	Maximum Detected	2.092
Mean of Detected	0.921	Mean of Detected	-3.143
SD of Detected	1.987	SD of Detected	3.075
Minimum Non-Detect	0.0009	Minimum Non-Detect	-7.013
Maximum Non-Detect	0.57	Maximum Non-Detect	-0.562

Note: Data have multiple DLs - Use of KM Method is recommended
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

Number treated as Non-Detect	99
Number treated as Detected	7
Single DL Non-Detect Percentage	93.40%

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.538	Shapiro Wilk Test Statistic	0.947
5% Shapiro Wilk Critical Value	0.916	5% Shapiro Wilk Critical Value	0.916
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.238	Mean	-5.32
SD	1.005	SD	2.564
95% DL/2 (t) UCL	0.4	95% H-Stat (DL/2) UCL	0.358
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	-7.381
		SD in Log Scale	3.227
		Mean in Original Scale	0.209
		SD in Original Scale	1.007
		95% t UCL	0.372
		95% Percentile Bootstrap UCL	0.387
		95% BCA Bootstrap UCL	0.458
		95% H-UCL	0.53

Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.233	**Data appear Lognormal at 5% Significance Level**	
Theta Star	3.955		
nu star	11.18		
A-D Test Statistic	1.186	**Nonparametric Statistics**	
5% A-D Critical Value	0.879	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.879	Mean	0.21
5% K-S Critical Value	0.196	SD	1.003
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.0995
		95% KM (t) UCL	0.375
Assuming Gamma Distribution		95% KM (z) UCL	0.374
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.372
Minimum	0.000001	95% KM (bootstrap t) UCL	0.539
Maximum	8.1	95% KM (BCA) UCL	0.391
Mean	0.215	95% KM (Percentile Bootstrap) UCL	0.379
Median	0.000001	95% KM (Chebyshev) UCL	0.644
SD	1.008	97.5% KM (Chebyshev) UCL	0.831
k star	0.089	99% KM (Chebyshev) UCL	1.2
Theta star	2.412		
Nu star	18.86	**Potential UCLs to Use**	
AppChi2	10.02	97.5% KM (Chebyshev) UCL	0.831
95% Gamma Approximate UCL	0.404		
95% Adjusted Gamma UCL	0.408		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Thallium

General Statistics

Number of Valid Data	102	Number of Detected Data	5
Number of Distinct Detected Data	5	Number of Non-Detect Data	97
		Percent Non-Detects	95.10%

Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.43	Minimum Detected	-0.844
Maximum Detected	22	Maximum Detected	3.091
Mean of Detected	4.968	Mean of Detected	0.317
SD of Detected	9.523	SD of Detected	1.575
Minimum Non-Detect	0.365	Minimum Non-Detect	-1.008
Maximum Non-Detect	20	Maximum Non-Detect	2.996

Note: Data have multiple DLs - Use of KM Method is recommended
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

Number treated as Non-Detect	101
Number treated as Detected	1
Single DL Non-Detect Percentage	99.02%

Warning: There are only 5 Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough to draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.569	Shapiro Wilk Test Statistic	0.707
5% Shapiro Wilk Critical Value	0.762	5% Shapiro Wilk Critical Value	0.762
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	1.074	Mean	-0.588
SD	2.555	SD	0.888
95% DL/2 (t) UCL	1.494	95% H-Stat (DL/2) UCL	0.992
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	-3.057
		SD in Log Scale	1.489
		Mean in Original Scale	0.326
		SD in Original Scale	2.176
		95% t UCL	0.683
		95% Percentile Bootstrap UCL	0.758
		95% BCA Bootstrap UCL	0.973
		95% H-UCL	0.212

Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.331	**Data do not follow a Discernable Distribution (0.05)**	
Theta Star	15		
nu star	3.312		
A-D Test Statistic	1.067	**Nonparametric Statistics**	
5% A-D Critical Value	0.712	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.712	Mean	0.664
5% K-S Critical Value	0.372	SD	2.125
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.235
		95% KM (t) UCL	1.055
Assuming Gamma Distribution		95% KM (z) UCL	1.051
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.978
Minimum	0.000001	95% KM (bootstrap t) UCL	4.403
Maximum	22	95% KM (BCA) UCL	1.596
Mean	0.351	95% KM (Percentile Bootstrap) UCL	1.385
Median	0.000001	95% KM (Chebyshev) UCL	1.69
SD	2.274	97.5% KM (Chebyshev) UCL	2.135
k star	0.0769	99% KM (Chebyshev) UCL	3.007
Theta star	4.558		
Nu star	15.69	**Potential UCLs to Use**	
AppChi2	7.742	95% KM (Chebyshev) UCL	1.69
95% Gamma Approximate UCL	0.71		
95% Adjusted Gamma UCL	0.718		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Appendix B-3
ProUCL Outputs for East Campus Soils 0-2 Feet
Former York Naval Ordnance Plant, York, PA

Trichloroethene

General Statistics

Number of Valid Data	106	Number of Detected Data	62
Number of Distinct Detected Data	49	Number of Non-Detect Data	44
		Percent Non-Detects	41.51%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.0006	Minimum Detected	-7.419
Maximum Detected	7.8	Maximum Detected	2.054
Mean of Detected	0.299	Mean of Detected	-4.739
SD of Detected	1.235	SD of Detected	2.283
Minimum Non-Detect	0.0009	Minimum Non-Detect	-7.013
Maximum Non-Detect	0.57	Maximum Non-Detect	-0.562

Note: Data have multiple DLs - Use of KM Method is recommended
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

Number treated as Non-Detect	101
Number treated as Detected	5
Single DL Non-Detect Percentage	95.28%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Lilliefors Test Statistic	0.432	Lilliefors Test Statistic	0.158
5% Lilliefors Critical Value	0.113	5% Lilliefors Critical Value	0.113
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.202	Mean	-4.884
SD	0.952	SD	2.223
95% DL/2 (t) UCL	0.355	95% H-Stat (DL/2) UCL	0.195
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	-5.494
		SD in Log Scale	2.097
		Mean in Original Scale	0.176
		SD in Original Scale	0.953
		95% t UCL	0.33
		95% Percentile Bootstrap UCL	0.341
		95% BCA Bootstrap UCL	0.418
		95% H-UCL	0.0746

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	0.208	Data do not follow a Discernable Distribution (0.05)	
Theta Star	1.438		
nu star	25.79		
A-D Test Statistic	9.685	Nonparametric Statistics	
5% A-D Critical Value	0.907	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.907	Mean	0.177
5% K-S Critical Value	0.125	SD	0.949
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.0929
		95% KM (t) UCL	0.332
Assuming Gamma Distribution		95% KM (z) UCL	0.33
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.331
Minimum	0.000001	95% KM (bootstrap t) UCL	0.926
Maximum	7.8	95% KM (BCA) UCL	0.344
Mean	0.186	95% KM (Percentile Bootstrap) UCL	0.345
Median	0.0014	95% KM (Chebyshev) UCL	0.582
SD	0.955	97.5% KM (Chebyshev) UCL	0.758
k star	0.125	99% KM (Chebyshev) UCL	1.102
Theta star	1.488		
Nu star	26.48	Potential UCLs to Use	
AppChi2	15.75	97.5% KM (Chebyshev) UCL	0.758
95% Gamma Approximate UCL	0.313		
95% Adjusted Gamma UCL	0.315		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Appendix B-4
ProUCL Outputs for West Campus Soils 0-15 Feet
Former York Naval Ordnance Plant, York, PA

Antimony

General Statistics

Number of Valid Data	367	Number of Detected Data	110
Number of Distinct Detected Data	61	Number of Non-Detect Data	257
		Percent Non-Detects	70.03%

Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.1	Minimum Detected	-2.303
Maximum Detected	122	Maximum Detected	4.804
Mean of Detected	4.163	Mean of Detected	-0.284
SD of Detected	15.36	SD of Detected	1.418
Minimum Non-Detect	0.42	Minimum Non-Detect	-0.868
Maximum Non-Detect	15	Maximum Non-Detect	2.708

Note: Data have multiple DLs - Use of KM Method is recommended
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

Number treated as Non-Detect	361
Number treated as Detected	6
Single DL Non-Detect Percentage	98.37%

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Lilliefors Test Statistic	0.421	Lilliefors Test Statistic	0.194
5% Lilliefors Critical Value	0.0845	5% Lilliefors Critical Value	0.0845
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	2.012	Mean	-0.374
SD	8.567	SD	1.09
95% DL/2 (t) UCL	2.75	95% H-Stat (DL/2) UCL	1.413
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	-1
		SD in Log Scale	1.181
		Mean in Original Scale	1.532
		SD in Original Scale	8.563
		95% t UCL	2.269
		95% Percentile Bootstrap UCL	2.321
		95% BCA Bootstrap UCL	2.585
		95% H-UCL	0.85

Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.382	**Data do not follow a Discernable Distribution (0.05)**	
Theta Star	10.89		
nu star	84.1		
A-D Test Statistic	15.8	**Nonparametric Statistics**	
5% A-D Critical Value	0.846	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.846	Mean	1.505
5% K-S Critical Value	0.0932	SD	8.553
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.449
		95% KM (t) UCL	2.245
Assuming Gamma Distribution		95% KM (z) UCL	2.244
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	2.243
Minimum	0.000001	95% KM (bootstrap t) UCL	3.049
Maximum	122	95% KM (BCA) UCL	2.407
Mean	2.015	95% KM (Percentile Bootstrap) UCL	2.305
Median	0.000001	95% KM (Chebyshev) UCL	3.462
SD	8.733	97.5% KM (Chebyshev) UCL	4.309
k star	0.106	99% KM (Chebyshev) UCL	5.973
Theta star	18.94		
Nu star	78.08	**Potential UCLs to Use**	
AppChi2	58.72	95% KM (BCA) UCL	2.407
95% Gamma Approximate UCL	2.679		
95% Adjusted Gamma UCL	2.682		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Appendix B-4
ProUCL Outputs for West Campus Soils 0-15 Feet
Former York Naval Ordnance Plant, York, PA

Aroclor-1254

General Statistics

Number of Valid Data	237	Number of Detected Data	74
Number of Distinct Detected Data	60	Number of Non-Detect Data	163
		Percent Non-Detects	68.78%

Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.013	Minimum Detected	-4.343
Maximum Detected	270	Maximum Detected	5.598
Mean of Detected	6.076	Mean of Detected	-0.736
SD of Detected	32.05	SD of Detected	2.02
Minimum Non-Detect	0.018	Minimum Non-Detect	-4.017
Maximum Non-Detect	0.89	Maximum Non-Detect	-0.117

Note: Data have multiple DLs - Use of KM Method is recommended
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

Number treated as Non-Detect	210
Number treated as Detected	27
Single DL Non-Detect Percentage	88.61%

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Lilliefors Test Statistic	0.425	Lilliefors Test Statistic	0.0545
5% Lilliefors Critical Value	0.103	5% Lilliefors Critical Value	0.103
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	

Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	1.927	Mean	-2.831
SD	18.04	SD	1.97
95% DL/2 (t) UCL	3.863	95% H-Stat (DL/2) UCL	0.614
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	-4.079
		SD in Log Scale	2.94
		Mean in Original Scale	1.906
		SD in Original Scale	18.04
		95% t UCL	3.841
		95% Percentile Bootstrap UCL	4.12
		95% BCA Bootstrap UCL	6.224
		95% H-UCL	2.908

Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.273	**Data appear Lognormal at 5% Significance Level**	
Theta Star	22.24		
nu star	40.43		
A-D Test Statistic	6.88	**Nonparametric Statistics**	
5% A-D Critical Value	0.876	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.876	Mean	1.91
5% K-S Critical Value	0.113	SD	18.01
Data not Gamma Distributed at 5% Significance Level		SE of Mean	1.178
		95% KM (t) UCL	3.854
Assuming Gamma Distribution		95% KM (z) UCL	3.847
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	3.845
Minimum	0.000001	95% KM (bootstrap t) UCL	18.11
Maximum	270	95% KM (BCA) UCL	4.136
Mean	1.897	95% KM (Percentile Bootstrap) UCL	4.149
Median	0.000001	95% KM (Chebyshev) UCL	7.043
SD	18.05	97.5% KM (Chebyshev) UCL	9.264
k star	0.0822	99% KM (Chebyshev) UCL	13.63
Theta star	23.09		
Nu star	38.95	**Potential UCLs to Use**	
AppChi2	25.66	97.5% KM (Chebyshev) UCL	9.264
95% Gamma Approximate UCL	2.88		
95% Adjusted Gamma UCL	2.888		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Appendix B-4
ProUCL Outputs for West Campus Soils 0-15 Feet
Former York Naval Ordnance Plant, York, PA

Arsenic

General Statistics

Number of Valid Data	382	Number of Detected Data	374
Number of Distinct Detected Data	115	Number of Non-Detect Data	8
		Percent Non-Detects	2.09%

Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.6	Minimum Detected	-0.511
Maximum Detected	221	Maximum Detected	5.398
Mean of Detected	6.688	Mean of Detected	1.656
SD of Detected	11.89	SD of Detected	0.586
Minimum Non-Detect	2	Minimum Non-Detect	0.693
Maximum Non-Detect	3	Maximum Non-Detect	1.099

Note: Data have multiple DLs - Use of KM Method is recommended
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

Number treated as Non-Detect	50
Number treated as Detected	332
Single DL Non-Detect Percentage	13.09%

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Lilliefors Test Statistic	0.32	Lilliefors Test Statistic	0.117
5% Lilliefors Critical Value	0.0458	5% Lilliefors Critical Value	0.0458
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	

Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	6.57	Mean	1.622
SD	11.79	SD	0.624
95% DL/2 (t) UCL	7.565	95% H-Stat (DL/2) UCL	6.531
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	5.484	Mean in Log Scale	1.632
SD	12.79	SD in Log Scale	0.603
95% MLE (t) UCL	6.562	Mean in Original Scale	6.583
95% MLE (Tiku) UCL	6.492	SD in Original Scale	11.79
		95% t UCL	7.578
		95% Percentile Bootstrap UCL	7.688
		95% BCA Bootstrap UCL	8.355
		95% H UCL	6.494

Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**
k star (bias corrected)	2.182	**Data do not follow a Discernable Distribution (0.05)**
Theta Star	3.065	
nu star	1632	
A-D Test Statistic	2.674E+28	
5% A-D Critical Value	0.765	
K-S Test Statistic	0.765	
5% K-S Critical Value	0.0475	
Data not Gamma Distributed at 5% Significance Level		

Assuming Gamma Distribution		**Nonparametric Statistics**	
Gamma ROS Statistics using Extrapolated Data		Kaplan-Meier (KM) Method	
Minimum	0.000001	Mean	6.58
Maximum	221	SD	11.77
Mean	6.547	SE of Mean	0.603
Median	5	95% KM (t) UCL	7.575
SD	11.81	95% KM (z) UCL	7.573
k star	1.042	95% KM (jackknife) UCL	7.575
Theta star	6.281	95% KM (bootstrap t) UCL	8.939
Nu star	796.4	95% KM (BCA) UCL	7.722
AppChi2	731.9	95% KM (Percentile Bootstrap) UCL	7.622
95% Gamma Approximate UCL	7.124	95% KM (Chebyshev) UCL	9.21
95% Adjusted Gamma UCL	7.127	97.5% KM (Chebyshev) UCL	10.35
		99% KM (Chebyshev) UCL	12.58
		Potential UCLs to Use	
		95% KM (BCA) UCL	7.722

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Benzo(a)pyrene

General Statistics

Number of Valid Data	264	Number of Detected Data	101
Number of Distinct Detected Data	73	Number of Non-Detect Data	163
		Percent Non-Detects	61.74%

Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.0096	Minimum Detected	-4.646
Maximum Detected	74	Maximum Detected	4.304
Mean of Detected	1.785	Mean of Detected	-1.538
SD of Detected	7.879	SD of Detected	1.794
Minimum Non-Detect	0.036	Minimum Non-Detect	-3.324
Maximum Non-Detect	19	Maximum Non-Detect	2.944

Note: Data have multiple DLs - Use of KM Method is recommended
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

Number treated as Non-Detect	262
Number treated as Detected	2
Single DL Non-Detect Percentage	99.24%

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Lilliefors Test Statistic	0.411	Lilliefors Test Statistic	0.114
5% Lilliefors Critical Value	0.0882	5% Lilliefors Critical Value	0.0882
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	

Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.84	Mean	-1.962
SD	4.955	SD	1.521
95% DL/2 (t) UCL	1.344	95% H-Stat (DL/2) UCL	0.57
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	-2.664
		SD in Log Scale	1.732
		Mean in Original Scale	0.728
		SD in Original Scale	4.93
		95% t UCL	1.229
		95% Percentile Bootstrap UCL	1.274
		95% BCA Bootstrap UCL	1.667
		95% H-UCL	0.422

Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**
k star (bias corrected)	0.319	**Data do not follow a Discernable Distribution (0.05)**
Theta Star	5.598	
nu star	64.42	
A-D Test Statistic	10.12	**Nonparametric Statistics**
5% A-D Critical Value	0.862	Kaplan-Meier (KM) Method
K-S Test Statistic	0.862	Mean 0.73
5% K-S Critical Value	0.0965	SD 4.921
Data not Gamma Distributed at 5% Significance Level		SE of Mean 0.305
		95% KM (t) UCL 1.233
Assuming Gamma Distribution		95% KM (z) UCL 1.231
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL 1.231
Minimum	0.000001	95% KM (bootstrap t) UCL 2.27
Maximum	74	95% KM (BCA) UCL 1.36
Mean	0.856	95% KM (Percentile Bootstrap) UCL 1.317
Median	0.000001	95% KM (Chebyshev) UCL 2.058
SD	4.949	97.5% KM (Chebyshev) UCL 2.632
k star	0.109	99% KM (Chebyshev) UCL 3.76
Theta star	7.823	
Nu star	57.8	**Potential UCLs to Use**
AppChi2	41.32	95% KM (Chebyshev) UCL 2.058
95% Gamma Approximate UCL	1.198	
95% Adjusted Gamma UCL	1.2	

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Appendix B-4
ProUCL Outputs for West Campus Soils 0-15 Feet
Former York Naval Ordnance Plant, York, PA

Cadmium

General Statistics

Number of Valid Data	382	Number of Detected Data	200
Number of Distinct Detected Data	118	Number of Non-Detect Data	182
		Percent Non-Detects	47.64%

Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.05	Minimum Detected	-2.996
Maximum Detected	224	Maximum Detected	5.412
Mean of Detected	3.99	Mean of Detected	-0.407
SD of Detected	18.35	SD of Detected	1.595
Minimum Non-Detect	0.043	Minimum Non-Detect	-3.147
Maximum Non-Detect	3.3	Maximum Non-Detect	1.194

Note: Data have multiple DLs - Use of KM Method is recommended
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

		Number treated as Non-Detect	354
		Number treated as Detected	28
		Single DL Non-Detect Percentage	92.67%

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Lilliefors Test Statistic	0.415	Lilliefors Test Statistic	0.0791
5% Lilliefors Critical Value	0.0626	5% Lilliefors Critical Value	0.0626
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	2.338	Mean	-0.979
SD	13.38	SD	1.702
95% DL/2 (t) UCL	3.467	95% H-Stat (DL/2) UCL	2.042
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	-1.603
		SD in Log Scale	1.972
		Mean in Original Scale	2.164
		SD in Original Scale	13.4
		95% t UCL	3.294
		95% Percentile Bootstrap UCL	3.479
		95% BCA Bootstrap UCL	4.138
		95% H-UCL	1.92

Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.37	**Data do not follow a Discernable Distribution (0.05)**	
Theta Star	10.8		
nu star	147.8		
A-D Test Statistic	18.14	**Nonparametric Statistics**	
5% A-D Critical Value	0.852	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.852	Mean	2.18
5% K-S Critical Value	0.0685	SD	13.38
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.687
		95% KM (t) UCL	3.312
Assuming Gamma Distribution		95% KM (z) UCL	3.31
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	3.311
Minimum	0.000001	95% KM (bootstrap t) UCL	5.387
Maximum	224	95% KM (BCA) UCL	3.656
Mean	2.29	95% KM (Percentile Bootstrap) UCL	3.466
Median	0.125	95% KM (Chebyshev) UCL	5.173
SD	13.43	97.5% KM (Chebyshev) UCL	6.468
k star	0.118	99% KM (Chebyshev) UCL	9.011
Theta star	19.37		
Nu star	90.31	**Potential UCLs to Use**	
AppChi2	69.4	97.5% KM (Chebyshev) UCL	6.468
95% Gamma Approximate UCL	2.98		
95% Adjusted Gamma UCL	2.983		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Chromium

General Statistics

Number of Valid Observations	382	Number of Distinct Observations	223

Raw Statistics

Minimum	4.86
Maximum	8200
Mean	108.9
Median	19.3
SD	607.8
Std. Error of Mean	31.1
Coefficient of Variation	5.583
Skewness	10.15

Log-transformed Statistics

Minimum of Log Data	1.581
Maximum of Log Data	9.012
Mean of log Data	3.195
SD of log Data	1.032

Relevant UCL Statistics

Normal Distribution Test

Lilliefors Test Statistic	0.432
Lilliefors Critical Value	0.0453

Data not Normal at 5% Significance Level

Lognormal Distribution Test

Lilliefors Test Statistic	0.25
Lilliefors Critical Value	0.0453

Data not Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	160.2

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	177.3
95% Modified-t UCL (Johnson-1978)	162.8

Assuming Lognormal Distribution

95% H-UCL	46.6
95% Chebyshev (MVUE) UCL	53.25
97.5% Chebyshev (MVUE) UCL	58.33
99% Chebyshev (MVUE) UCL	68.32

Gamma Distribution Test

k star (bias corrected)	0.433
Theta Star	251.6
MLE of Mean	108.9
MLE of Standard Deviation	165.5
nu star	330.6
Approximate Chi Square Value (.05)	289.5
Adjusted Level of Significance	0.0494
Adjusted Chi Square Value	289.4
Anderson-Darling Test Statistic	84.32
Anderson-Darling 5% Critical Value	0.839
Kolmogorov-Smirnov Test Statistic	0.385
Kolmogorov-Smirnov 5% Critical Value	0.0495

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL	124.3
95% Adjusted Gamma UCL	124.4

Data Distribution

Data do not follow a Discernable Distribution (0.05)

Nonparametric Statistics

95% CLT UCL	160
95% Jackknife UCL	160.2
95% Standard Bootstrap UCL	159.2
95% Bootstrap-t UCL	210.4
95% Hall's Bootstrap UCL	199.7
95% Percentile Bootstrap UCL	167
95% BCA Bootstrap UCL	185.6
95% Chebyshev(Mean, Sd) UCL	244.4
97.5% Chebyshev(Mean, Sd) UCL	303.1
99% Chebyshev(Mean, Sd) UCL	418.3

Potential UCL to Use	Use 95% Chebyshev (Mean, Sd) UCL 244.4

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Dimethylphthalate

General Statistics

Number of Valid Data	258	Number of Detected Data	1
Number of Distinct Detected Data	1	Number of Non-Detect Data	257
		Percent Non-Detects	99.61%

Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!
It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Dimethylphthalate was not processed!

Hexachlorobenzene

General Statistics

Number of Valid Data	258	Number of Detected Data	1
Number of Distinct Detected Data	1	Number of Non-Detect Data	257
		Percent Non-Detects	99.61%

Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!
It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Hexachlorobenzene was not processed!

Appendix B-4
ProUCL Outputs for West Campus Soils 0-15 Feet
Former York Naval Ordnance Plant, York, PA

Lead

General Statistics

Number of Valid Data	382	Number of Detected Data	380
Number of Distinct Detected Data	214	Number of Non-Detect Data	2
		Percent Non-Detects	0.52%

Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	1	Minimum Detected	0
Maximum Detected	2760	Maximum Detected	7.923
Mean of Detected	60.04	Mean of Detected	3.009
SD of Detected	207.6	SD of Detected	1.063
Minimum Non-Detect	15	Minimum Non-Detect	2.708
Maximum Non-Detect	15	Maximum Non-Detect	2.708

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Lilliefors Test Statistic	0.397	Lilliefors Test Statistic	0.175
5% Lilliefors Critical Value	0.0455	5% Lilliefors Critical Value	0.0455
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	59.76	Mean	3.004
SD	207.1	SD	1.063
95% DL/2 (t) UCL	77.23	95% H-Stat (DL/2) UCL	39.94
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	3.006
		SD in Log Scale	1.061
		Mean in Original Scale	59.78
		SD in Original Scale	207.1
		95% t UCL	77.25
		95% Percentile Bootstrap UCL	77.83
		95% BCA Bootstrap UCL	83.24
		95% H-UCL	39.96

Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.57	**Data do not follow a Discernable Distribution (0.05)**	
Theta Star	105.3		
nu star	433.5		
A-D Test Statistic	57.95	**Nonparametric Statistics**	
5% A-D Critical Value	0.815	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.815	Mean	59.78
5% K-S Critical Value	0.049	SD	206.8
Data not Gamma Distributed at 5% Significance Level		SE of Mean	10.6
		95% KM (t) UCL	77.25
Assuming Gamma Distribution		95% KM (z) UCL	77.21
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	77.25
Minimum	0.000001	95% KM (bootstrap t) UCL	85.86
Maximum	2760	95% KM (BCA) UCL	78.72
Mean	59.72	95% KM (Percentile Bootstrap) UCL	77.92
Median	13.75	95% KM (Chebyshev) UCL	106
SD	207.1	97.5% KM (Chebyshev) UCL	125.9
k star	0.546	99% KM (Chebyshev) UCL	165.2
Theta star	109.3		
Nu star	417.5	**Potential UCLs to Use**	
AppChi2	371.1	95% KM (Chebyshev) UCL	106
95% Gamma Approximate UCL	67.18		
95% Adjusted Gamma UCL	67.21		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Tetrachloroethene

General Statistics

Number of Valid Data	374	Number of Detected Data	112
Number of Distinct Detected Data	84	Number of Non-Detect Data	262
		Percent Non-Detects	70.05%

Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.0003	Minimum Detected	-8.112
Maximum Detected	1400	Maximum Detected	7.244
Mean of Detected	13.68	Mean of Detected	-3.49
SD of Detected	132.3	SD of Detected	2.79
Minimum Non-Detect	0.0009	Minimum Non-Detect	-7.013
Maximum Non-Detect	0.36	Maximum Non-Detect	-1.022

Note: Data have multiple DLs - Use of KM Method is recommended
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

Number treated as Non-Detect	356
Number treated as Detected	18
Single DL Non-Detect Percentage	95.19%

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Lilliefors Test Statistic	0.481	Lilliefors Test Statistic	0.136
5% Lilliefors Critical Value	0.0837	5% Lilliefors Critical Value	0.0837
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	4.113	Mean	-4.914
SD	72.43	SD	2.398
95% DL/2 (t) UCL	10.29	95% H-Stat (DL/2) UCL	0.202
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	-7.229
		SD in Log Scale	3.496
		Mean in Original Scale	4.098
		SD in Original Scale	72.43
		95% t UCL	10.27
		95% Percentile Bootstrap UCL	11.52
		95% BCA Bootstrap UCL	19.01
		95% H-UCL	0.792

Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.131	**Data do not follow a Discernable Distribution (0.05)**	
Theta Star	104.3		
nu star	29.38		
A-D Test Statistic	21.77	**Nonparametric Statistics**	
5% A-D Critical Value	0.996	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.996	Mean	4.098
5% K-S Critical Value	0.0986	SD	72.34
Data not Gamma Distributed at 5% Significance Level		SE of Mean	3.757
		95% KM (t) UCL	10.29
Assuming Gamma Distribution		95% KM (z) UCL	10.28
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	10.27
Minimum	0.000001	95% KM (bootstrap t) UCL	241.1
Maximum	1400	95% KM (BCA) UCL	11.61
Mean	4.391	95% KM (Percentile Bootstrap) UCL	11.51
Median	0.000001	95% KM (Chebyshev) UCL	20.48
SD	72.47	97.5% KM (Chebyshev) UCL	27.56
k star	0.072	99% KM (Chebyshev) UCL	41.48
Theta star	60.95		
Nu star	53.88	**Potential UCLs to Use**	
AppChi2	38.02	97.5% KM (Chebyshev) UCL	27.56
95% Gamma Approximate UCL	6.223		
95% Adjusted Gamma UCL	6.232		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Thallium

General Statistics

Number of Valid Data	367	Number of Detected Data	77
Number of Distinct Detected Data	51	Number of Non-Detect Data	290
		Percent Non-Detects	79.02%

Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.062	Minimum Detected	-2.781
Maximum Detected	212	Maximum Detected	5.357
Mean of Detected	4.991	Mean of Detected	0.0833
SD of Detected	24.26	SD of Detected	1.352
Minimum Non-Detect	0.3	Minimum Non-Detect	-1.204
Maximum Non-Detect	20	Maximum Non-Detect	2.996

Note: Data have multiple DLs - Use of KM Method is recommended
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

		Number treated as Non-Detect	364
		Number treated as Detected	3
		Single DL Non-Detect Percentage	99.18%

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Lilliefors Test Statistic	0.42	Lilliefors Test Statistic	0.131
5% Lilliefors Critical Value	0.101	5% Lilliefors Critical Value	0.101
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	1.939	Mean	-0.272
SD	11.23	SD	1.05
95% DL/2 (t) UCL	2.906	95% H-Stat (DL/2) UCL	1.488
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	-1.143
		SD in Log Scale	1.213
		Mean in Original Scale	1.323
		SD in Original Scale	11.22
		95% t UCL	2.289
		95% Percentile Bootstrap UCL	2.474
		95% BCA Bootstrap UCL	3.181
		95% H-UCL	0.77

Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.419	**Data do not follow a Discernable Distribution (0.05)**	
Theta Star	11.91		
nu star	64.56		
A-D Test Statistic	8.785	**Nonparametric Statistics**	
5% A-D Critical Value	0.835	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.835	Mean	1.343
5% K-S Critical Value	0.109	SD	11.2
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.59
		95% KM (t) UCL	2.315
Assuming Gamma Distribution		95% KM (z) UCL	2.312
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	2.31
Minimum	0.000001	95% KM (bootstrap t) UCL	6.353
Maximum	212	95% KM (BCA) UCL	2.625
Mean	1.611	95% KM (Percentile Bootstrap) UCL	2.501
Median	0.000001	95% KM (Chebyshev) UCL	3.912
SD	11.3	97.5% KM (Chebyshev) UCL	5.024
k star	0.0953	99% KM (Chebyshev) UCL	7.208
Theta star	16.9		
Nu star	69.95	**Potential UCLs to Use**	
AppChi2	51.7	95% KM (BCA) UCL	2.625
95% Gamma Approximate UCL	2.18		
95% Adjusted Gamma UCL	2.182		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Appendix B-4
ProUCL Outputs for West Campus Soils 0-15 Feet
Former York Naval Ordnance Plant, York, PA

Trichloroethene

General Statistics

Number of Valid Data	382	Number of Detected Data	187
Number of Distinct Detected Data	114	Number of Non-Detect Data	195
		Percent Non-Detects	51.05%

Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.0006	Minimum Detected	-7.419
Maximum Detected	460	Maximum Detected	6.131
Mean of Detected	3.849	Mean of Detected	-4.162
SD of Detected	34.62	SD of Detected	2.545
Minimum Non-Detect	0.0009	Minimum Non-Detect	-7.013
Maximum Non-Detect	0.36	Maximum Non-Detect	-1.022

Note: Data have multiple DLs - Use of KM Method is recommended
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

Number treated as Non-Detect	358
Number treated as Detected	24
Single DL Non-Detect Percentage	93.72%

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Lilliefors Test Statistic	0.463	Lilliefors Test Statistic	0.147
5% Lilliefors Critical Value	0.0648	5% Lilliefors Critical Value	0.0648
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	1.901	Mean	-4.546
SD	24.26	SD	2.249
95% DL/2 (t) UCL	3.948	95% H-Stat (DL/2) UCL	0.197
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	-5.508
		SD in Log Scale	2.533
		Mean in Original Scale	1.887
		SD in Original Scale	24.26
		95% t UCL	3.934
		95% Percentile Bootstrap UCL	4.26
		95% BCA Bootstrap UCL	5.876
		95% H-UCL	0.161

Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.142	**Data do not follow a Discernable Distribution (0.05)**	
Theta Star	27.09		
nu star	53.14		
A-D Test Statistic	38.07	**Nonparametric Statistics**	
5% A-D Critical Value	1.02	Kaplan-Meier (KM) Method	
K-S Test Statistic	1.02	Mean	1.887
5% K-S Critical Value	0.077	SD	24.23
Data not Gamma Distributed at 5% Significance Level		SE of Mean	1.243
		95% KM (t) UCL	3.936
Assuming Gamma Distribution		95% KM (z) UCL	3.931
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	3.934
Minimum	0.000001	95% KM (bootstrap t) UCL	11.96
Maximum	460	95% KM (BCA) UCL	4.432
Mean	2.065	95% KM (Percentile Bootstrap) UCL	4.236
Median	0.0008	95% KM (Chebyshev) UCL	7.305
SD	24.29	97.5% KM (Chebyshev) UCL	9.65
k star	0.0887	99% KM (Chebyshev) UCL	14.26
Theta star	23.26		
Nu star	67.8	**Potential UCLs to Use**	
AppChi2	49.85	97.5% KM (Chebyshev) UCL	9.65
95% Gamma Approximate UCL	2.808		
95% Adjusted Gamma UCL	2.811		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Zinc

General Statistics

Number of Valid Observations	382	Number of Distinct Observations	285

Raw Statistics

Minimum	2
Maximum	37000
Mean	268.2
Median	44.15
SD	1970
Std. Error of Mean	100.8
Coefficient of Variation	7.346
Skewness	17.27

Log-transformed Statistics

Minimum of Log Data	0.693
Maximum of Log Data	10.52
Mean of log Data	4.014
SD of log Data	1.202

Relevant UCL Statistics

Normal Distribution Test

Lilliefors Test Statistic	0.446
Lilliefors Critical Value	0.0453

Data not Normal at 5% Significance Level

Lognormal Distribution Test

Lilliefors Test Statistic	0.166
Lilliefors Critical Value	0.0453

Data not Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	434.4

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	529.2
95% Modified-t UCL (Johnson-1978)	449.2

Assuming Lognormal Distribution

95% H-UCL	131.4
95% Chebyshev (MVUE) UCL	153.3
97.5% Chebyshev (MVUE) UCL	170.5
99% Chebyshev (MVUE) UCL	204.2

Gamma Distribution Test

k star (bias corrected)	0.413
Theta Star	649.2
MLE of Mean	268.2
MLE of Standard Deviation	417.3
nu star	315.6
Approximate Chi Square Value (.05)	275.5
Adjusted Level of Significance	0.0494
Adjusted Chi Square Value	275.3
Anderson-Darling Test Statistic	2.618E+28
Anderson-Darling 5% Critical Value	0.843
Kolmogorov-Smirnov Test Statistic	0.323
Kolmogorov-Smirnov 5% Critical Value	0.0497

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL	307.3
95% Adjusted Gamma UCL	307.4

Data Distribution

Data do not follow a Discernable Distribution (0.05)

Nonparametric Statistics

95% CLT UCL	434
95% Jackknife UCL	434.4
95% Standard Bootstrap UCL	435.1
95% Bootstrap-t UCL	844.9
95% Hall's Bootstrap UCL	1007
95% Percentile Bootstrap UCL	452.7
95% BCA Bootstrap UCL	616.3
95% Chebyshev(Mean, Sd) UCL	707.5
97.5% Chebyshev(Mean, Sd) UCL	897.7
99% Chebyshev(Mean, Sd) UCL	1271

Potential UCL to Use	Use 95% Chebyshev (Mean, Sd) UCL 707.5

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.